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PART 5
NATIONAL ENERGY ACT

HEARINGS

BEFORE THE

SUBCOMMITTEE ON ENERGY AND POWER

OF THE

COMMITTEE ON
INTERSTATE AND FOREIGN COMMERCE
HOUSE OF REPRESENTATIVES

NINETY-FIFTH CONGRESS

FIRST SESSION

ON

H.R. 6831, H.R. 687, H.R. 1562, H.R. 2088, H.R. 2818, H.R. 3317, H.R. 3664, H.R. 6660, and all similar and identical bills

BILLS TO ESTABLISH A COMPREHENSIVE NATIONAL ENERGY POLICY

JUNE 1, 1977

Serial No. 95–26

Printed for the use of the
Committee on Interstate and Foreign Commerce

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- Rivlen, Dr. Alice M., Director.
- Scheppach, Dr. Raymond C., Assistant Director, Natural Resources and Commerce.

Executive Office of the President:
- Goldman, Les, Assistant Administrator.
- Nordhaus, Robert, Energy Policy and Planning Office.
- Nordhaus, William D., member, Council of Economic Advisers.
- Schlesinger, James R., Assistant to the President.
- Verleger, Philip K., Jr., Ph. D., Council of Economic Advisers.

NATIONAL ENERGY ACT

WEDNESDAY, JUNE 1, 1977

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON ENERGY AND POWER,
COMMITTEE ON INTERSTATE AND FOREIGN COMMERCE,
Washington, D.C.

The subcommittee met at 10 a.m., pursuant to notice, in room 2123, Rayburn House Office Building, Hon. John D. Dingell, chairman, presiding.

Mr. DINGELL. The subcommittee will come to order.

The subcommittee meets today to conclude 3 weeks of hearings on H.R. 6831, the President's proposed National Energy Act. Previous hearings have focused on the residential insulation program, appliance standards, conservation in schools and hospitals, natural gas policy, public utility regulatory policies, and amendments to the Energy Supply and Environmental Coordination Act.

Today's hearings are intended to let us take a step back from the details of the many components of the President's plan and take a broad and longer term view of the plan as a whole. What are the goals of the plan? Are production and conservation goals properly balanced? Do the various regulatory, tax, and price components of the plan provide coordinated incentives to move toward those goals? Does the plan build properly upon existing energy law, or does it threaten to lead to excessive government interference in the daily choices of energy consumers?

The past 3 weeks of hearings have elicited substantial criticism of the many costs and burdens that would accompany the President's program. This is largely because the costs of conservation and conversion to coal precede the benefits by several years.

Presumably, the President believes that the long-term benefits of his plan will more than offset the short-term costs. But what are those benefits? And when will they be realized? Maybe a better way of putting the question is this: What are the costs of not adopting the President's program and merely following current policy? Will current policy lead to a higher level of oil imports? What are the economic and national security implications of the differential in import levels associated with the President's plan versus current policy?

While the President's program is generally regarded as a conservation initiative, its greatest impacts in 1985 occur as a result of

coal conversion. As described in the National Energy Plan, the program aims to reduce oil imports in 1985 by 4.5 million barrels per day. Conservation reduces demand by roughly 1.9 million barrels per day. Coal utilization in 1985 is projected to increase so as to displace the equivalent of 2.3 million barrels of oil per day under the President's program. So more than 50 percent of the measurable impact on oil imports is due to coal conversion. We must ask how this high priority on coal use matches with other national environmental goals, particularly for clean air and strip mine controls.

James R. Schlesinger, Special Assistant to the President, and William D. Nordhaus, a member of the Council of Economic Advisers, will appear on behalf of the administration to address these important concerns. Another concern is the potential inflationary and recessionary effect of the program. How will total output of the economy be affected? What will be the impact on jobs? Dr. Alice Rivlin, Director of the Congressional Budget Office, will help in evaluating these difficult questions.

Finally, our hearings this afternoon will address the long-range implications of the President's energy program and energy policy alternatives. While the analysis prepared by the administration looks to the impact of the program in 1985, one expects that any significant long-term effects are only beginning to emerge in 1985 due to the long lead times involved in raising national energy efficiency and accumulating coal-using capital equipment.

As many of you already know, the subcommittee is operating under extraordinary time limitations. Markup on title I, part A, will begin tomorrow. Our objective, which cannot be easily met, is to finish subcommittee markup on title I on June 17. Full committee markup would begin on June 21 and finish by July 13 if the Speaker's timetable is to be achieved.

The Chair indicates that the subcommittee, and I am sure the full committee under the leadership of Mr. Staggers, will make every effort towards that end.

It is unfortunate that time permits only 1 day to be devoted to critically important hearing on the overall goals and impacts of the President's plan. Clearly, the issues are complex and do not lend themselves to simple or quick resolution. I hope that we can obtain today a better sense of the positive overall design of the plan so that markup will proceed on a constructive path, with long-term benefits properly factored against short-term costs.

The Chair is delighted that we have here with us Dr. James Schlesinger. The Chair observes that Dr. Schlesinger appears as an extraordinary courtesy to the committee in view of his difficult time schedule, and also in view of the fact that he is technically a member of the President's personal staff.

Dr. Schlesinger, we are particularly appreciative of that, and of your kindness in making available to us from your limited amount of time the opportunity to inquire of some of the questions raised by the Chair. We are particularly pleased to see Mr. Les Goldman with you, who is a respected former member of the staff on the Hill, and a very dear and old friend of all of us on this committee, Mr. Nordhaus, who is an extremely able and respected member of your staff.

Gentlemen, we are pleased that you are with us.

Doctor, if you wish to proceed, we will recognize you.

STATEMENT OF HON. JAMES R. SCHLESINGER, ASSISTANT TO THE PRESIDENT, EXECUTIVE OFFICE OF THE PRESIDENT; ACCOMPANIED BY LES GOLDMAN, ASSISTANT ADMINISTRATOR; AND ROBERT NORDHAUS, ENERGY POLICY AND PLANNING OFFICE

Mr. SCHLESINGER. Thank you, Mr. Chairman.

Mr. Chairman, the Nation faces a challenge. We are operating under tight deadlines, as you have observed. Our staffs have been working overtime.

If we had sufficient time, of course, we could spend months and years in deliberation, but we face a national challenge, and the time to begin to act is now.

I will discuss today the basic direction of this program. I think that everybody on the Hill, and in the executive branch, agrees that the basic direction of the program is correct. There will be differences about detail, but there is recognition that we must begin to make a transition now to a future in which the degree of dependency on oil and gas will have to be reduced. If we make that transition now, and make it smoothly, we can avoid severe economic, political, and social effects in the 1980's when we reach a limit of production capacity around the world with regard to oil.

The severity of the challenge that we face is reflected in that future oil production. The world will probably never exceed 75 or 80 million barrels a day of production. At the current American rate of consumption per capita, we would exhaust all of the reserves that the oil geologists in their wildest dreams ever expected would be found and could be recovered in 15 years. At a growth rate of 5 percent a year, we will reach a capacity limit by the middle 1980's, so we face a situation in which we must begin to make the adjustments now if we have foresight, if we have vision, and we must operate as a united country in order to do so.

The President has called for the moral equivalent of war. That does not mean, as it has been misinterpreted, that we need to turn to wartime measures, or go on a war footing, in order to grapple with this problem. The stress is on the moral equivalent of war, the achievement of national cohesion, a drawing together of all of our interest groups, peoples and regions, in order to respond to this national problem.

As I understand from your opening remarks, Mr. Chairman, we have not yet achieved that degree of cohesion, and as predicted, there has been a good deal of criticism along the lines of "Yes, we need to have a plan, we need to respond, but the particular part of this plan that may affect me is the unwelcome part of the plan." We cannot deal with this issue by picking apart the details of the plan. It is a comprehensive whole, and we do face a problem that our primary reliance on oil and gas will have to be diminished in the future. Right now it runs 75 percent of our total energy. In the future, we will have to begin to choose to use fuels more in terms of their highest and best use.

Natural gas obviously has its highest and best use in residential heating. Oil will have to be increasingly used to maintain our transportation sector, and as a consequence, for stationary sources we will have to go over increasingly to coal. It is necessary for us to begin to act now if we are to be prudent, if we are to take out insurance against a difficult future.

We can recognize two things. First, that making these adjustments now, as the witnesses before this committee have indicated, will not be entirely painless. It is far less painful to drift along for a few years longer, putting off the day of reckoning when we must begin to make those adjustments, but unless we begin now to alter our stock of capital from its excessive dependence on oil and gas, and its high use of energy per unit of output, conservation, we will face a much more difficult point of decision in the 1980's as we begin to run short of the fuels of primary choice. Then we will face a problem not of adjusting our stock of capital, but an interruption in the flow of goods and services, a decline in per capita incomes, a rise in unemployment, and an acceleration of the rate of inflation.

If we have vision and foresight, we will begin to make that adjustment now. That is what the President's plan is intended to do. Since we have time to react, let us make use of that time, as best suits our purposes, rather than drifting along for a few more years with a policy of too little and too late. We should avoid listening to the soothing lullabies that somewhere out there there may, may indeed, be more oil to be found.

The record of prediction in this area, Mr. Chairman, is pretty spotty. The National Petroleum Council some years ago, for example, indicated that if only the Nation gave a price of $6 or $7 a barrel, and at that time the price was $3 a barrel, that we would be able to produce all of our needs domestically in some near term. Right now the price is $11.28 a barrel for upper tier oil. For frontier oil we will be offering $13.50 a barrel, but there will be no substantial flow of oil. We face the fact that domestically we are running out and that in some 10 to 15 years time, the entire world will peak out in terms of production, so let us not listen to those soothing lullabies that somehow we can make it all painless. Let us face up to the transition now.

The President's program established seven goals that are attainable if we take the appropriate steps. Some of those goals are more difficult to achieve than others and may require additional legislation at a future date to assure that indeed those goals are made, but we have time now, and we have proposed to the Congress legislation that depends ultimately on the essential free choice of corporations and of individuals to make adjustments through the price system. This will require major adjustments in the prices facing corporations, somewhat lesser adjustments in the prices facing consumers.

Consumers are helped to make adjustments in home heating and automobiles by mechanisms other than the price mechanism, but we must have the price mechanism working for us rather than against us, and we must make this adjustment in a way that is consistent with our free society and with a free economy.

The transition now can be primarily through the free choice of corporations and individuals. If we fail to take action now, that is likely to change, much to our regret.

Mr. Chairman, you mentioned the question of what will be the costs of not following the plan of the President. Those will be serious. We have heard much discussion of the economic consequences of the plan. It will bring about an increase in the rate of inflation of something on the order of a quarter of a point per year, but if we fail to take action, the failure to take action will have drastic economic consequences in the middle 1980's.

We have a number of goals. We can indeed reduce our energy growth below 2 percent a year. The measures before you will reduce it to 2.2 percent a year, and reduce our importation of oil to some 7 million barrels a day. Above that, we are asking for voluntary measures on the part of the American people that will further reduce oil consumption by 100,000 barrels of oil a month, and pull the importation of oil below 6 million barrels a day, and it would also reduce total energy growth to less than 2 percent.

The achievement of the reduction of gasoline consumption by 10 percent by 1985 from 1977 levels is embodied in this legislation. Not only can we increase coal production by at least 400 million tons, as the President has suggested, the legislation before you and our projections suggest that coal production would actually increase by 565 million tons. That is once again necessary to move away from oil and gas and towards coal.

We hope to achieve insulation of 90 percent of our homes as well as all new buildings. The legislation before you, according to Treasury estimates, will achieve 60 percent insulation, and we may be back to you at a later stage when that queue has diminished for additional measures if the willingness to insulate additional homes flags. Finally, we expect to see, according to Treasury projections, the use of solar energy in 1.3 million homes as a result of the proposed tax credit, compared to our goal of 2.5 million homes, but once again we will be back to you for additional measures.

Mr. Chairman, this program is basically one that reflects the use of voluntary measures, the use of the price mechanism, to reinforce decisions by individuals. It depends in part on tax changes which do not lie presently before your committee, but the program is a comprehensive whole. It will affect the future of our children and grandchildren. Future generations will judge carefully how well we in the government, both the legislative branch and the executive branch, responded to this emergency. Mr. Chairman, I welcome the opportunity to appear before this committee to provide a view as to the overall nature of the plan, rather than what is perfectly natural, a tendency to pick at particular elements of the plan that affect this interest group or that interest group. We must respond to this as a united country. We cannot afford division according to the lines of interest groups, economic groups, and regions of the country.

Thank you, Mr. Chairman.

Mr. DINGELL. Doctor, the committee thanks you for being here with us this morning. I think it is extremely important that we have the opportunity to have this last interchange before we commence the markup. It will be extremely helpful, I think, in clearing the air and affording the members an opportunity to raise questions.

I appreciate the great concern with which you and the administration view this problem and the urgency with which you solicit speedy action by the Congress on the markup of the presentation of the legislation through the administration.

The Chair now recognizes members according to the order of their appearance. The Chair recognizes first my friend and colleague from Indiana, Mr. Sharp.

Mr. SHARP. Thank you, Mr. Chairman.

Mr. Schlesinger, I certainly appreciate your remarks, and share your view that we have to act now and we have to act like a nation instead of a group of struggling interests who can't ever rise above our own self-interest.

On Sunday you may have seen in the Washington Post an article by Barry Commoner which took, in a couple of fundamental instances, exception to what the claims for the President's plan are, and, it seems to me, it might be worth your responding to those.

As I recall, there were two such claims. One was that what essentially is involved, and he even used the term "allocation," is that this would allocate energy away from residential and he used the term "consumer," I think he meant residential area, to the industrial sectors of our economy, and therefore in his view, it was unfair to consumers.

Secondly, he took the view that embodied in the plan, or at least the result of the actions that we will take is really, as he called it, a hidden commitment to a nuclear policy, which in his view we could never then switch by the year 2000 towards solar because of the enormous capital investment and the commitment to the electrical industry.

I wondered if you would care to respond to those two claims since I suspect we will hear them time and again.

Mr. SCHLESINGER. Thank you, Mr. Sharp.

There is no intent to allocate energy resources. That will continue to be done on the basis, by and large, of the free choice of individuals and corporations. What we are attempting to do is to conserve dramatically on the use of energy in comparison with the past growth rates; and that, I believe, is a goal that Mr. Commoner fervently shares. He fears that we may not have gone far enough along those lines, but as to the division between household users and corporate users or industrial users, there is no allocation. What we are attempting to do is, through assistance to the household, dramatically reduce the requirements for household consumption of energy. The insulation of homes will permit us to reduce oil and gas use in individual homes, by somewhere between 30 and 50 percent, depending on the home in question, and that should reduce substantially the aggregate requirement for energy and at the same time should restrain the growth of fuel bills for the consumer.

This program has been designed to assist the consumer. Price increases affect the consumer only slowly and to a far lesser extent than they affect industry. The program has been shaped to protect the consumer.

In the area of automobile use, of course, the household consumer will be using less because we are moving towards more fuel-efficient cars, but the fact that we are able to reduce significantly the

prodigal use of energy in the home is a national benefit and a benefit to the consumer in terms of his bills.

On the industrial side, we face two trends. First, we hope to reduce substantially the growth of energy per unit of output, and we have proposed a variety of conservation devices in order to achieve that, including higher prices for industry, and industry does keep a fairly sharp pencil.

Industry, unlike the household consumer, will be urged to make the transition to coal. The household consumer will have first priority on the use of natural gas; and, to the extent that he is part of the transportation sector, he will have first priority on the use of oil. Industry will be pushed, at some cost to industry, to using coal, which is a less efficient fuel in a number of respects. However, as we move industry away from oil and gas towards coal, and at the same time we urge industry through price measures and through ancillary regulatory devices to conserve more, we want the American economy to continue to grow. We need to have growth in the American economy. It should grow at 5 percent a year according to the projections. It is axiomatic in this plan that we must have more jobs for the American population, and, as a result, the industrial use of energy will continue to grow. In terms of energy consumption per unit of output, it will shrink; but the proportions will change as between industry and the household because we are effectively conserving in the household to the benefit of the consumer and we are permitting the expansion of industry to the benefit of the American people at large.

Mr. KRUEGER [presiding]. Sorry, I thought you were finished, Mr. Schlesinger.

The time of the gentleman has expired.

Mr. SCHLESINGER. No, sir. The other question was the question of the allegation of a hidden commitment to nuclear. There is no hidden commitment to nuclear. There is an open commitment that the Nation must move its utilities away from oil and gas to other fuels. In the near term those are coal and nuclear. We have endorsed the light water reactor as an appropriate option. We are not, however, proceeding with the development of breeder technology. In the short term we will continue to develop the technology, but we will not commercialize it.

None more fervently hope that we will be able to prove out solar electric production than do the members of this administration. If so, we will be able to terminate the use of nuclear power with the presentation of light water plants.

In the longer run, we may be able to develop fusion. If we are unable to develop fusion, if solar electric proves to be unpromising, and we hope that it will not, we may be forced to continue with nuclear fission; but there is no hidden commitment to that. The commitment is to the vigorous development of the technologies of solar power and of fusion power to develop the options to avoid continued reliance on nuclear fission.

Mr. KRUEGER. The time of the gentleman from Indiana has expired.

Recognizing in order of appearance, the Chair recognizes himself for 5 minutes.

Mr. Schlesinger, I am sure that the Congress is not less interested in a comprehensive energy view than the administration.

Mr. SCHLESINGER. Yes, sir.

Mr. KRUEGER. And I know that your statement was not intended to imply anything otherwise.

I wonder in connection with the conversion to coal, which is a kind of keystone for the administration's proposal, I have had a staff member do some rough figures on what it would mean in terms of atmospheric pollution if, for example, we converted 1.5 trillion cubic feet of natural gas to coal for the production of electricity, and if we assume that a standard amount of sulfur in coal, not the most high sulfur coal, and if we assume that this coal produces 15,000 Btu per pound, and 4 percent sulfur content in coal, then even if we assume the best available control technology in which some 90-odd percent of the sulfur would be removed, figures that we get are that by converting 1.5 trillion cubic feet of gas to coal, we would be adding 800 million pounds of sulfur to the atmosphere, or about 4 pounds of sulfur for every man, woman, and child.

Now I am in concurrence that we will need to convert increasingly from gas and oil to coal for the production of electricity, but I wonder whether this kind of problem of substantially different atmospheric pollution is one that the proposed Department of Energy has addressed because I never found it really addressed in the President's message and it is a problem that I think the Congress persistently needs to deal with as we deal with the Clean Air Act and clean air legislation. I wonder, though I have one other question, whether you would comment on that particular problem.

Mr. SCHLESINGER. Yes, sir. As you indicate, the administration supports the use in the near term of the best available control technology, which is only the best available. There is no permanent solution. In the longer run we hope to develop fluidized bed combustion in widespread use which will more effectively deal with the problems of unfavorable emissions.

We have carefully reconnoitered with EPA the problems that you have mentioned. We estimate that by 1985, as a consequence of the coal conversion program, sulfur oxide emissions would increase by a maximum of 5 percent nationwide. We will have to work on the 1.5 trillion cubic feet of natural gas, and insert in the record just what the consequences of that will be, whether indeed your figures are similar to our figures. [See p. 12.]

We would have a 5-percent increase at maximum of sulfur oxide emissions as a result of the coal conversion program. If we do indeed achieve the 565 million extra tons, which we project, that will result from persuading industry to make those transitions. We estimate that 44 percent of new facilities will be coal fired. Ten percent of existing facilities will make the conversion to coal.

Mr. KRUEGER. The record will, without objection, be held open for additional figures to be supplied.

In particular, it would be helpful, I believe, if we could have additional figures on the total amount of both sulfur to be added to the atmosphere by, say, 1985, and also I noticed in this morning's

newspaper that there were some problems suggested in carbon dioxide levels. [See p. 12]

Mr. SCHLESINGER. Carbon monoxide?

Mr. KRUEGER. I believe carbon dioxide levels as a result of the burning of coal, and the article in this morning's paper suggested we might have a 4-degree temperature change as a result. That was one of the local dailies called the Washington Post. If you might look at that, and then if there are any comments on that, I would appreciate that.

[The following information was received for the record:]

The Administration is not of the opinion that carbon dioxide generation occurring *as a result of the National Energy Plan* is likely to become a serious problem, even in the longer term. Carbon dioxide is a natural respiration product of plants and animals, including humans. The gas is also produced as the end product of combustion and/or oxidation of any compound containing the element carbon. Carbon dioxide is generated not only by the burning of coal, but also by the burning of gasoline, fuel oil, or natural gas, although CO_2 emissions are about 80 percent higher on a Btu equivalent basis when burning the former. The additional CO_2 generated as a result of the NEP, however, would be small compared to current concentrations. Conversion of the full 3.3 MMb/D expected under the Oil and Gas Replacement Program would increase the amount of CO_2 in the atmosphere by less than 1 percent.

The Administration does not wish to minimize the seriousness of the possible long-term effects of increased generation of carbon dioxide. The problem should not be substantially affected by the provisions of H.R. 6831. However, this will obviously be a central issue in our study of the health effects of increased coal production and use, as called for by the National Energy Plan.

Mr. KRUEGER. I believe I have time for one more question. That one question concerns the soothing lullaby.

Another journal recently, The Wall Street Journal, indicated that the Energy Research and Development Administration foresaw very substantially larger quantities of natural gas than has been suggested in the President's message, and in an editorial called "1,001 Years of Natural Gas," and in succeeding editorials called "ERDA Gate" and one other implied that there was the possibility that the administration might be interested in suppressing and withholding information about this particular ERDA study, and I am sure the Congress will wish to get back to that but would you care in the short run to make any comment, if you are familiar with these suggestions, that the administration has in fact suppressed an ERDA study that would suggest that there are from 20,000 to 50,000 trillion cubic feet of natural gas more than was proposed in the President'a message?

Mr. SCHLESINGER. Mr. Chairman, let me make an initial observation with regard to the greenhouse effect and carbon dioxide. The way to deal with that problem is through conservation. The more effectively we conserve on the use of energy, the more efficiently we use energy, the less will be the production of carbon dioxide, and consequently the less will be the greenhouse effect. So to the extent that we worry about that problem, it points to a clear remedy. Coserve more rather than less.

With regard to the suspicion of conspiracy and suppression of a report, suspicion of conspiracy seems to be developing in the oddest places these days. The report has been available apparently to The Wall Street Journal.

Let me emphasize the point that is left out of the editorials that have appeared in The Wall Street Journal. Those are technologies

that have not as yet been developed and on which the government is working energetically, putting major resources, for example, into the development of Devonian shale, into geopressurized brine. We fervently hope that, indeed, we are able to make these sources for the production of gas economically effective; and, if so, the gas situation in the United States will be far better than the prudent estimates in the report, which are based upon the conventional sources of natural gas.

We will energetically pursue those new technologies but we will not count our chickens before they are hatched or our new sources of natural gas. Indeed, if we are able to use Devonian shale, tight formations in the West, or geopresurized brine, we shall be happy to do so. First, however, we have to develop the technologies that will bring that gas in at a respectable price, which we would expect to be on the order of, perhaps, $4 per Mcf, if we can develop the technologies, but it is inadvisable for us to base our policies on technologies that we have yet failed to develop.

Mr. KRUEGER. The time of the gentleman from Texas has expired.

The Chair next recognizes the gentleman from Colorado, Mr. Wirth.

Mr. WIRTH. Thank you, Mr. Chairman.

Mr. Schlesinger, I have two questions, one related to an overall conservation approach, and the second related to the set of air pollution problems illustrated by the decision on the floor of the House on automobiles last Thursday. Let me take those one at a time.

If we are really concerned about limiting the amount of oil used in this country, and concerned about limiting the amount of oil that is imported in this country, why don't we simply say that, starting in 1978 we have a factor of 100 barrels being imported into this country, and in 1979 we are going to then have 99 and move it right back in that kind of a fashion, just by saying we are not going to import any more oil? Did you all consider doing that, taking an approach like that?

Mr. SCHLESINGER. No, but we will reflect on that, Mr. Wirth. The problem with establishing an import limitation, unless the economic underpinnings have been adjusted to it, is that it will result in a bidding up of prices, and if there are controls, as there are at the present time, this will result in the development of a black market, but it may be desirable for the Congress to review the possibility in relation to the reduction of oil imports to 5.8 million, that indeed we have an annual goal established, and we would be happy to work with the Congress on that.

Mr. WIRTH. There are a number of us on this subcommittee and in the Congress who are interested in this approach, having, over the last 2-1/2 years, thought of just about everything else. Now it seems to me we may have the underpinnings in terms of legislation, in terms of entitlement programs and so on, that would allow us to move on a percentage reduction of this kind. We will get back to you on that, but that was not considered in the development of this program or was not analyzed in any depth by the administration?

Mr. SCHLESINGER. We have an implicit goal for the reduction of imports, but we did not tie that to an import limitation.

Mr. WIRTH. If I might, Dr. Schlesinger, let me jump to the second issue, and that relates to the emissions standards voted on by the Congress last Thursday, and the relationship which those might have, and I think probably do have, to the President's coal conversion program. I think all of us agree with the importance of the coal conversion program and would be concerned as to how much we can in fact pollute the atmosphere. I would assume that in the development of the administration's coal conversion program, that you made various assumptions about how much pollution the atmosphere could handle; is that not correct?

Mr. SCHLESINGER. We have made some estimates as to the immpact on atmospheric pollution. The additional impact is minimal from stationary sources, and overall, as a result of the reduction of projected automobile pollution, the quality of the air would improve, I believe, but I shall have to check that for the record.

Mr. WIRTH. Therefore what you are saying is that as we move from what I understand to be your goal of 800 million tons a year to 1.2 billion of coal being burned, that that would not significantly add to air pollution in this country.

Mr. SCHLESINGER. As I mentioned to the chairman, that would add approximately 5 percent to the sulfur oxides in the atmosphere in the country, 5 percent nationwide. It would add 1 percent to particulates, assuming once again the best available control technology, but that is from those sources that would be changed. It does not include other sources, including the automobile, and we should have to make an aggregate judgment on that.

Mr. WIRTH. In testimony last Friday, Mr. Costle of EPA said that he was very concerned about the aggregate pollution that we were now talking about. If in fact we were adding so much in terms of sulfur oxides, so much in terms of particulates, are adding so much NOx and so much carbon monoxide, we in fact might be causing the American public very severe health problems at a time when lung cancer is already becoming an epidemic in this country.

What kind of an analysis should we be looking at on that front so that we can better understand, given the constraints placed on pollution that came out of the congressional action on automobile standards last week, how much can we allow in terms of coal conversion. Shouldn't we have that information as quickly as possible here in order to make a decision on the package set forth by the administration?

Mr. SCHLESINGER. We will work with you, Mr. Wirth, on that. I should point out that EPA has worked closely with us on these estimates, that the overall direction for air quality should be upward as a result of the improvement of the available control technologies, but let me emphasize once again that we have no alternative but to begin to make that transition.

Mr. WIRTH. I agree with you completely but my concern is that while we make that transition we are letting one industry in this country get away with more than their fair share of how much pollution you can put up in the air. That is the basic concern that I have, and I think that it is our obligation to make sure that those sets of trade offs are made clear to the people of this country.

Thank you.

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Mr. SCHLESINGER. We shall insert some material, Mr. Chairman, in the record, in response to Mr. Wirth's question.

Mr. DINGELL. Without objection, it is so ordered.

[Testimony resumes on p. 63.]

[The following document was received for the record:]

AIR POLLUTION IMPACTS OF

THE OIL AND GAS REPLACEMENT PROGRAM

IN THE UTILITY AND INDUSTRIAL SECTORS

EXECUTIVE OFFICE OF THE PRESIDENT
ENERGY POLICY AND PLANNING
AND
ENVIRONMENTAL PROTECTION AGENCY
JUNE 20, 1977

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AIR POLLUTION IMPACTS OF THE OIL AND GAS REPLACEMENT PROGRAM IN THE INDUSTRIAL AND UTILITY SECTORS

I. EXECUTIVE SUMMARY

The purpose of this paper is to present the results of analyses of air pollutant emission impacts associated with the oil and gas replacement program.[1/] The paper focuses on the industrial and utility sectors, identifying air pollutant emissions from these sectors under the oil and gas replacement program as well as the entire President's Program. Analyses of the energy and economic impacts of the National Energy Plan (NEP) policies on these sectors are contained in a separate document.[2/] The environmental analysis relies heavily on the results described in this earlier document. In addition to presentation of analytical results, this paper details the methodology used to calculate the air pollutant emission levels.

A. Program Description

The oil and gas replacement program requires, with certain exceptions, that all new utility plants and large industrial boilers (greater than 10 MW) must burn coal or other fuels rather than oil and gas. Authority is also granted to require use of coal by other new industrial facilities (non-boilers). In addition to these regulatory provisions, the program includes taxes on the use of oil and gas by utilities and large industrial facilities and refunds (or investment tax credits for industry) for investments in non-oil and gas facilities or retirements of existing oil and gas facilities.

B. Environmental Protection Measures

The NEP also contains several provisions designed to mitigate potential adverse environmental effects from the expanded use of coal. Specifically, the National Energy

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1/ Also referred to as the Coal Program.

2/ "Replacing Oil and Gas with Coal and Other Fuels in the Industrial and Utility Sectors," Executive Office of the President, Energy Policy and Planning, June 2, 1977.

Plan calls for the use of best available control technology (BACT)[1/] on all new facilities larger than 25 MW.

In addition to BACT, the President has announced several policies specifically designed to minimize adverse environmental impacts from increased coal utilization. The policies most closely related to mitigation of air impacts are the Clean Air Act Amendments supported by the Administration. The key provisions of these amendments are listed below:

- o the requirement for a policy for prevention of significant deterioration,
- o disallowance of credit for tall stacks to meet air quality requirements,
- o establishment of non-compliance penalties for sources which do not meet compliance dates or do not operate and maintain pollution control equipment adequately, and
- o continuation of the current EPA emissions offset policy in non-attainment areas.

The National Energy Plan also recognizes that it may be necessary to continue use of oil and gas in areas where serious air pollution problems currently exist by allowing exemptions and exceptions on the basis of environmental constraints. As a part of the NEP the President called for a Committee to study:

(1) the health effects of increased coal production and use, and

(2) the environmental constraints on coal mining and on the construction of new coal-burning facilities.

The Committee is scheduled to report its findings by October 1977.

1/ See Section II for assumptions about BACT.

C. Summary of Findings

The major air pollutants of concern when burning coal rather than oil or gas are sulfur dioxide (SO_2) particulates (TSP), and nitrogen oxide (NO_x). Figure 1 compares the national emissions of industries and utilities for each of these pollutants under several scenarios:

- o the 1975 actual emissions
- o a 1985 baseline which would occur with no energy plan
- o an estimate of the impacts of the oil and gas replacement (coal) program alone in 1985, and
- o an estimate of the impact of the entire President's Program in 1985.

The incremental effects of the coal program and the President's program are identified through comparison with the 1985 baseline which represents a forecast based on current trends with no NEP. These emission levels are combined totals for industrial and utility sources. The 1975 emission levels provide a means for comparison with current emissions.

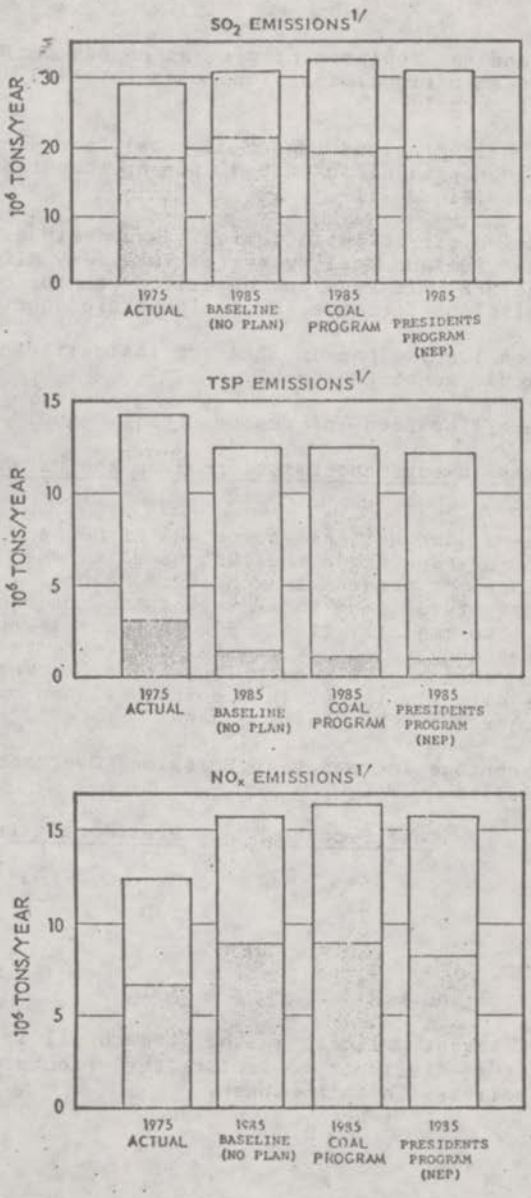
All of the 1985 cases assume the use of BACT[1/] on new sources (i.e., as required by the Clean Air Act Amendments) and full compliance with emission requirements.[2/] If the 1985 baseline did not include the BACT provision, the comparative emission impacts of the NEP would appear even less significant since BACT contributes to reductions in the 1985 baseline.[2/]

1/ BACT is applied to all new utilities which begin operation after 1984 and to new industrial sources, after 1979.

2/ The emissions impacts assuming New Source Performance Standard (NSPS) control are presented in Appendix 2.

FIGURE 1

NATIONAL AIR POLLUTANT EMISSIONS FROM INDUSTRIES AND UTILITIES



1/ The 1985 estimates assume full compliance with applicable emission limitations and implementation of best available control technology (BACT) provisions of Clean Air Act Amendments.

Major Findings

There are four major findings from the air pollution impact analysis:

- The oil and gas replacement program causes small increases in national emissions over the 1985 baseline. (Figure 1)[1/]
- The national emissions impact of total President's program is not significantly different than the 1985 baseline. (Figure 1)[1/]
- The relative air pollutant emissions contribution of the industrial and utility sectors are very different. Under the NEP emissions in the utility sector decline while emissions increase in the industrial sector.
- The regional emissions impacts are insignificant in all regions except Region VI.

These findings are discussed in greater detail below.

Moderate Increases in National Emissions from the Oil and Gas Replacement Program

As shown in Table 1, the national emissions of SO_2 and NO_x are all predicted to increase above the 1985 baseline when the oil and gas replacement program is considered alone.[2/] Total national emissions of TSP from these sectors is not changed by the program. The majority of the SO_2 increase is attributable to greater industrial use of coal and reflects the fact that even under the BACT assumption, emissions when burning coal are slightly larger than emissions when burning oil and much larger than when burning gas.

Table 1. Percentage Increases in Emissions Over the 1985 Baseline

	Coal Program	President's Program
SO_2	5%	-3%
TSP	0%	-2%
NO_x	5%	2%

1/ See Tables 4, 5 and 6.

2/ Since the different policies in the NEP are all interdependent, it is difficult to isolate the effects of individual policies in this manner.

Total increases for SO_2 and NO_x are approximately 5 percent above the 1985 baseline. If the 1985 baseline assumes NSPS rather than BACT emission controls, SO_2 emissions would increase 3 percent and TSP emissions would decrease 3 percent.

Minimal Impact of the Total President's Program

Table 1 shows that the emissions of TSP, NO_x and SO_2 predicted to occur under the President's Program are very close to the 1985 baseline levels: TSP, 2 percent decrease; SO_2, 3 percent decrease; and NO_x, 2 percent increase. While the oil and gas replacement program contributes to increased emissions, the load management and conservation policies in the remainder of the Plan cause a decrease in total fuel consumption and therefore a reduction in combustion related emissions. These reductions effectively balance the increases from the oil and gas replacement program at the national level.[1/] If the NEP emissions are compared to a NSPS baseline in 1985 that does not include the impacts of BACT, the impacts are as follows: TSP, 2 percent decrease; SO_2, 5 percent decrease; and NO_x, 1 percent increase.[2/]

The only significant national emission increases projected to occur between 1975 and 1985 are projected for NO_x. However, this increase is common to all the 1985 cases, not just the NEP scenario. NO_x emission increases are not related to the use of different fuels but reflect the lack of highly effective control technology. Since increases in fuel combustion are projected in the baseline, NO_x emission increases are projected for 1985 both with and without the NEP.

Relative Emissions Contribution of Industries and Utilities

The NEP affects both utility and industrial fuel use; however, the effects in these two sectors are very different. Utilities are already planning to burn coal rather than oil and gas in virtually all new baseload units except for those currently under construction. While the coal program would tend to increase coal use (with related oil and gas savings),

1/ As is discussed later, this balance is not always evident at the regional level.

2/ See Appendix 1 for full presentation of results under this assumption.

conservation measures would reduce coal consumption. The net effect is that coal use by utilities in 1985 is projected to be approximately the same both with and without the President's Program but oil and gas use by utilities would be reduced substantially. Therefore, the following percentage reductions in emissions from utilities in 1985 occur under the President's Plan as compared to the 1985 baseline: Particulates, 8 percent; SO_2, 9 percent; and NO_x, 9 percent.

The effect of the NEP on the industrial sector is much more pronounced. By 1985 industrial facilities are projected to consume almost 200 million more tons of coal per year than they would without the Plan. Without the Plan it is estimated that industry would continue to burn oil and gas, chiefly because fuel costs for industry are not as large a fraction of operating expenses as they are for utilities and because oil and gas is less troublesome to handle at an industrial site than is coal. However, significant shifting from gas and oil to coal is expected under the Plan. As a result of this increase in coal use, emissions from the industrial sector will increase in 1985.

The percentage increases in particulate emissions are insignificant under the NEP. Industrial processes rather than fuel combustion are the major contributors of industrial TSP emissions. This analysis has focused on changes in TSP emission from industrial fuel combustion only since these are the activities in the industrial sector which are impacted by the NEP policies. SO_2 emissions from the industrial sector increase by 19 percent in the oil and gas replacement program and 8 percent under the President's Program when compared to the 1985 baseline. Comparable NO_x emissions increases are 12 percent and 17 percent.

Regional Trends

In general, regional emissions estimates reflect the major trends discussed above. The results are summarized below for each pollutant under the oil and gas replacement program and under the entire President's Program. Tables 9, 10 and 11 in Section III provide the background material for this summary. (See Figure 2, Federal Regions)

Oil and Gas Replacement Program

Emissions of TSP increase in four regions (V, VI, VII, and IX) under the oil and gas replacement program as

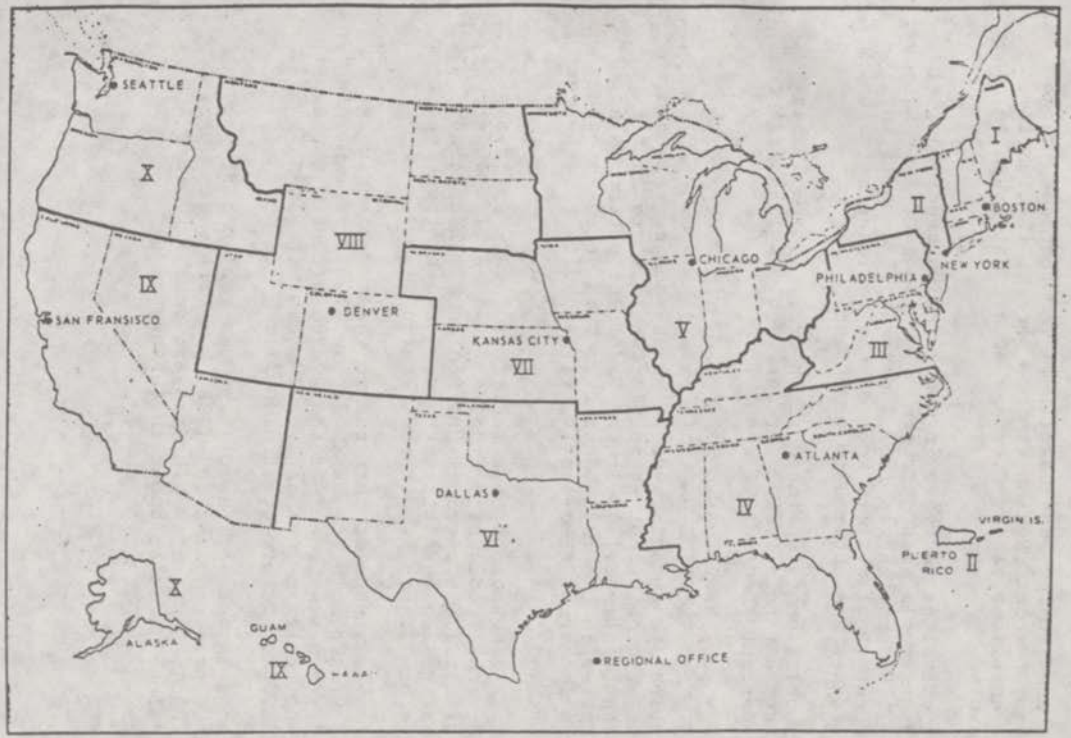


Figure 2 Federal Regions

compared to the 1985 baseline. The increases range from 1 percent (Region V) to 3 percent (Region IX). TSP emissions either decrease or are unchanged in other Regions.

SO_x emissions increase in every region under the oil and gas replacement program. The range of increase over the 1985 baseline is from 2 percent (Region I) to 31 percent (Region VI). Most of the regional emissions increases are about 3 to 4 percent.

NO_x emissions also increase in every Region. This increase ranges from 2 percent (Regions I and II) to 12 percent (Regions VI and IX).

Total President's Plan

Particulate emissions decrease or remain unchanged in every Region except Region IX (where there is a 1 percent increase) under the President's Program as compared to the 1985 baseline. This decrease ranges from 1 percent (Regions IV, VI, and VII) to 4 percent (Region I).

Only three Regions show increases in SO_2 emissions under the President's Program: Region VI, 30 percent; Region VIII, 6 percent; and Region X, 12 percent. All other regions exhibit decreases ranging from 1 percent (Region III) to 16 percent (Region I).

NO_x emissions also increase in three regions under the President's Program: Region VI, 22 percent; Region VIII, 9 percent; and Region X, 38 percent. Decreases in NO_x emissions range from 2 pecent (Regions I, III, and V) to 10 percent (Region II).

If regional impacts of the oil and gas replacement program and the NEP are compared to a 1985 baseline which does not include BACT, comparative impacts are smaller. (See Appendix 1 for regional results under this assumption.)

Qualifications and Assumptions

These national and regional emissions do not indicate how the coal program is expected to affect attainment of air quality standards in specific areas of the country. There are some areas where additional use of coal could impair attainment of health standards. However, the NEP was developed assuming that increased coal use would not occur, and should not be allowed, in some areas due to environmental constraints.

Assumptions which are important to interpretation of the analysis include:

(1) all existing facilities will comply with applicable emission limitations in the state implementation plans (SIP) by 1985. The validity of this assumption depends on effective enforcement effort by both the State and the Federal Governments.

(2) BACT controls for SO_2 will require scrubbers on large boilers (above 25 MW). Scrubbers are assumed to have 90 percent effective SO_2 removal and to be available 90 percent of the time (i.e., 80 percent efficient).

(3) a revised new source performance standard of 1.5 lbs SO_2/MMBtu covering boilers between 10 MW and 25 MW will be promulgated.

(4) BACT will apply to new utilities beginning operation in 1984 and industry beginning operation in 1979.

(5) the NEP will be implemented as proposed. Under the entire energy plan, the conservation measures and the programs which free up gas for use in the residential and industrial sectors are particularly important for producing the offsetting emission reductions under the entire plan.

Analysis of the effects of the oil and gas replacement program and of the entire NEP in 1990 will be issued in a supplementary document. Most of the effects of the coal conversion program in the industrial sector are expected to occur by 1985. However, both the oil and gas replacement program and the conservation measures are expected to have a larger impact on the utility sector in 1990 than in 1985.

The remaining sections of this paper discuss the methodology used to calculate emissions and present more detailed air pollutant emission results.

II. DESCRIPTION OF METHODOLOGY

There are four basic steps to the methodology for calculating emission impacts of SO_2, TSP, and NO_x:

(1) Estimate the type and quantity of fuel consumed in each scenario (e.g., 1975, 1985 baseline, President's Program, and Oil and Gas Replacement Program) by certain categories of industrial and utility users.

(2) Construct different cases which represent a range of potential emission control assumptions.

(3) Calculate the emission factors for SO_2, TSP, and NO_x which are applicable to new and existing facilities under these cases, and

(4) Determine national and regional emission levels.

The approach in each sector differs somewhat. However, Appendix 2 provides a detailed accounting of the methodology used in the industrial sector and Appendix 3 describes the methodology used in the utility sector.

A. Energy Baseline

Construction of the energy baseline was accomplished primarily through the FEA Project Independence (PIES) model.[1] The first step in formulating the baseline was to forecast the fuel type (oil, gas, coal, other) and quantity of fuel used in each sector. This is a function of fuel prices and other economic factors input to PIES as well as the impacts of specific provisions of the NEP such as conversions to coal and load management. Table 2 provides several different energy scenarios for the industrial and utility sectors:

- o actual 1975
- o 1985 baseline without the NEP
- o 1985 with the oil and gas replacement program alone
- o 1985 with the entire President's Program.

These energy scenarios are used consistently throughout the analysis.

After obtaining the breakout by fuel type and quantity in each sector it was necessary to apportion these totals to new as opposed to existing units. It was further necessary to determine what percentage of fuel is used in large installations (greater than 25 MW) and small[2] installations (from 10-25 MW, industrial only). All of these refinements are necessary because different emission regulations may apply to small vs. large, new vs. existing units.[3]

1/ For a detailed explanation of the energy impact numbers see Appendices A and B to "Replacing Oil and Gas with Coal and other Fuels in the Industrial and Utility Sectors." This PIES baseline was adjusted for the utility sector as described in Appendix 3 of this paper.

2/ Very small installations (less than 10 MW) were not considered in this analysis.

3/ This methodology is explained in detail in a separate report "The Replacement of Oil and Gas with Coal and Other Fuels in The Industrial and Utility Sectors" Appendix A.

TABLE 2: Energy Used for Fuel Combustion in the Industrial and Utility Sectors

INDUSTRIAL SECTOR[1/]

	Oil (oil equivalents MMB/D)	Gas	Coal (10^6 tons)	Increase in Coal Use over 1985 Baseline: (10^6 tons)
1975	1.4	3.8	63	
1985 Baseline	3.8	3.9	101	
1985 Coal Program (Savings over 1985 baseline)	(0.9)	(1.3)	300	199
1985 President's Program[2/]	1.6	3.5	278	177

UTILITY SECTOR

	Oil (oil equivalents MMB/D)	Gas	Coal (10^6 tons)	Increase in Coal Use over 1985 Baseline: (10^6 tons)
1975	1.3	1.6	404	
1985 Baseline[3/]	2.3	0.9	763	
1985 Coal Program (Savings over 1985 baseline)	(0.7)	(0.4)	860	97
1985 President's Program[2/]	1.5[4/]	0.5	779	16

1/ This does not include oil and gas feedstock and metallurgical coal.

2/ The President's Program includes the effects of the coal program and conservation policies.

3/ PIES run A148524C.

4/ PIES run A158569C. (There was a technical error in the PIES specifications for this run. The effect of correcting this error is estimated to be that oil consumption would be 1.2 MMB/D)

The most important information from the standpoint of emissions impacts is where the increased coal is used. As shown in Table 2, the majority of increased coal use in 1985 occurs in the industrial sector. When the increase in industrial coal from the coal program is combined with the increase in the baseline between 1976 and 1985, the additional demand is apportioned as follows:

- o new energy facilities - 81 percent
- o existing facilities with capability to burn coal - 9 percent
- o accelerated replacement of existing oil-and-gas-fired facilities - 10 percent

Almost all of the increased coal use in the utility sector occurs in replacement or new coal-fired facilities both of which are subject to new source emission limitations. As a result over 90 percent of the increased coal use between 1976 and 1985 is subject to either new source performance standards (NSPS) or best available control technology (BACT).1/

B. Emission Control Assumptions

There is some uncertainty about emission control requirements that will apply to new and replacement facilities converting to coal in the 1985 time frame. The uncertainty can be categorized into three areas:

- o status of the proposed Clean Air Act Amendments
- o definition of BACT, and
- o emission control requirements for small facilities.

Several cases were developed for this analysis to represent differing assumptions about each of these variables. These cases are summarized on Table 3. Different emission control requirements apply to new vs. existing sources.

1/ Assuming that a revised new source performance standard is promulgated for facilities between 10MW to 25 MW. In any case, 90 percent of the facilities would undergo new source review.

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TABLE 3: Range of Emission Control Assumptions

		NEW SOURCES		EXISTING SOURCES
		Large[1]	Small[2]	
Case 1:	SO2	BACT(90%)[3]	1.5 lb/MMBTU[4]	SIP
	TSP	BACT(0.01 lb/MMBTU)	0.03 lb/MMBTU	SIP
	NOx	NSPS	*	*
Case 2:	SO2	BACT(80%)[5]	1.5 lb/MMBTU	SIP
	TSP	BACT(0.05 lb/MMBTU)	0.05 lb/MMBTU	SIP
	NOx	NSPS	*	*
Case 3:	SO2	BACT(80%)	SIP	SIP
	TSP	BACT(0.05 lb/MMBTU)	SIP	SIP
	NOx	NSPS	*	*
Case 4:[6]	SO2	NSPS	SIP	SIP
	TSP	NSPS	SIP	SIP
	NOx	NSPS	*	*

* Emission factors for these sources of NOx were obtained from AP-42, "Compilation of Air Pollutant Emission Factors," and reflect uncontrolled emissions.

1/ Utilities and industrial boilers greater than 25 MW (250 MMBtu/D).

2/ Boilers between 10 MW and 25 MW.

3/ This assumes 90 percent efficiency and 100 percent reliability from scrubber equipment as well as coal cleaning.

4/ This assumes a revision of current NSPS to cover small boilers, which are not now regulated by current NSPS.

5/ This assumes 90 percent efficiency and 90 percent reliablity from scrubber equipment as well as coal cleaning.

6/ This case assumes no change in the current Clean Air Act.

Three of the four cases used in this analysis are described below. Cases 1 and 4 provide the bounds on the ranges of emission estimates because of the assumptions about BACT. Case 2 was chosen as the most probable case so the assumptions implicit in Case 2 are described in greatest detail.

Case 1 represents the most stringent environmental requirements. The BACT level for SO_2 called for removal of 90 percent of the sulfur from locally available coals. The TSP controls assume a 99.8 percent reduction from BACT for large sources. For small sources (10 to 25 MW), revised NSPS[1/] of 1.5 pounds per MMBtu for SO_2 and 0.03 pounds per MMBtu for TSP were assumed. All existing sources were assumed to meet SIP. NO_x emissions were assumed to meet NSPS.

Case 4 represents the least stringent environmental control requirements. Current NSPS for SO_2, TSP, and NO_x were assumed to apply to all existing sources greater than 25 MW capacity. All existing sources and smaller facilities (10 to 25 MW) are assumed to meet SIP for TSP, SO_2 and NO_x.

The results of Case 2 are presented throughout this paper. Case 2 was considered the most realistic case for several reasons. The BACT level for SO_2 reflects 80 percent removal of SO_2 from locally available coal. This assumes 90 percent efficiency and 90 percent reliabilty from SO_2 scrubbers which provides for some possible deterioration of efficiency or unavailability.

The TSP control level for Case 2 is 99 percent which can be met by an SO_2 scrubber or with an electrostatic precipitator or baghouse where scrubbers are not required. This case also includes revised NSPS for small new sources. These levels of control on new and modified sources are reasonable based on activities already underway in EPA to revise current NSPS.

The impacts estimated under the assumptions in Cases 1 and 4 described above are used to provide some insight into the sensitivity of the results. Case 4 estimates are included in Appendix 1 at a comparable level of detail to the Case 2 impacts.

1/ New source performance standards.

C. Emission Factors

The emission control assumptions cases described above were structured to determine what emission factors would be applicable in the analysis. Emission factors are keyed to fuel use (oil, gas, and coal) and the level of environmental control required.

Emissions from new sources are regulated at the Federal level (NSPS or BACT). However, variability in emissions of SO_2 when using coal under BACT will occur because of the varying sulfur content of the coal burned. Therefore, it is necessary to have a different set of emission factors for each region which are based on the coal used and the 80 percent BACT control requirement.

Emissions from existing sources must meet SIP requirements. These requirements vary from state-to-state and often from county-to-county. In order to calculate regional emissions for industries, these SIP requirements were weighted to reflect the percentage of fuel of a certain type which had to conform to each requirement. These weighted factors were then aggregated to the regional level.

D. Regional Emission Levels

In general, emission levels are a function of fuel mix and emission factors for each type of fuel. The energy baseline and the NEP scenarios must be presented in terms of the mix of oil, gas, and coal in each region. The percentage of each of these fuels burned in new versus existing and small versus large sources also must be identified in every region. Then the emission factors denoted in Step 3 above are applied to each of these classes of use to calculate total emissions on each fuel. The total of emissions on all fuels consumed by industries added to a similar total for utilities in each region provides the impact numbers presented in this document.

E. Non-Compliance

A key assumption in all of the 1985 energy scenarios is that there will be full compliance with the Clean Air Act, either current or as amended. This assumption is particularly

important with respect to TSP where the current rate of non-compliance is very high. If this assumption proves to be optimistic then the 1985 TSP emission levels would not show the significant improvements over the 1975 levels illustrated in Figure 1.

It should also be noted that the proposed amendments to the Clean Air Act, which are supported by the Administration, call for non-compliance penalties. The probable enactment of the Clean Air Act amendments including such penalties reinforces the full compliance assumption.

F. Limits to the Analysis

There are several important factors which were not included in this analysis due to time constraints, lack of data, and other considerations. It is necessary to recognize these factors so that the results which are presented may be put into an appropriate context. Four major considerations are listed below:

- o local, site-specific impacts
- o new national ambient air quality standards (NAAQS)
- o environmental limits to coal supply and use, and
- o institutional factors.

These concerns include areas where the program impacts are not fully identified as well as constraints which may limit the full potential of the program.

Local impacts: The national and regional emission estimates provide little insight into local or site-specific problems. Such problems must be identified on a case-by-case basis. No analysis of the potential for and severity of site specific problems has been done to date. However, over 90 percent of the increased coal use is in new facilities subject to NSPS or BACT and significant deterioration and non-attainment policies can be used to assure the protection of public health.

New NAAQS: In the time frame between 1977 and 1985 it is possible that additional new ambient air quality standards may be promulgated for sulfates, short term NO_x, and fine particulates. This analysis only estimates impacts for particulates, SO_2 and NO_x. The estimation of constraints to

coal use due to the additional pollutants listed above is not possible because of the uncertainty concerning the timing, level, and emission control implications of future ambient air quality standards. Similarly, the effects of this program on CO_2 levels has not been addressed.

Environmental Limits to Coal Use. The primary constraints on increased coal use are expected to arise from non-attainment and air quality maintenance considerations. This analysis accounts for such constraints in a rough manner by approximating the new fuel use that might be eligible for exemptions or the existing fuel use which might not be capable of converting to coal due to environmental constraints. Further refinement at the site-specific level is necessary because air quality problems from coal combustion, particularly SO_2 and TSP, are very site-specific problems.

Institutional Factors: Delays may be experienced in the implementation of the oil and gas replacement program. These delays may occur as a result of legislative delays, long lead times for siting of facilities, or time requirements for purchase and installation of equipment. The effect of these delays would be to spread the conversions over a longer time period therefore reducing emissions impacts in 1985. In addition, delays in the implementation of BACT requirements could occur past the 1984 and 1979 dates assumed for utilities and industries in this analysis. The impact of a delay in BACT would be an increase in 1985 emission levels.

III. FINDINGS

This section presents the air pollutant emission impacts of the coal program and the entire President's Program.

The following estimates are provided for each energy scenario:

- o national emissions from the industrial and utility sectors for TSP, SO_2 and NO_x
- o regional emissions of TSP, SO_2 and NO_x, and
- o an indication of sensitivity of the predicted impacts.

Before presenting the results of the analyses, it is useful to have some perspective on the proportion of total emissions which is represented by the industrial and utility categories in this analysis. Table 4 presents total national emissions in 1975 as a function of source categories. The importance of industrial and utility sources to the total emissions is heavily dependent upon the specific pollutant. In the case of TSP, combustion sources represent 37 percent of the total emissions, whereas for SO_2 they represent 80 percent and for NO_x approximately 50 percent. It is important to note that this analysis is confined to the effect of NEP policies on the emissions contribution from only the industrial and utility sectors.

One additional point of clarification is necessary. All emissions from industrial sources are included in this analysis (e.g., total 1975 TSP emissions for the industrial sector of 11.2 MT/year consist of 2.5 MT/year from industrial fuel combustion and 8.7 MT/year from industrial process sources as shown in Table 4). However, only those industrial emissions due to fuel combustion (boiler and non-boiler) are affected by the oil and gas replacement program. The process emissions are assumed to remain the same in each of the three 1985 scenarios.

Although it is not included in this analysis there is an important secondary impact of the oil and gas replacement program. The shifts from gas to coal and the reduction in gas use due to the gas pricing policy free up gas for use in the residential/commercial sector. The replacement of oil with gas in the residential commercial/sector will result in

TABLE 4: Nationwide Emission Estimates for all Source Categories, 1975 Preliminary[1/]

(10^6 tons/year)

Source Category	Particulates[2/]	%	SO_2	%	NO_x	%
Transportation	1.3	(7)	0.8	(2)	10.7	(44)
Stationary Fuel Combustion						
Electric Utilities	3.5		21.0		6.8	
Industrial	2.5		5.0		4.9	
Other	.6		0.3		0.7	
Total	6.6	(37)	26.3	(80)	12.4	(51)
Industrial Processes	8.7	(48)	5.7	(17)	0.7	(3)
Solid Waste	0.6	(3)	0.1	(—)	0.2	(1)
Miscellaneous	0.8	(4)	0.1	(—)	0.2	(1)
Total	18.0	(99)	32.9	(99)	24.2	(99)

1/ Source: EPA National Emission Data System (NEDS). This is preliminary data and has been updated by EPA at other places in this analysis.

2/ TSP concentrations can be significantly affected by natural, agricultural, and other sources of fugitive dust. These sources are not included in this total.

a decrease in emissions from this sector. These emissions benefits are not considered in this analysis.

A. National Emission levels

The national emission levels of TSP, SO_2 and NO_x estimated for each of the energy scenarios are contained on Tables 5, 6, and 7. The discussions below consider each pollutant individually.

1. Particulates

As shown in Table 5, the oil and gas replacement program causes a negligible increase in TSP emissions in 1985 and a 1 percent increase in the industrial sector. The impact of the entire President's program is a slight decrease in emissions of TSP; 2 percent as compared to the 1985 baseline. This decrease occurs because of conservation effects of the total program which cause an 8 percent decrease in utility emissions of TSP. The significant reductions in the 1985 baseline over 1975 reflect the assumption of compliance in 1985 as compared to the high levels of non-compliance in 1975.

2. Sulfur Dioxide

Table 6 presents the national emissions of SO_2 from industries and utilities. The most notable impacts occur in the industrial sector where emissions increase by 19 percent over the 1985 baseline in the oil and gas replacement program, and by 8 percent in the total President's Program. The emissions reductions in the utility sector are attributable to reduced fuel combustion because of conservation and load management. The reduction in SO_2 emissions from utilities (9 percent over the 1985 baseline) causes an overall decrease of 3 percent in SO_2 emissions under the President's Program.

TABLE 5: National Emissions of TSP From Industries and Utilities

Source	1975 Actual (10^6 tons)	1985 Baseline (10^6 tons)	1985 Coal Program (10^6 tons)	% [1]	1985 President's Program (10^6 tons)	% [1]
Industry	11.2	11.2	11.3	(+1%)	11.2	(0%)
Utility	3.1	1.3	1.2	(-8%)	1.2	(-8%)
Total	14.3	12.5	12.5	(0%)	12.3	(-2%)

TABLE 6: National Emissions of SO_2 From Industries and Utilities

Source	1975 Actual (10^6 tons)	1985 Baseline (10^6 tons)	1985 Coal Program (10^6 tons)	% [1]	1985 President's Program (10^6 tons)	% [1]
Industry	10.8	10.8	12.8	(+19%)	11.7	(+8%)
Utility	18.6	20.2	19.9	(-1%)	18.3	(-9%)
Total	29.4	31.1	32.7	(+5%)	30.1	(-3%)

[1] % change from 1985 Baseline

3. Nitrogen Oxides

As shown in Table 7, total national emissions of NO_x will increase about 2 percent due to the President's Program as compared to the 1985 baseline. This slight overall increase is the result of increases in the industrial sector (17 percent) balanced by decreases in the utility sector (9 percent). Table 7 also shows that significant increases of NO_x emissions are predicted in 1985 as compared to the actual 1975 levels regardless of whether or not the NEP is implemented. This increase in NO_x emission is caused by general growth, and the lack of highly effective control technology rather than alternative fuel use.

4. Sensitivity of Results

Table 8 provides estimates of the sensitivity of the analytical results. The totals represent the range of emissions impacts calculated for all four of the cases described in Table 3. (Case 1 provides the lower bound and Case 4 the upper bound). As Table 8 shows, the range of estimates for particulates is very small. The range for SO_2 is considerably greater especially in the industrial sector.

TABLE 7: National Emissions of NO_x From Industries and Utilities

Source	1975 Actual (10^6 tons)	1985 Baseline (10^6 tons)	1985 Coal Program (10^6 tons)	% 1/	1985 President's Program (10^6 tons)	% 1/
Industry	6.0	6.6	7.4	(12%)	7.7	(17%)
Utility	6.6	9.0	9.0	(0%)	8.2	(-9%)
Total	12.6	15.6	16.4	(5%)	15.9	(2%)

1/ percent change from the 1985 baseline.

TABLE 8: Range of National Emissions Predicted for Industries and Utilities [1/]

(10^6 Tons)

PARTICULATES

Scenario	Industry[2/]	Utility
1975 Actual	11.2	3.1
1985 Baseline	11.2-11.4	1.2-1.2
1985 Coal Program	11.2-11.8	1.2-1.3
1985 President's Program	11.1-11.7	1.2-1.2

SO_2

1975 Actual	10.8	18.6
1985 Baseline	10.7-12.4	19.7-20.2
1985 Coal Program	12.3-16.6	19.3-20.2
1985 President's Program	11.3-15.9	17.8-18.3

1/ This table presents the results of the four cases decribed in Table 3. Case 1 (stringent BACT) results represent the lower bound and Case 4 (current NSPS) results, the upper bound. Only one case was considered for NO_x.

2/ The results for Case 3 are not shown in the above table. Case 3 assumes that no revised NSPS for small boilers is promulgated and that small boilers (less than 25 MW) are subject to SIP. Utility emissions do not vary under this assumption. The results from Case 3 for industry are as follows:

	SO_2	TSP
1985 Baseline	11.2	11.3
1985 Coal Program	14.8	11.6
1985 President's Program	14.0	11.8

Only one case was analyzed for NO_x.

This range reflects the variation between application of NSPS and BACT. Even though the case presented in the analysis (Tables 5, 6, and 7) is not the most stringent BACT case, the impacts predicted are very close to the low end of the range.

B. Regional Emission Levels

Regional emissions of particulates, SO_2, and NO_x were calculated for both industries and utilities in each of the energy scenarios. The results are presented on Tables 9, 10, and 11. These estimates should be considered as interim projections because work is still underway to refine them further. Special care should be taken in interpreting small differences when the totals are small since PIES does not have the capability to accurately site power plants. The discussion below addresses each pollutant separately.

The most significant regional impacts occur in Region VI in the form of increased SO_2 emissions. These increases occur for several reasons, all of which are related to the current reliance of this region on natural gas. First, the 1985 baseline SO_2 emissions are over two times as large as the 1975 levels for SO_2. This occurs because of increased utility use of coal between 1975 and 1985 in the baseline. While utility emissions do not increase significantly in Region VI under the NEP, compared to the 1985 baseline, industry emissions approximately double due to increased coal use. As a result, the President's Program shows a 30 percent increase over the 1985 baseline in Region VI.

Emissions of NO_x also increase in Region VI under the coal program (12 percent) and the President's Program (22 percent). The increase under the coal program is due to replacement of oil with coal which has higher NO_x emissions. Under the President's Program, conservation measures "free up" some gas which replaces oil in Region VI. Emissions of NO_x on gas are higher than those from oil, thus NO_x emissions increase further with the incremental use of gas under the President's Program.

1. Particulates

As shown in Table 9, the regional emission trends for particulates conform closely to the national trends in that:

TABLE 9: Projected Particulate Emissions From Utilities and Industries by Region (10^3 Tons)

Federal Region		1975 Actual	1985 Base	Change: Coal Program (from 1985 base)	1985 Coal Program	Change: President's Program (from 1985 base)	1985 President's Program
I	Utility	40	30	0	30	-10	20
	Industry	210	210	0	210	0	210
	Total	250	240	0	240	-10	230
II	Utility	120	40	0	40	0	40
	Industry	550	550	0	550	0	550
	Total	670	590	0	590	0	590
III	Utility	500	100	0	100	0	100
	Industry	1280	1280	0	1280	0	1280
	Total	1790	1380	0	1380	0	1380
IV	Utility	1050	270	-20	250	-30	240
	Industry	2490	2490	10	2500	-10	2480
	Total	3540	2760	-10	2750	-40	2720
V	Utility	990	400	0	400	-10	390
	Industry	3040	3040	20	3060	-50	2990
	Total	4030	3440	20	3460	-60	3380
VI	Utility	130	170	-20	150	-30	140
	Industry	1210	1210	30	1240	20	1230
	Total	1340	1380	10	1390	-10	1370

TABLE 9: Projected Particulate Emissions From Utilities and Industries by Region (10^3 Tons) (Cont)

Federal Region		1975 Actual	1985 Base	Change: Coal Program (from 1985 base)	1985 Coal Program	Change: President's Program (from 1985 base)	1985 President's Program
VII	Utility	190	110	0	110	-10	100
	Industry	1040	1040	10	1050	0	1040
	Total	1230	1150	10	1160	-10	1140
VIII	Utility	80	90	-10	80	-10	80
	Industry	400	400	10	410	0	400
	Total	480	490	0	490	-10	480
IX	Utility	30	30	10	40	0	30
	Industry	660	660	10	670	10	670
	Total	690	690	20	710	10	700
X	Utility	0	10	0	10	0	10
	Industry	330	330	0	330	-10	320
	Total	330	340	0	340	-10	330
National							
	Utility	3140	1250	-40	1210	-100	1150
	Industry	11200	11210	90	11300	-40	11170
	Total	14340	12460	50	12510	-140	12320

1) there is no significant impact from the President's Program; and 2) the Coal Program causes small increases which are usually offset by the entire NEP. This does not reflect any impact of the NEP but rather the non-compliance in 1975 and assumed compliance in 1985.

2. Sulfur Dioxide

Table 10 shows that regional emissions of SO_2 would increase slightly under the oil and gas replacement program but would decrease again under the total President's Program. The most significant increases in emissions of SO_2 occur in Region VI and are 30 percent over the 1985 baseline under the Coal Program and the President's Program. These increases occur for reasons outlined above. Regions IV and V both show decreases when comparing the President's Program to the 1985 baseline. In general, regional utility emissions of SO_2 are less under the President's Program than for the 1985 baseline. In all but three regions (VI, VII, VIII) this decline offsets industrial increases in SO_2 emissions. It should be noted that increases in SO_2 emissions occur in most regions (I, IV, VI, VII, VIII, IX, X) in the 1985 baseline as compared to 1975. This occurs because of increased coal use by utilities in these areas.

3. Nitrogen Oxides

Table 11 presents the regional estimates of NO_x emissions for each energy scenario. It should be recognized that these results represent NSPS assumptions rather than BACT, since BACT for NO_x has not been assumed in this analysis.

Every region shows an increase in NO_x emissions from the 1975 levels, however, this result shows up in the 1985 baseline as well as the NEP cases. This impact is explained by the fact that highly effective NO_x controls are not currently available so growth in sources translates directly to growth in emissions.

Region VI experiences the most substantial increases in NO_x emissions: 22 percent in the President's Program over the 1985 baseline. In fact, Regions VI and X are the only regions in which NO_x emissions increase under the President's Program as compared to the 1985 baseline.

NO_x emissions from the utility sector decrease in almost every region due to conservation and reduced fuel use. The regional industrial emissions increase in the Coal Program and either remain the same or decrease under the President's Program. Region VI is the most important exception where industrial NO_x emissions increase substantially (30%) under the President's Program as compared to the Coal Program for reasons described in a previous section.

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TABLE 10: Projected SO_2 Emissions from Utilities and Industries by Region (10^3 Tons)

Federal Region		1975 Actual	1985 Base	Change: Coal Program (from 1985 base)	1985 Coal Program	Change: President's Program (from 1985 base)	1985 President's Program
I	Utility	220	400	-10	390	-50	350
	Industry	230	230	20	250	-50	180
	Total	450	630	10	640	-100	530
II	Utility	780	760	-10	750	-130	630
	Industry	590	600	50	650	50	650
	Total	1370	1360	40	1400	-80	1280
III	Utility	3120	2820	-30	2790	-170	2650
	Industry	1500	1510	160	1670	110	1620
	Total	4620	4330	130	4460	-60	4270
IV	Utility	5010	5130	-80	5050	-740	4390
	Industry	2060	2060	260	2320	-50	2010
	Total	7070	7190	180	7370	-790	6400
V	Utility	7550	6450	-240	6210	-350	6100
	Industry	3730	3740	460	4200	-230	3510
	Total	11280	10190	220	10410	-580	9610
VI	Utility	160	1920	80	2000	0	1920
	Industry	690	690	730	1420	790	1480
	Total	850	2610	810	3420	790	3400

TABLE 10: Projected SO_2 Emissions from Utilities and Industries by Region (10^3 Tons) (Cont)

Federal Region		1975 Actual	1985 Base	Change: Coal Program (from 1985 base)	1985 Coal Program	Change: President's Program (from 1985 base)	1985 President's Program
VII	Utility	1300	1800	-10	1790	-300	1500
	Industry	660	660	90	750	80	740
	Total	1960	2460	80	2540	-220	2240
VIII	Utility	240	400	0	400	0	400
	Industry	230	230	60	290	40	270
	Total	470	630	60	690	40	670
IX	Utility	180	420	-10	410	-130	290
	Industry	980	990	70	1060	100	1090
	Total	1160	1410	60	1470	-30	1380
X	Utility	40	110	0	110	0	110
	Industry	140	140	60	200	30	170
	Total	180	250	60	310	30	280
National							
	Utility	18600	20210	-310	19900	-1870	18340
	Industry	10810	10850	1960	12810	870	11720
	Total	29410	31060	1650	32710	-1000	30060

TABLE 11: Projected NO_x Emissions From Utilities and Industries by Region (10^3 Tons)

Federal Region		1975 Actual	1985 Base	Change: Coal Program (from 1985 base)	1985 Coal Program	Change: President's Program (from 1985 base)	1985 President's Program
I	Utility	200	210	0	210	-30	180
	Industry	230	250	10	260	20	270
	Total	430	460	10	470	-10	450
II	Utility	650	720	-10	710	-160	560
	Industry	550	600	30	630	30	630
	Total	1200	1320	20	1340	-130	1190
III	Utility	1090	1280	-10	1270	-80	1200
	Industry	680	760	70	830	40	800
	Total	1770	2040	60	2100	-40	2000
IV	Utility	1120	1620	0	1620	-170	1450
	Industry	910	1000	100	1100	70	1070
	Total	2030	2620	100	2720	-100	2520
V	Utility	1860	2260	0	2260	-80	2180
	Industry	1420	1580	130	1710	20	1600
	Total	3280	3840	130	3970	-60	3780
VI	Utility	690	1330	50	1380	-110	1220
	Industry	930	1030	240	1270	-630	1660
	Total	1620	2360	290	2650	520	2880

TABLE 11: Projected NO_x Emissions From Utilities and Industries by Region (10^3 Tons) (Cont)

Federal Region		1975 Actual	1985 Base	Change: Coal Program (from 1985 base)	1985 Coal Program	Change: President's Program (from 1985 base)	1985 President's Program
VII	Utility	440	680	0	680	-30	650
	Industry	430	470	30	500	30	500
	Total	870	1150	30	1180	0	1150
VIII	Utility	170	450	0	450	-40	410
	Industry	200	230	30	260	20	250
	Total	370	680	30	710	-20	660
IX	Utility	300	380	0	380	-50	330
	Industry	460	510	40	550	70	580
	Total	760	890	40	930	20	910
X	Utility	40	50	0	50	-30	20
	Industry	190	210	30	240	80	290
	Total	230	260	30	290	50	310
National							
	Utility	6560	8980	30	9010	-780	8200
	Industry	6000	6640	710	7350	1010	7650
	Total	12560	15620	740	16360	230	15850

Appendix 1: EMISSIONS PROJECTIONS ASSUMING NSPS[1/]

This Appendix contains the results of Case 4 of the analysis defined in Section II (See Table 3). This represents application of NSPS rather than BACT as assumed in Case 2 for all of the 1985 cases. Both regional and national results are provided below. Only TSP and SO_2 are included because the NO_x case presented in the paper assumes NSPS.

Table A-1. NATIONAL EMISSIONS FROM INDUSTRIES AND UTILITIES - NSPS (10^6 Tons)

PARTICULATES

	1975	1985 BASELINE	1985 COAL PROGRAM		1985 PRESIDENT'S PROGRAM	
INDUSTRY	11.2	11.4	11.8	(4%) [2/]	11.7	(3%) [2/]
UTILITY	3.1	1.2	1.3	(8%)	1.2	(0%)
TOTAL	14.3	12.6	13.1	(4%)	12.9	(2%)

SULFUR DIOXIDE

	1975	1985 BASELINE	1985 COAL PROGRAM		1985 PRESIDENT'S PROGRAM	
INDUSTRY	10.8	12.4	16.6	(34%) [2/]	15.9	(28%) [2/]
UTILITY	18.6	20.2	20.2	(0%)	18.2	(-10%)
TOTAL	29.4	32.6	36.8	(13%)	34.1	(5%)

NITROGEN OXIDES

	1975	1985 BASELINE	1985 COAL PROGRAM		1985 PRESIDENT'S PROGRAM	
INDUSTRY	6.0	6.7	7.3	(9%) [2/]	7.6	(13%) [2/]
UTILITY	6.6	9.0	9.0	(0%)	8.2	(-9%)
TOTAL	12.6	15.7	16.3	(4%)	15.8	(1%)

[1/] New Source Performance Standards for units above 25 MW. For specific emission limits under NSPS, see Case 4 for TSP and SO_2, and case 1 for NO_x in Appendix 2.

[2/] Percentage over 1985 baseline.

TABLE A-2 PROJECTED TSP EMISSIONS FROM INDUSTRIES AND UTILITIES BY REGION - (NSPS)
(10^3 TONS)

	FEDERAL REGION	1975 ACTUAL	1985 BASE	CHANGE COAL PROGRAM (from 1985 base)	1985 COAL PROGRAM	CHANGE PRESIDENT'S PROGRAM (from 1985 base)	1985 PRESIDENT'S PROGRAM
I.	UTILITY	40	30	0	30	0	30
	INDUSTRY	210	220	0	220	0	220
	TOTAL	250	250	0	250	0	250
II.	UTILITY	120	50	0	50	-10	40
	INDUSTRY	550	560	10	570	10	570
	TOTAL	670	610	10	620	0	610
III.	UTILITY	510	100	0	100	0	100
	INDUSTRY	1280	1300	20	1320	10	1310
	TOTAL	1790	1400	20	1420	10	1410
IV.	UTILITY	1050	260	10	270	-10	250
	INDUSTRY	2490	2540	40	2580	10	2550
	TOTAL	3540	2800	50	2850	0	2800
V.	UTILITY	990	400	0	400	-10	390
	INDUSTRY	3040	3090	60	3150	-40	3050
	TOTAL	4030	3490	60	3550	-50	3440
VI.	UTILITY	130	150	20	170	10	160
	INDUSTRY	1210	1230	180	1410	260	1490
	TOTAL	1340	1380	200	1580	270	1650
VII.	UTILITY	190	110	0	110	-20	90
	INDUSTRY	1040	1060	20	1080	20	1080
	TOTAL	1230	1170	20	1190	0	1170

TABLE A-2 PROJECTED TSP EMISSIONS FROM INDUSTRIES AND UTILITIES BY REGION - (NSPS) (Cont)
(10^3 TONS)

FEDERAL REGION		1975 ACTUAL	1985 BASE	CHANGE COAL PROGRAM (from 1985 base)	1985 COAL PROGRAM	CHANGE PRESIDENT'S PROGRAM (from 1985 base)	1985 PRESIDENT'S PROGRAM
VIII.	UTILITY	80	90	0	90	-10	80
	INDUSTRY	400	410	10	420	10	420
	TOTAL	480	500	10	510	0	500
IX.	UTILITY	30	40	-10	30	0	40
	INDUSTRY	660	670	20	690	20	690
	TOTAL	690	710	10	720	20	730
X.	UTILITY	-	10	0	10	0	10
	INDUSTRY	330	330	10	340	0	330
	TOTAL	330	340	10	350	0	340
NATIONAL							
	UTILITY	3140	1240	20	1260	-50	1190
	INDUSTRY	11200	11410	370	11780	300	11710
	TOTAL	14340	12650	390	13040	250	12900

TABLE A-3 PROJECTED SO_2 EMISSIONS FROM INDUSTRIES AND UTILITIES BY REGION - (NSPS)
(10^3 TONS)

	FEDERAL REGION		1975 ACTUAL	1985 BASE	CHANGE COAL PROGRAM (from 1985 base)	1985 COAL PROGRAM	CHANGE PRESIDENT'S PROGRAM (from 1985 base)	1985 PRESIDENT'S PROGRAM
I.		UTILITY	220	400	0	400	-40	360
		INDUSTRY	230	260	50	310	-20	240
		TOTAL	450	660	50	710	-60	600
II.		UTILITY	780	760	10	770	-110	650
		INDUSTRY	590	680	60	740	60	740
		TOTAL	1370	1440	70	1510	-50	1390
III.		UTILITY	3120	2810	-20	2790	-180	2630
		INDUSTRY	1500	1720	250	1970	130	1850
		TOTAL	4620	4530	230	4760	-50	4480
IV.		UTILITY	5010	5200	-60	5140	-730	4470
		INDUSTRY	2060	2360	520	2880	120	2480
		TOTAL	7070	7560	460	8020	-610	6950
V.		UTILITY	7550	6410	-200	6210	-360	6050
		INDUSTRY	3730	4280	500	4780	230	4050
		TOTAL	11280	10690	300	10990	-590	10100
VI.		UTILITY	160	1970	220	2190	-40	1930
		INDUSTRY	690	790	2280	3070	2990	3780
		TOTAL	850	2760	2500	5260	2950	5710
VII.		UTILITY	1300	1760	0	1760	-290	1470
		INDUSTRY	660	760	180	940	160	920
		TOTAL	1960	2520	180	2700	-130	2390

TABLE A-3 PROJECTED SO_2 EMISSIONS FROM INDUSTRIES AND UTILITIES BY REGION - (NSPS) (Cont)
(10^3 TONS)

FEDERAL REGION		1975 ACTUAL	1985 BASE	CHANGE COAL PROGRAM (from 1985 base)	1985 COAL PROGRAM	CHANGE PRESIDENT'S PROGRAM (from 1985 base)	1985 PRESIDENT'S PROGRAM
VIII.	UTILITY	240	400	0	400	-60	340
	INDUSTRY	230	260	100	360	80	340
	TOTAL	470	660	100	760	20	680
IX.	UTILITY	180	400	10	410	-100	300
	INDUSTRY	980	1130	110	1240	150	1280
	TOTAL	1160	1530	120	1650	50	1580
X.	UTILITY	40	110	0	110	-50	60
	INDUSTRY	140	160	120	280	80	240
	TOTAL	180	270	120	390	30	300
NATIONAL							
	UTILITY	18600	20220	-40	20180	-1960	18260
	INDUSTRY	10810	12400	4170	16570	3520	15920
	TOTAL	29410	32620	4130	36750	1560	34180

Appendix 2: METHODOLOGY FOR EMISSIONS CALCULATIONS IN THE INDUSTRIAL SECTOR

The general methodology for industrial emissions calculations begins with PIES fuel use estimates for industries under the NEP and a 1975 and 1985 baseline. The 1985 baseline is then modified to reflect changing fuel use. This discussion will describe:

(1) Baseline Emissions
(2) Emission Factors, and
(3) Assumptions Used in the Regulation Cases

(1) Baseline Emissions

Industrial baseline air emissions are affected due to the variable levels of baseline emissions under the different regulatory assumptions for each case as well as the direct impacts of coal conversion. The NSPS baseline emissions for fuel combustion are determined using the current applicable State Implementation Plan (SIP) emission limitations for existing sources and new sources with less than 25 megawattts (MW) heat input capacity. New Source Performance Standards (NSPS) are applied to new facilities with greater than 25 MW capacity. The baseline change is then calculated as the difference in baseline air emissions which would result when compared to fuel combustion emissions under the NSPS baseline case.

The total industrial emission baseline, which includes fuel combustion as an emission source, is calculated for each pollutant by using 1985 projected national emissions [1] to derive that portion of the national figures which originate from industrial sources. This industrial breakout is obtained by applying the 1975 distribution of emissions for all sources [2] to the 1985 totals and computing that portion which is projected to originate in the industrial sector.

1/ Priorities and Procedures for Development of Standards of Performance for New Stationary Sources of Atmospheric Emission, Argonne National Laboratory, for EPA, EPA-450/3-76-020, May 1976.

2/ Data from EPA's National Emissions Data System.

(2) Emission Factors

The derivation of emission factors to calculate change in air emissions from conversion of oil and gas to coal involves:

- For the SIP regulations for coal and oil, regional emission limits were developed using AQCR-specific regulations which are aggregated to the regional level by weighting with the relative industrial fuel combustion for each AQCR.[1/] The oil emission factors also assume that distillate oil represents a minimum of 30 percent of the oil savings through conversion which decreases the overall level of air emissions from oil burning before conversion. Gas emission factors have been developed using EPA data for all three pollutants.[2/]

- For the NSPS regulations, national standards were used as promulgated by EPA.[3/]

- For coal burning in new facilities three different assumptions were used to project potential air impacts under EPA's Best Available Control Technology (BACT) air regulations. Various levels of SO_2 and TSP control efficiency are explained with the assumptions for each specific case. Operating and maintenance practices are assumed adequate to maintain stated control efficiencies. Non-compliance with applicable environmental regulations is not considered a factor in the air impact analysis.

1/ Laws and Regulations Affecting Coal, for the U.S. Department of Interior, Energy and Environmental Analysis, Inc., June 1976.

2/ AP42, Compilation of Air Pollutant Emission Factors, EPA Second Edition, February 1976.

3/ 40 CFR 60 Standards of Performance, Subpart D, revised 40 FR 46250.

- For oil burning in new facilities, a moderate desulfurization policy and TSP control strategy were assumed to calculate air emissions. These emissions are deducted from coal burning emissions to compute the incremental change due to conversion.

- For NO_x emissions in new facilities with 25 MW or greater capacity, boiler design and operating procedures were applied to reduce flame and furnace temperatures and increase the amount of excess air in the flame to attain the NSPS national emission standards.

Non-boiler fuel combustion is assumed to use the same air emission factors which have been developed for fuel combustion in boilers.

(3) Assumptions in the Regulatory Cases

Several different regulatory cases were constructed to reflect potential variations in the Clean Air Act and in the definition of BACT. These cases are summarized in Table 2 of the analysis document. The discussion below provides more detail on the assumptions for each pollutant.

Sulfur Dioxide

Case No. 1. BACT is applied on new facilities with greater than 25 MW capacity to achieve a 90 percent reduction in SO_2 emissions (this assumes 90 percent efficiency and 100 percent reliability of scrubber equipment). Also, a 20 percent reduction through coal cleaning is obtained in the sulfur content of the most locally abundant coal available within each FEA region. An emission limit of 1.5 pounds per MMBtu is set for new facilities with 10-25 MW capacity, assuming 25 percent of the units use FGD and the remaining burn low sulfur coal. A BACT emission limit of .53 pounds per MMBtu is used for oil-burning. In comparing the emissions results for the Coal Conversion and President's Programs, the decrease in emissions observed in the President's Program is primarily due to oil to gas fuel switching which occurs with the conservation policies of the National Energy Plan.

Case No. 2. The same assumptions are used as in Case No. 1, except for new facilities with greater than 25 MW capacity, where an 80 percent reduction in SO_2 emissions is achieved instead of 90 percent (this assumes 90 percent reliability instead of 100 percent).

Case No. 3. The same assumptions are used as in Case No. 2, except for new facilities with 10-25 MW capacity. Coal burning in these units is assumed to be regulated by applicable SIP SO_2 emission limitations instead of 1.5 pounds per MMBtu.

Case No. 4. This case assumes the attainment of the NSPS regulation of 1.2 pounds per MMBtu for coal burning in facilities with greater than 25 MW capacity. All other assumptions are the same as in Case No. 3. Case No. 4 in effect assumes attainment of the same environmental standards used to compute the NSPS baseline emissions from industrial fuel combustion.

Total Suspended Particulates

Case No. 1. BACT is applied to limit TSP emissions to .01 pounds per MMBtu in new facilities with greater than 25 MW capacity. This assumes a 99.8 percent reduction in TSP using a baghouse or electrostatic precipitator (ESP). For new facilities with 10-25 MW capacity, TSP emissions are limited to .03 pounds per MMBtu, which assumes a 99.5 percent reduction. This BACT for small new facilities requires use of a baghouse or ESP, since it is unlikely that a scrubber for S02 will achieve this degree of TSP removal. A BACT regulation of .05 pounds per MMBtu is used for oil. TSP emissions from gas are assumed to be .017 pounds per MMBtu (from AP42).

Case No. 2. The same assumptions are used as in Case No. 1, except for TSP emissions from coal, where an effective limit of 0.5 pounds per MMBtu is assumed. This emission regulation achieves a 99.0 percent reduction in TSP, which can be obtained with an SO_2 scrubber, or a baghuse or ESP if no scrubbing is necessary.

Case No. 3. The same assumptions are used in Case No. 3, except for new facilities with 10-25 MW capacity, where applicable SIP regulations apply for coal combustion. This case assumes 92 to 97 percent TSP reduction under current SIP's, using either a baghouse or ESP.

Case No. 4. This case assumes attainment of the NSPS for new facilities greater than 25 MW capacity, which allows emissions of .1 pounds per MMBtu. In effect, the emission regulations for this case are identical to the standards used for the TSP baseline for industrial fuel combustion.

Nitrogen Dioxide

Case No. 1. This one case for NO_x uses emission factors developed from AP42[1/] for oil (.40 pounds per MMBtu), gas (.69 pounds per MMBtu), and coal (.75 pounds per MMBtu) for existing facilities and new facilities of 10-25 MW capacities. For new facilities greater than 25 MW capacity NSPS regulations apply for oil (.3 pounds per MMBtu), gas (.2 pounds per MMBtu) and coal (.7 pounds per MMBtu).

1/ AP42, Compilation of Air Pollution Emission Factors, Second Edition, February 1976.

Appendix 3: METHODOLOGY FOR EMISSIONS CALCULATIONS IN THE UTILITY SECTOR

This Apppendix describes the methodology used to calculate emissions in the utility sector. These estimates were provided by the Energy Strategies Branch (ESB) of the Office of Air Quality Planning and Standards of EPA. A separate report is under preparation by ESB documenting their projections.[1/]

I. COMPUTATION OF BASELINE EMISSIONS

Baseline emissions are (1) 1975 emissions of SO_2, particulates, and NO_x from all sources (total emissions) and from power plants, and (2) 1985 emissions of SO_2, particulates, and NO_x from power plants. The 1985 baseline emissions are termed "business as usual," which assumes continuance of the regulatory and legislative environment prior to the proposed National Energy Plan or other legislation currently being considered for increased coal use. All emissions were aggregated by State, EPA region, and the Nation.

A. 1975 Emissions

Emissions of SO_2 from power plants were obtained from the Energy Data System (EDS). EDS calculates SO_2 emissions based on the type, amount, and sulfur content of fuels actually burned in each power plant (as reported on the 1975 FPC Form 67 and assuming 98 percent of input S is emitted as SO_2). Emissions of NO_x and particulates for power plants were obtained from the National Emissions Data System (NEDS), which reflects 1975 data for about 40 states and somewhat older data for the remainder of the country. Adjustment was made for a known error in the NEDS file for the State of Florida.

Total emissions for SO_2, particulates, and NO_x in 1975 were obtained from NEDS (as of March 21, 1977). Total SO_2 emissions were adjusted by replacing the NEDS SO_2 emissions for electric generation with SO_2 emissions from power plants calculated using the Energy Data System. This adjustment was made for two reasons:

1/ "Air Pollution Impacts of Increased Coal Use in the Utility Sector: An Analysis of Emissions Under the National Energy Plan."

(1) to provide a consistent baseline of power plant emissions (the estimates of 1985 power plant emissions were based on EDS); and

(2) because, on a national basis, EDS data is more current than NEDS.

B. 1985 Emissions

Power plant emissions in 1985 were estimated using the model depicted in Figure A-1. In general, emissions were computed assuming that existing sources in 1975 would meet existing State Implementation Plan (SIP) emission regulations for 1985. Emissions from units which are planned to

Figure A-1. Model for Estimating 1985 Power Plant Emissions (SO_2, Particulate, NO_x)

1985 Power Plant Emissions	=	Maximum Allowable Emissions Existing Sources	-	Emissions From Retired Units	+	Emissions From New Sources	+	Emissions from Fuel Switching
						Gas Curtail-ments		ESECA		Other Dual-Fired

be retired between 1975 and 1985 were subtracted. Emissions from planned new units were added along with increased emissions from existing units which are likely to convert from burning oil or gas. The following paragraphs discuss the assumptions, data sources, and procedures for computing each of the elements depicted in Figure A-1.

Maximum Allowable Emissions for Existing Sources

For SO_2, maximum allowable emissions (MAE) for existing (in 1975) coal- and oil-fired units were computed by EDS assuming that each power plant meets the applicable

SIP regulation for 1985. SIP regulations in EDS were those effective as of January 1977. No adjustment was made to account for the possibility of revised SIPs in the future since the impact of such revisions (toward either tightening or loosening regulations) is difficult to predict.

For particulates, MAE for coal-fired power plants were computed by EDS in the same manner as SO_2 emissions were calculated. For oil-firing, however, 1985 emissions were assumed to be the same as 1975 since most oil burners today emit particulates at a rate well below that required by SIPs.[1/] To have assumed that all oil-burners meet SIP levels in 1985 would have resulted in a substantial and unrealistic increase in particulate emissions between 1975 and 1985.

For NO_x, MAE were assumed to be the same as emissions in 1975, because only Los Angeles and Chicago have NO_x regulations which limit emissions from existing sources.

Retirements

Power plant retirements (in megawatts) were determined on a State basis using data from FPC Order 383-3 (April 1, 1976). Retired megawatts were converted to fuel amounts using national average heat rates (BTU/kw-hr) as computed by FPC and a 0.60 capacity factor.

For SO_2 and particulates, emissions from retired coal and oil units were computed by assuming a drop in 1985 maximum allowable emissions proportional to the reduction in fuel use brought about by retirements.

For NO_x, 1985 emissions by fuel use were not available. Therefore, emissions from retired units were computed using a national weighted average emission factor (#NO_x/unit fuel use) for coal, oil, and gas. The average emission factor for each fuel type was based on published EPA emission factors[2/] and 1973 capacity of tangentially-fired boilers versus other types of firing (as reported to FPC).

1/ Comparison of FPC fuel quality data with SIP emission regulations in EDS.

2/ Compilation of Air Pollution Emission Factors, AP-42, US EPA, April 1976.

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Emission from New Sources

Planned growth in the power plant sector was that reported on FPC Order 383-3 in April 1976, and subsequently updated by FPC through mid-March 1977. Fuel use for this growth was calculated using a national average heat rate (Btu/kw-hr) for coal as provided by FPC and a 0.60 capacity factor. For the "Business as Usual - NPS" case all growth was assumed to meet the current Federal new source performance standards[3], except where SIP regulations for particulates and SO_2 were more stringent than the NSPS. For the "Business as Usual - BACT" case, BACT was assumed to be 80 percent control of input sulfur assuming use of locally available coal, 0.05 #particulate/MMBtu, and 0.6 #NO_x/MMBtu. BACT was assumed to apply to units coming on line in or after 1984.

For the NSPS and BACT case, this approach, to a small degree, may underestimate emissions of SO_2, since some new plants coming on line after 1975 are not subject to NSPS. Emissions of NO_x and particulates probably would not be underestimates since, over the past few years, most new power plants typically emit at levels near the NSPS.[4]

Emission From Fuel Switching

The potential fuel-switchers were identified from three sources of information. One source was the Federal Energy Administration's lists of what that agency terms "Round 1" and "Round II" candidates for prohibition orders (limiting the use of oil or gas as primary boiler fuel) authorized by the Energy Supply and Environmental Coordination Act (ESECA) of 1974. For this analysis, it was assumed that all of the Rounds I and II boilers would burn only coal by 1985. A second group of potential fuel-switchers were identified from boiler fuel-use data in the Energy Data System. It was assumed that any boiler which used both coal and oil in 1975 would burn only coal by 1985. The third source of information was the Foster Associates' study of gas curtailments

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3/ 1.2 #SO_2/MMBtu; 0.1 #particulate/MMBtu; 0.7 #NO_x/MMBtu

4/ Data collected by EPA's Emission Standards and Engineering Division for work on revising NSPS.

done under SASD contract. This study identifies the power plant boilers which can burn either gas and oil or gas and coal, and estimates, through 1980, how much gas-burning will be curtailed in these boilers because of natural gas shortages. These estimates were extended through 1985 using a report sponsored by the gas industry.[5/] For these boilers, it was assumed that those which can burn coal would convert to coal, and those which cannot burn coal would convert to oil. Some boilers are designed for multi-fuel use, but cannot, without considerable cost, be restored to a previous coal-burning capability. For this set of boilers, it was assumed that coal-burning capability would be restored only in those identified by FEA as conversion candidates. Although some boilers designed to burn only gas are being converted to oil use (conversion to coal is impractical for such boilers), these conversions were not considered, since no hard data are available on the location and extent of such conversions.

The changes in emissions that will result from fuel switching were computed on a plant-by-plant basis by subtracting 1975 base year emissions from projected 1985 emissions after switching fuels. Base year SO_2 emissions came from an Energy Data System program (described earlier) which operated on the types of fuels used and their sulfur contents. Base year particulate matter and NO_x emissions were derived from the National Emissions Data System which uses either measured emissions or emission factors from AP-42 (Compilation of Air Pollution Emission Factors, US EPA). To estimate 1985 SO_2 emissions, it was assumed that all coal and oil would be burned in compliance with applicable SIP regulations. To estimate 1985 particulate matter emissions, the same assumption was made for coal-burners, but for those sources which will switch from gas to oil, the AP-42 emission factor for oil-burning was used. The reason for this assumption was that, while most states apply the same particulate emission limit for both coal-burners and oil-burners, oil-burners rarely emit particulates up to the allowed limit. To estimate 1985 NO_x emissions, emission factors were applied to boilers switching from oil or gas to coal. For boilers switching from gas to oil, the

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5/ "Future Gas Consumption of the United States," Volume No.6, University of Denver Research Institute, September 1976.

1985 emissions were assumed to be the same as those in 1975. The reason for this assumption was that, based on AP-42 emission factors, the change in NO_x emissions is near zero when switching from gas to oil and is highly dependent on the heating values assumed for the two fuels.

In computing the 1985 emission limits for SO_2 and particulate matter, it was assumed that replacement fuels equaled replaced fuels on a total heat input basis. Exceptions were made where inspection data on ESECA boilers (gathered by PEDCO Environmental Specialists, Inc. under SASD contract) showed that oil-to-coal switching resulted in either boiler derating or increased boiler efficiency, both of which would result in lesser coal heat input.

II. COMPUTATION OF EMISSIONS IMPACT OF THE NATIONAL ENERGY PLAN

Future changes in fuel use patterns resulting from the proposed National Energy Plan were furnished from the PIES model. This section describes the assumptions used to translate changes in "business as usual" fuel use into changes in "business as usual" emissions of SO_2, particulates, and NO_x.

For this project, PIES forecasted (on an EPA regional basis) changes in consumption of coal, oil, and gas that may occur in 1985 and 1990 if the economic policies of the National Energy Plan are implemented. Two sets of estimates were provided -- one for the coal substitution portion of the Plan and one for the impact of the entire program (including coal substitution and conservation). Fuel use data were expressed in heat equivalents (Btus).

Increased coal consumption was assumed to be in newly constructed units, and thus the associated emission increases were computed both at the NSPS emission rates (1.2 #SO_2/MMBtu, 0.1 #particulate/MMBTU, and 0.7 #NO_x/MMBtu) and at BACT emission rates (90 percent control SO_2, 0.05 #particulate/MMBtu, and 0.6#NO_x/MMBtu). Decreases in coal consumption under the total NEP were assumed to be by reduction in the construction of planned new units. Decreased emissions were

computed at both the NSPS and BACT emission rates. Exceptions to this assumption were made where projected NEP decreases in a given time period exceeded the projected "business as usual" growth for the same period. In this situation some of the reduced consumption was assumed to be in a projected growth (meeting NSPS or BACT) and some in existing units (meeting SIP).

Decreases in oil or gas consumption were assumed to be the result of retirements or fuel conversions and, thus, would affect plants that were on line in 1975 (thus meeting SIPs at the time the action took Place). Accordingly, emission decreases were computed using a weighted average SIP emission limit for each pollutant by region. This weighted average SIP was determined by dividing the maximum allowable emissions for existing (in 1975) sources (in tons/year) by the total regional fuel use (in Btus). (Maximum allowable emissions had been calculated for estimation of the 1985 "business as usual" emissions by assuming that each power plant existing in 1975 met applicable SIP emission limits for 1985). Increases in oil consumption were assumed to be as a result of boiler conversions from gas to oil-firing, since no new oil-burning plants were being built. It had been assumed that fuel switching in all dual-fired boilers -- where replacement fuels are subject to SIP emission regulations -- would take place under "business as usual." Any additional conversions from gas to oil would require boiler modifications, and, thus, it was assumed that increased oil use under the NEP would be subject to NSPS.

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Mr. DINGELL. The time of the gentleman has expired.

The Chair now recognizes the gentleman from Tennessee, Mr. Gore, for 5 minutes.

Mr. GORE. Thank you, Mr. Chairman.

Welcome, Dr. Schlesinger. It is always a pleasure to hear your testimony up here. I heard you talk about the need for unity in the country and I agree with that too. I have listened to all of the witnesses we have had here during these hearings from different industries, from the gas industry, from the utility industry, and it is amazing how almost everyone of them started out their testimony by saying "We applaud the President's initiative, and we think the overall program is just wonderful. There are, of course, some specific difficulties that we have."

When you add all those specific difficulties up, it amounts to a major political problem.

One of the biggest political problems in this subcommittee, to be quite frank about it, is going to be the battle over deregulation of natural gas. Assuming we are asked to vote on a bill with a very liberal definition of new gas, that does not include incremental pricing, what in your opinion would be the impact on this country of deregulating natural gas in that manner.

Mr. SCHLESINGER. The administration's bill has, I think, been quite generous on the question of oil and gas pricing. The cap which

is suggested is higher than it has been everywhere except the State of Texas, which has certain peculiar features.

The difference between deregulation and the bill which the President proposes amounts, in our projections, to $120 billion between now and 1985 in additional revenues for the gas industry, $120 billion. It moves up to approximately $25 billion.

Mr. GORE. One hundred and twenty billion dollars. Eighty percent of that will go to about 25 companies?

Mr. SCHLESINGER. It would be concentrated, yes, sir.

Mr. GORE. So these are pretty high stakes. When you are talking about a regional interest being placed in the way of the President's bill, this is a big one.

I was frankly surprised to find out when I came to the Congress that deregulation had as much support here as it does because I can't really reconcile it with the public interest. It seems incredible to me.

That $120 billion figure must assume a pretty large cost per Mcf on the so-called "free market." What is your prediction as to how high the cost per Mcf would rise?

Mr. SCHLESINGER. About $2.50 per Mcf in constant dollars. Otherwise, it would be higher than this. We can insert for the record the annual effects. It runs from about $5 billion in 1978 to $25 billion in 1985, the cumulative effects are about $120 billion.

Mr. GORE. By 1985 we would be talking about an annual revenue to these companies of $25 to $30 billion each year.

Mr. SCHLESINGER. These are constant dollars. You can apply whatever rate of inflation you wish. If you think the rate of inflation will be zero, it will be $25 billion in 1985.

Mr. GORE. I won't make that assumption, Doctor.

Now, what supply response over and above that projected in the President's plan would come from this kind of deregulation, given the limitation on drilling capacity? We are currently right up against a ceiling on drilling capacity, as I understand it.

Mr. SCHLESINGER. You have indicated the nature of the problem. There might be some response on the gas side because the producers would go for gas rather than oil. That doesn't solve our national problem. But, putting that aside, given the fact we are increasing the number of rigs at as substantial a pace as we can, and that existing rigs are fully employed at the present time, the short-time response would be small. In the intermediate term, we would have a slightly larger response, but at the expense of longer-term production.

Now, on the other side——

Mr. KRUEGER [presiding]. The time of the gentleman has expired. He may complete the question and the answer; and that will be the last.

Mr. GORE. How do you justify the rollover figures in the plan if the $1.75 figure for new gas is supposed to be sufficient to provide incentive and capital for exploration? It seems like a large give away to me.

Mr. SCHLESINGER. There is no give away. The interstate contract is permissive of a rise to as high as $1.42 if it is necessary to maintain production, but there is no requirement, indeed there is

no predilection, toward raising that price to $1.42. This would permit a continuation of production but we would not anticipate all those interstate contracts went up. And, of course, there are similar provisions with regard to the intrastate market, which would go to $1.75.

One could argue about the discrepancy between old intrastate and old interstate contracts. The answer is we did not think it appropriate to roll back the price on intrastate contracts to $1.42.

Mr. GORE. Thank you, Mr. Chairman.

Thank you, Doctor.

Mr. KRUEGER. Recognizing, in order of appearance, Mr. Stockman.

Mr. STOCKMAN. Dr. Schlesinger, I would like to follow up on that $120 billion figure a little bit. It is a rather inflammatory number and I am sure there will be exchanges during debate. But you will have to admit that it is misleading in that it is based on a $2.50 price assumption for new natural gas which will generate a certain incremental amount of conventional gas we would not otherwise have. We don't know, either one of us, what it is.

But if you don't have the incremental increase in production you will still have the demand for use in the economy and the additional costs are going to be basically SNG and LNG imports.

You were talking about $120 billion going to domestic producers and that is bad, but it would seem even worse having it go to SNG stocks or LNG imports which will go to Algeria and other foreign producers.

So it seems to me the $120 billion figure might be right, but where are the alternatives and where will those cash or revenue flows be going?

Mr. SCHLESINGER. The points you are making are well taken in a number of respects. We desire to avoid making use of LNG imports or synthetic natural gas at $4 per Mcf if we can produce natural gas at $2 or $2.25.

The $120 billion figure was not intended to be inflammatory. It was in response to Mr. Gore's question.

The $2.50 price, actually $2.45, I believe, runs a little bit higher than the emergency sales of last winter. We would expect, as a practical matter, that given the disproportionate difference between demand and supply the price would be less than $2.45. We think that is probably a modest estimate for gas. But this is not different with regard to allocation questions, it is different with regard to equity considerations. Everybody in the industry will grant that $1.75 is a price at which they are going to make a great deal of money. It is an appropriate incentive price. It will probably bring out substantial effort by the industry. The industry is now almost fully employed in expanding the number of rigs. It has doubled the number of rigs since 1973. We have in the legislation the opportunity to remove any controls from deep or tight formations if it is necessary to have a higher price. Our problem is that, given the imbalance in this market, those prices could go sky high. Last winter they could have gone to $3 or $3.50. As the chairman and I discussed, this would have had a grave consequence of rolling into the interstate market gas from Texas, it would have wreaked rapid

havoc in the State of Texas. For that reason, there was a desire on the part of the Texas legislators to avoid that result.

This may be regarded as a first step towards deregulation. If we are able to prove up the technologies to which the present chairman, Mr. Krueger, referred, then we may take further steps toward deregulation.

Mr. STOCKMAN. As the real price for gas rises, it will take more income from the economy. It drops down to whether it will go to foreign or domestic producers.

I think there is a very self-defeating cycle generated here and that is because the prospects are modest for domestic production. I think it could be documented. I would like to hear from you as to the outflow of our drilling rigs and seismic crews into Indonesia and other places where foreign natural gas may be liquefied and sent back to this country. What sense does that make?

Mr. DINGELL. The gentleman's time has expired.

Mr. SCHLESINGER. It makes relatively little sense. The issue is equity. It is not an issue of the advantages of a higher price. We have doubled the number of drill rigs in the course of the last 4 years as a result of dramatic increases in price of both oil and gas to this point. We will continue the limitation on the importation of liquefied gas on a case-by-case basis. In the case of synthetic gas, of course, the impact would be on American income but it would be at a higher price.

We certainly desire to have a reasonable maximum flow of natural gas. The $1.75 maximum price is higher than the prices which have prevailed in the intrastate market until last December, with the sole exception of Texas, and there are peculiar features in the Texas market. There are renegotiation clauses and renegotiation clauses which ratchet up the prices but do not permit them to recede.

But if you might look at the other States—Louisiana only missed $1.75 during last winter's natural gas shortage. So that is a generous incentive price.

Mr. DINGELL. The Chair recognizes the gentleman from Illinois, Mr. Madigan.

Mr. MADIGAN. Dr. Schlesinger, you indicated, I think in response to the question by the gentleman from Texas who was in the Chair, that your agency had made estimates as to the increases which would occur in sulfur dioxide emissions from the coal conversion you are hoping to accomplish with the program. I assume those estimates are based on maintaining the standards for ambient air quality.

Mr. SCHLESINGER. Those estimates should be compared to the ambient air standards, but those estimates are based simply upon the impact on the atmosphere of this coal conversion program.

The assumption has been that we would retain the ambient air standards. However, the estimates are independent of that.

Mr. MADIGAN. In the testimony we have had on the obstacles that seem to stand in the way, according to the witnesses, in implementing any major coal conversion effort, is the environmental regulations which exist at the State level, State implementation plans addressing an air quality plan in one part of the State; impose restrictions in other parts of the State.

What should the Congress do with the problems as to State implementation plans for air quality?

Mr. SCHLESINGER. Usually one says one is happy that you raised that question, Congressman. I can't say that in this particular case.

I have no easy advice to offer to the Congress as to the difference in the State plans and the ambient air quality standards. I feel the ambient air standards, given the nature of the crisis we face, are appropriate as a benchmark.

Mr. MADIGAN. It would be your position that you would and perhaps we should allow coal conversion so long as the conversion doesn't result in a violation of the national primary and secondary air quality standards.

Mr. SCHLESINGER. I think I will have to hesitate with regard to endorsing that. I gave my personal judgment a moment ago but I don't know whether or not the Congress would desire to override State implementation plans. I would have to reflect on that matter for sometime before I could give that kind of concrete advice to you, Mr. Madigan.

Mr. MADIGAN. I am assuming you have had some opportunity to reflect on the criticisms directed at the program. As you reflect on those, do you feel the President's program should have greater emphasis on coal gasification and desulfurization plants?

Mr. SCHLESINGER. We will work as hard as we can on desulfurization. With regard to degasification, we are prepared to subsidize new technologies should they be promising. With regard to existing technologies such as the Lurgi projects, we wish to avoid such subdization. We don't want to exclude it, but we wish to delay it for awhile.

With regard to the plant on the West Coast, it would seem all expense would be borne by the State of California; and it would seem appropriate that the State of California apply the cost rather than it being loaded onto the taxpayer at large. Those are existing technologies. I think such plants should be built but it is an institutional matter, not technological.

Mr. MADIGAN. The electric generating people indicate the coal conversion part of this program could impose a capital requirement upon them between now and 1985 of some additional $50 billion, which they indicate an inability to generate. They suggest either rate reform or some kind of government assistance to obtain that capital.

Have you any suggestion as to the proper direction for Congress to take?

Mr. SCHLESINGER. They are looking at one part of this program. For new construction our estimate runs $35 billion. But the effective rate reform by squaring up loads will reduce the requirement for additional generating capacity on the order of something like $40 to $75 billion.

In order to pay for whatever capacity expansion is necessary, there will be generated a substantial flow of funds through the tax on oil and gas used by utilities. That will pay for some significant part of that conversion program. We expect virtually all of that funding to be used. It is about $6 billion of the $35 billion.

Mr. DINGELL. The time of the gentleman has expired. The Chair recognizes Mr. Walgren, the gentleman from Pennsylvania.

Mr. WALGREN. I wanted to pursue the thought that the administration came into office, I think, being relatively open as to the feeling that natural gas should be deregulated for a trial period of about 5 or 6 years. At least I have seen statements by President Carter to that effect.

Now, we have your statement that this price is a first step toward deregulation. This sort of indicates there is some continuity of that change.

I wonder if you could really pinpoint just what exactly it is that resulted in that change? I suspect it is in the area of facing such a shortage that you are actually moving toward altering the capital stock and trying to set up a system where capital is, in fact, not going to go toward the development of the delivery of more natural gas. I suppose there is an awful lot of invasion of the pure free market setting of price by supply and demand in that once you have made the assumption you are going to alter the capital stock, it would be justified.

I wanted to give you the opportunity to try to take me through the conversion of the President's and the administration's position from the pure deregulation into what you feel we face now.

Mr. SCHLESINGER. On the first point, we went through last winter's natural gas crisis which brought changes in perspective on the part of many parties. I mentioned earlier the attitude of legislators from Texas who didn't want to see that big interstate market overwhelming the intrastate market.

We have a potential demand for natural gas of some 30 trillion cubic feet per year. We are fighting to maintain production of 20 trillion cubic feet per year. This is a market which was exacerbated by the effects of last winter's severe weather. Everybody who went through last winter's experience recognizes the imbalance. We hope that if some of the technologies mentioned by Mr. Krueger are brought in we will have better balance between supply and demand. Until that time, we have moved toward deregulation. We are permitting the Btu equivalent price; we are taking steps to produce gas from tight and deep formations, and from geopressurized brine and Devonian shale. As long as this market is in such imbalance, I don't think it appropriate to take any further steps.

What we have is a tremendous growth of the economy and, in relation to that growing economy, a relative shortage of oil and gas. We will have to make an adjustment in our use of energy irrespective of regulation or deregulation: Stationary sources increasingly are going to have to make use of coal. Unless we make an adjustment, we will face a point in the future where that transition may be forced upon us painfully and forcefully. We are talking about a substance whose lifetime is 30 years. You can't bring about suddenly a change from oil and gas to coal. But we shall have to make use of more coal, and it is more convenient for industry to use oil and gas. That is our problem.

Mr. WALGREN. I yield back the balance of my time.

Mr. DINGELL. Mr. Brown.

Mr. BROWN. You indicated the technology was not there for geopressurized shale. I believe ERDA has completed a development.

Mr. SCHLESINGER. Yes.

Mr. BROWN. And California Standard has also undertaken this.

We had testimony from Houston Power and Light that they were doing experiments. Even the utility which testified before us from Mississippi indicated they are studying that. The Universities of Texas and Louisiana are on the development question as well.

At the recent Reston meeting set up by ERDA there was substantial pressure by the geomethane group to the effect that the technology was there to develop these rather large resources. I believe there is no question the resources are there.

I understand the estimates per Mcf cost ranged anywhere from $5 to as low as $2.

We had a speech here in this complex of buildings by Dr. Bernath from the United Nations, who says his estimate is $2.50. He is not a fly-by-night. I think he was Mr. Geothermal of 1975, or whatever.

My question is, why do we want to put a lid on natural gas with this vast resource just over what the price horizon is?

One final comment. I understand the most recent request for conventional natural gas pricing was $2.45 and $2.36 from the developer of natural gas in Texas in February of 1977.

That is why I am disturbed at our natural gas policy.

Mr. SCHLESINGER. Mr. Brown, I think I can in large measure reassure you on that. The natural gas policy, of course, applies to conventional flowing gas. If the price necessary to bring it out is $3, we are prepared to deregulate geopressurized brine.

Mr. BROWN. On a case-by-case basis?

Mr. SCHLESINGER. No, we are prepared to remove from deep and tight formations, Devonian shale——

Mr. DINGELL. Would you include coal seam gas, Doctor.

Mr. SCHLESINGER. I think so, Mr. Chairman.

Mr. DINGELL. I don't want to force you to take a hard position this morning.

Mr. SCHLESINGER. Generally speaking, the natural gas pricing refers to the very low cost gas which comes from existing reservoirs or provable reservoirs. The returns to the producers are not to be determined by these new technologies. However, we are prepared to see that the price is right for those new technologies.

Mr. BROWN. Are you prepared to make the commitment before or after the fact? I happen to know there are a lot of people who do not trust the government that much.

Mr. SCHLESINGER. We can promulgate a rule; in fact, it is in section 104.

We have the environmental problem of disposing of tens of thousands of barrels a day of water which is highly saline. We can't dump it into the Gulf of Mexico; we have to develop technologies for disposing of that water and determine the corrosive effects of that highly saline water on equipment. We can produce it in an R&D way, but the rest of the problems remain to be solved.

Mr. BROWN. One of the publications on the Hill states I am tough on energy people by asking difficult questions.

I am surprised the administration did not ask for an environmental impact statement on the whole business, because the conversion of coal will have a significant impact.

I might ask, why did you eschew the opportunity?

Mr. SCHLESINGER. I did not regard it as an opportunity to be seized.

Mr. BROWN. My question was, why not?

I would like to submit one other question for the record, if I may.

Mr. DINGELL. So ordered. The record will remain open.

The gentleman from Massachusetts, Mr. Markey.

Mr. MARKEY. I yield 20 seconds of my time to Mr. Gore.

Mr. GORE. Thank you.

Mr. Schlesinger indicated he would be prepared to submit for the record figures and information over and above the President's request.

Mr. DINGELL. Without objection, the information requested will go in at the appropriate place. [See p. 74.]

The time of the gentleman from Massachusetts is running.

Mr. MARKEY. On the Today Show, I heard you talk about the energy industry and you said they were a greedy lot.

Mr. SCHLESINGER. The interrogator stated that to be a proposition and asked if I agreed with it. I stated that sometimes I agreed but not on that particular occasion.

Mr. MARKEY. How about today?

Mr. SCHLESINGER. Usually when I feel that way, I feel that way privately.

Mr. MARKEY. Assuming right now the innermost soul has gravest reservations about the energy industry and talking about the $1.75 natural gas price as very generous, I was wondering what you would think would be a generous allocation for the gas industry. What would be the minimum?

Mr. SCHLESINGER. We have to recognize the need to bring together the intrastate and interstate market. The effort of the FPC to bring the cost to $1.42 was designed to provide a generous incentive price when that decision was made by the FPC a year ago.

In general, let me state that in the course of recent years, gas has gone from 13 cents per Mcf to a prospective $1.75 per Mcf. Even from a base of 26 cents per Mcf, you have a seven-fold increase in the price of gas. As a result of the actions of the oil-producing countries, whose governments have imposed taxes of $11, approximately, $11 to $11½ per barrel, world oil prices have quadrupled. That is why we have the activity in the oil industry. We are offering for frontier oil $13. Those are prices the industry would not have dreamed of a number of years ago. Indeed, as I mentioned earlier, the National Petroleum Council told us 4 years ago that at a price of $6 we would have all the oil we would ever need. That price is now on the order of $10. These are very generous prices, indeed. The argument is not about the incentive; it is whether the old oil should also give to the producers the OPEC price, and that is a question on equity ground, on which I think we should all have grave misgivings.

Mr. MARKEY. We don't have any projected figures yet from the administration as to the new revenues which will accrue to the producers from the new prices, yet the administration talks about no new prices accruing as windfall profits. Do you have anything to back up that statement?

Mr. SCHLESINGER. We have nothing which would indicate there would be no windfall profits. They will be minimized by the wellhead tax which will generate at its peak something on the order of $15 billion a year. The profits for the industry will continue to grow. As under the base line case in 1985, the oil industry will be making $9.5 billion in profits in 1985, as compared to $3.5 billion in 1972.

That will be lower than it would have been in the base line case and far lower than if we had deregulation of crude oil.

Mr. MARKEY. I agree with you. The oil company figures, themselves, show they are doing quite well. The administration is calling for a new system of gathering information as to the type of profits the industry is making. I was wondering why we don't delay until you gather this information.

Mr. DINGELL. The Chair will permit the witness to respond, Doctor. The gentleman's time has expired.

Mr. SCHLESINGER. We wanted to establish for the industry planning a formula which is stable. That has been our aspiration. I am not sure the industry has wholly endorsed stability when instability would benefit the position of the industry.

But it has been our objective to establish a set of price levels according to which the companies can make their calculations. On new oil they have said, "Yes, indeed. We will have the world price." Whatever decision the Congress makes, it should include as much stability for the industry as it can.

Mr. DINGELL. The Chair recognizes one of the members of the full committee, Ms. Barbara Mikulski.

Ms. MIKULSKI. As to the cost of actually delivering services, I wonder if that was ever given consideration?

Let me express my concern. It would cost the mayor of Baltimore, Detroit, or Chicago more money to run police cars or heat schools. Then that mayor has to make a decision to either cut services or raise the property tax, which would have a tremendous impact on the local government.

Did you look at this aspect and what were your thoughts? Were any assistance programs thought of, particularly to large cities?

Mr. SCHLESINGER. The complaint has been made about this plan with some degree of validity, that the burden of the plan and particularly of the higher cost of transportation falls on people in rural areas. This turns out to be a city-oriented plan rather than a rural-oriented plan. The benefits do go to urban areas.

As to the impact on State and local governments, we have looked at State funding of highways, for example, and have indicated we would open up the Highway Trust Fund to the States, so the burden on them of the decline in gas tax receipts would be alleviated.

There are other provisions in this plan to assist State and local governments and the institutions which serve in local areas, in increasing the efficiency of their use of energy. So there is something in this, but we didn't go into the matter in the depth which you suggest with regard to alleviating the problems of local municipal finances.

Ms. MIKULSKI. Do you share with me the fact this can have an enormous impact? If you think of the family who will be hit by

increased residential utility bills, you might have to pay a hidden tax for energy and increased taxes. No mayor wants to choose between hiring teachers or keeping kids warm, or hiring psychiatrists and keeping patients warm.

Mr. SCHLESINGER. We agree. We have a task force for the study of additional legislative requirements. But with regard to utility bills, the effect of this bill will be to reduce the cost of utilities to the household consumer. We are attempting to protect consumers by not exposing them to any tax and by incremental pricing. Those households who use fuel oil will be protected against the increase in fuel oil prices resulting from the crude oil equalization tax. So we have attempted to avoid some of the difficulties to which you quite correctly refer.

Ms. MIKULSKI. So the administration is not thinking of any kind of energy countercyclical aid?

Mr. SCHLESINGER. We will be exploring a range of additional legislative proposals in the course of the years ahead. That may be appropriate.

Ms. MIKULSKI. I would hope this would be pursued.

This country is thriving because it has enjoyed a large voluntary social service program. I wonder if there was any thought given to this. For example, the impact of the program such as "Meals on Wheels" which has extraordinary impact on institutionalization of handicapped.

Mr. SCHLESINGER. That will be a major feature, but we don't have direct assistance for the alleviation of higher gasoline prices for such institutions as you suggest.

But let me suggest once again, we can avoid that gasoline tax. This is a challenge to the American people. We all know we can reduce our gasoline consumption and thereby avoid the tax if we all make the effort.

Mr. DINGELL. The Chair recognizes Mr. Moore.

Mr. MOORE. Dr. Schlesinger, when you were last here we asked you send to the committee information from your office about the fact how much natural gas the $1.75 cap would produce or whatever information you have on that score and also you indicated deregulation would produce appreciably no new natural gas. I would like to renew my request at this time for that.

Mr. SCHLESINGER. That has been sent up, Mr. Moore.

It may be lost in transition but it has been prepared.

Mr. MOORE. We appreciate that.

Although I was not here, I have been informed the comment was made that deregulation would produce $120 billion to natural gas producers over what they would ordinarily receive over the next 10 years.

Mr. SCHLESINGER. According to the President's plan, which contemplates an increase of $15 billion in natural gas producers as compared with the present legislation.

Mr. MOORE. These are gross receipts?

Mr. SCHLESINGER. Yes, sir; and cumulative.

Mr. MOORE. How was the figure arrived at?

Mr. SCHLESINGER. The assumed price was $2.45 on a constant dollar basis, and it was also assumed there would be a 5-year rollover of all existing contracts.

Mr. MOORE. Would you produce for us that information to show us how that came about?

Mr. SCHLESINGER. Yes. If you would like to change the assumptions, we are prepared to run the calculations for a different set of assumptions.

Mr. MOORE. The gentleman from Michigan wants me to yield.

Mr. STOCKMAN. I said before this is an inflammatory figure. Unless you are talking about deregulating totally flowing gas, there is no way you can get that figure. If you are to get $120 billion you would have to be talking about 240 Tcf. The only way to get that figure is to assume all the flowing gas is going to be at $2.50. Not one of us has ever sugested that old gas be rolled over or deregulated.

Mr. SCHLESINGER. But the assumption is that all new wells are going to get the deregulated price, and new wells will be run into the same pools very simply, by the producers. It is very easy to put more straws in the soda.

Rather than being an inflammatory figure, that is a very modest figure. If there had been any contemplation of using an inflammatory figure, we would have used a current dollar figure. If you want to assume a rate of inflation of 7 percent between now and 1985, then indeed those figures will be staggering. But deregulation of all new wells would result in the drilling of new wells which would go into existing reservoirs, and in 5 years' time we would have a rollover of all gas.

Mr. STOCKMAN. The bill we have doesn't contemplate the rollover of the old gas. Surely that is far more limited.

Mr. SCHLESINGER. We are prepared to run these calculations with whatever assumptions any member of the committee would care to make; and, of course, the effects will be different; but I think it is quite obvious that higher prices, a more generous definition of new gas, and the ability to rollover contracts are all going to increase the aggregate take of the industry.

Mr. DINGELL. The time of the gentleman has expired.

Doctor, the Chair and the staff have some questions. I understand you have some time problems which we respect. We thank you and your associates for your assistance and kindness to us.

[The following letter and attached report were received for the record:]

THE WHITE HOUSE

WASHINGTON

May 9, 1977

Dear Mr. Dingell:

I am enclosing an analysis of the economic and budgetary consequences of the National Energy Plan. This statement has been developed by Administration officials with responsibilities for economic, budget and energy policies.

In order to complete such an assessment, final legislative proposals were required as a starting point. It was necessary to examine not only individual proposals, but also their overall interrelationships and the direct and indirect consequences for economic growth, prices, employment, budget impact and other factors. The results were then carefully scrutinized by the appropriate agencies to ensure the assessment would be as accurate as possible.

The results are described in the enclosure. The statement not only provides specific estimates of the impacts of the Plan, but also attempts to make explicit uncertainties where they exist. As the analysis indicates the economic impact is neutral to positive in most respects. The Plan would have a modest net inflationary impact, the specific size of which would depend on whether the standby gasoline tax is triggered. The budgetary impact of the Plan through 1985 is modest in terms of the cumulative impact on the Federal deficit. This is a relatively small price to pay for building a sound foundation for the Nation's continued growth throughout this century.

Sincerely,

James R. Schlesinger

James R. Schlesinger
Assistant to the President

The Honorable John Dingell
United States House of Representatives
Washington, D.C. 20515

OVERALL ECONOMIC AND BUDGETARY IMPACTS OF THE NATIONAL ENERGY PLAN

There are attached the analyses of the overall economic impact and of the budgetary impact of the National Energy Plan. These analyses, prepared by the Administration officials responsible for economic, budget and energy policy, assess the economic and budgetary consequences of the detailed proposals in the National Energy Plan on April 29.

The analysis of the overall economic impacts of the National Energy Plan covers the period 1978 through 1981, and describes the expected results of the Plan with what would otherwise occur. The uncertainties and difficulties in making an economic forecast are elaborated. Because of its standby nature and its impact on the economy, the analysis separates the effects of the Plan with and without the standby gasoline tax.

After reviewing the effects of the major components of the Plan, the overall economic analysis for the 1978-1981 period concludes that the Plan will have no significant impact on the growth of real Gross National Product (GNP) or unemployment. The Plan will have a measurable, but modest net inflationary impact of 0.3 to 0.4 percent annually over the next two years and 0.1 to 0.3 percent annually over the following two years. These forecasts recognize the uncertainties of the amount of new proposed taxes which will be passed through into consumer prices, OPEC pricing decisions, and transitional effects.

While there is considerable hope that the gasoline tax will not be triggered in the period analyzed, an assessment has been made assuming the tax is triggered each year, beginning in 1979. In that event, prices would be expected to increase by an additional 0.2 to 0.3 percent. The impact on real GNP would be slightly contractionary, though this finding is so small as to be difficult to assess within the general accuracy of the forecast.

The cumulative budgetary impact of the National Energy Plan has been assessed through 1985. Like the economic forecast, it is subject to considerable uncertainty, particularly beyond 1981. The cumulative net effect of the Plan's proposals over the period is expected to have a relatively neutral effect on the Federal deficit.

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of the Plan's proposals over the period is expected to have a relatively neutral effect on the Federal deficit. Outlays are estimated to increase about $50.4 billion through 1985, while cumulative revenues are projected to increase about $51.3 billion over the same period.

The budgetary consequences of the Plan increase the outlays and the deficit in the near-term, offset later by increasing tax revenues. In 1978, outlays would increase by $1.76 billion, offset by increased revenues of $0.31 billion, thereby adding $1.45 billion to the deficit.

In a separate, but related matter to the Plan, re-estimates of receipts for the Naval Petroleum Reserves are projected to decrease Federal receipts, with the amount of the decrease to be fixed based on future decisions. This adjustment would increase the Federal deficit over the period.

OVERALL ECONOMIC IMPACTS OF THE NATIONAL ENERGY PLAN

The Administration has now completed an assessment of the overall economic impact of the National Energy Plan. The purpose of the analysis is to estimate the effects of the Plan on the major macroeconomic variables, relative to what would otherwise occur through 1981. Given the state of economic forecasting, these estimates are, at best, suggestive. It is exceedingly difficult to forecast the precise response of the economy to a comprehensive restructuring of a vital sector. Notwithstanding these difficulties, the following represents current findings.

Base Case Assumptions

In estimating the effects, the following assumptions have been made about the "base case." In line with recent trends, the composite price of domestic crude oil was assumed to rise at 10 percent annually until it reached the world price. Natural gas prices were assumed to follow existing FPC regulations. OPEC oil prices were assumed to rise at the same rate as the general price level.

Effects of Major Components of the Plan

The economic impacts of the major items in the Plan (in current prices unless otherwise stated) are:

- The oil pricing rules and wellhead oil tax: The new pricing regulations and wellhead oil tax would have the effect over time of lowering the average producer prices on oil and raising the user prices. The Plan's net effect on oil prices is expected to add approximately $5 billion to expenditures on oil products by 1981.

- The gas-guzzler tax: The effect of the gas-guzzler tax would be to shift the demand for new automobiles from fuel-inefficient, relatively expensive cars to fuel-efficient, relatively inexpensive cars. However, some of the savings due to the shift to more fuel efficient cars may be offset by cost increases necessary to achieve better fuel efficiency.

Several econometric models have been used to estimate the net effects. Assuming that the share of imported cars is unaffected by the gas-guzzler tax and rebate, a small increase is expected in the number of vehicles sold accompanied by a very small reduction in the total real dollar value of sales for the automotive industry.

- The conservation tax on oil and gas: Beginning in 1979, taxes would be levied on major industrial and commercial users of oil and gas. Total Treasury revenues net of rebates for qualified investment for coal conversion would reach $5 billion by 1981. Some of the inflationary effects of the conservation taxes are expected to be offset by the rebate for coal conversion.

- Investment: The National Energy Plan will in some cases induce, in others mandate investment in equipment and structures to replace those now burning oil and gas. Since investment behavior is difficult to predict, the assumptions used in this analysis are very conservative. There should be positive impacts from consumer expenditures on insulation, as well as industrial coal conversion. These may be offset, however, by lower utility investments in new capacity as more efficient use made of generating capacity through peak load pricing. In any case, the effect on total net investment will be between 0 and $2 billion annually over the next four years.

- The gasoline tax: There is considerable hope that the President's gasoline consumption goals can be achieved without triggering the standby tax over the period of the present analysis. If it were triggered and the revenues recycled as proposed, the effect on the overall economy will be to accelerate the movement from fuel-inefficient to fuel-efficient automobiles. In addition, there may be some decline in total vehicle miles traveled. Overall, a fractional increase in the rate of inflation in those years that the tax is triggered would occur. Some economic models also foresee

that there will be a slight drag on the economy as a whole. Even with real incomes maintained by the rebates, rising gasoline prices would induce somewhat lower automobile sales. In the past, decreases in automobile sales have, in part, increased consumer savings rather than going completely into other consumption expenditures.

Overall Assessment of the National Energy Plan

In analyzing the overall effect of the Plan, the results have been divided into two parts: (A) the Plan without triggering the standby gasoline tax; and (B) the effects of triggering the gasoline tax.

(A) Assessment of the Plan Without the Gasoline Tax

In making the assessment, the results have been divided for the period 1977 to 1979 and for 1979 to 1981. The reason for choosing these periods is that the year to year variations in output growth and inflation are sensitive to assumptions about the exact timing of taxes and rebates; and these are subject to some uncertainty as to exact details and economic impact.

- The impact of the Plan will have no significant impact on the growth of real GNP or upon unemployment over the next four years. Depending on the exact econometric model used and upon the subperiod, the estimated effect ranges from minus 0.1 percent to plus 0.1 percent on the annual growth rate of real GNP. There is so little impact on real output because the program changes the relative prices of energy to non-energy products without changing the real aggregate demand.

- The Plan will have a measurable, but modest net inflationary impact. Over the next two years (Calendar Year 1979 over Calendar Year 1977), the annual rate of inflation would be 0.3 to 0.4 percent higher than it would otherwise be. In the subsequent two years, the price impact would be smaller, with an increase in the annual inflation rate of about 0.1 to 0.3 percent.

There are several uncertainties in the overall economic evaluation of the Plan.

- The assessment assumes that two-thirds of the wellhead taxes will be passed through into increased product prices. This view is at variance with the results from some of the macroeconomic models which assume implicitly that all of the tax will be passed through to prices, sometimes with an additional mark-up. However, it seems more likely that profit margins at the refinery will be reduced because of the pressure of world markets on U.S. prices.

- In this assessment, it is assumed that OPEC pricing will be unchanged by the Plan. It is reasonable to expect, however, that over the next decade, reduced U.S. dependency on imported oil will induce OPEC to restrain price increases. If OPEC price increases were moderated by only 1 percent per annum over the next 10 years, this would offset a sizable fraction of the inflationary impact of the program.

- It is recognized that the Plan will cause some transitional effects on the economy over the next few years. For example, the automobile industry will need to move more strongly toward fuel efficient vehicles. Industries that are induced or mandated to convert to coal may experience problems in conversion or in obtaining the necessary expertise and equipment. The impact of these effects will require monitoring, but are not expected, overall, to be large.

- What will be the effects on the economy while the country is debating the Energy Plan? There may well be some temporary reactions to the Plan as investors and firms sort out their own reactions and wait for final Congressional action. While this is unavoidable, an effort has been made to minimize such reactions by proposing that the major tax credits and rebates be made retroactive.

(B) Impact of the Gasoline Tax Alone

Although there is considerable hope that the gasoline tax will not be triggered over the period under examination, an analysis has been performed of the impact of the tax on the assumption that it is triggered each year, beginning in 1979.

- The annual rate of inflation over the period 1977 to 1981, as measured by the GNP deflator, would be 0.2 to 0.3 percent higher than otherwise. The major uncertainty in this figure is the extent to which wages and other prices would respond to such an increase.

- It is expected that the gasoline tax would have a slight contractionary effect. Over the period 1977 to 1981, the annual growth rate of real GNP would be between 0.0 and 0.2 percent lower than would otherwise occur. This results from a projected reduction in vehicle miles driven which extends the life of the automobile stock and lowers automobile sales. These reduced automobile sales could be potentially offset, however, if the gasoline tax reinforces the gas-guzzler tax and rebate and spurs consumers to acquire fuel-efficient cars more quickly.

Conclusions

In any program as comprehensive and far-reaching as the National Energy Plan, there are difficulties in precisely forecasting the economic effects. The Plan will increase the rate of inflation by a modest amount. But there is no way to increase prices for oil and gas to their value without having an effect on the overall price level. The most that can be done to ameliorate this effect is to spread the inflation out over time. In addition, the effect on economic growth is minimal over the next four years covered by this analysis. However, if the assessment proves faulty, steps can and will be taken to ensure that the economy stays on the desired growth path. The basic strategy of the Plan is to lay the foundation for healthy and sustainable growth, one based on energy sources which are dependable, environmentally acceptable, and in sufficient abundance to be used for many years to come. The transitional problems of price increases and industrial adjustments are the costs of laying the foundation for stable growth for the rest of this century.

BUDGET IMPACT OF THE NATIONAL ENERGY PLAN

The attached table contains estimates of budget outlays and revenue impacts associated with the President's proposals. The estimates shown cover the eight-year period through fiscal year 1985. The estimates are subject to considerable uncertainty, particularly in the years beyond fiscal year 1981.

Cumulative additions to budget outlays through 1985 are projected at $50.4 billion. These increases are in addition to outlay estimates transmitted to the Congress in April 1977. During the same eight-year period, the President's energy proposals will bring in additional new revenues of about $51.3 billion. When these new revenues are offset against budget outlays, the net impact on the deficit through 1985 is a positive $0.9 billion. In short, the cumulative net budgetary effect of the Plan's proposals over the period is expected to be roughly neutral.

Key items influencing budget outlays include the proposal to expand the Federal strategic oil stockpile to 1 billion barrels and an adjustment for the overall inflationary effect of the energy proposals on Federal programs whose spending levels are closely linked to changes in the cost of living. In addition, the estimates include the direct payments to individuals from the revenues collected from the crude oil tax, not otherwise returned through tax credits. The estimates also include the taxes and rebates for the auto efficiency ("gas guzzler") tax. It should be noted that no net budget effect results from these taxes since net revenues will exactly offset outlays. The most significant item affecting net revenues is the oil and natural gas conservation taxes, which would be levied under the President's plan beginning in 1979 on high volume industrial users for continued use of oil and natural gas. This tax will increase revenues by $40.34 billion through 1985, even after rebates have been paid to industries for the costs of converting to coal.

In fiscal year 1978, the energy proposals will add an estimated $1.45 billion to the deficit, reflecting the fact that anticipated tax revenues will initially lag behind budget expenditures associated with the President's proposals. Specifically, budget outlays are estimated to increase by $1.76 billion offset by increased revenues of $0.31 billion.

In addition to the new initiatives set forth in the National Energy Plan, estimates have also been revised for receipts for the Naval Petroleum Reserves. Prior estimates assumed continuing production at Elk Hills. The availability of Alaskan oil and the projected surplus on the West Coast makes previously planned production at Elk Hills undesirable, at least until additional pipeline or refinery capacity is available. Accordingly, previously expected revenues will be foregone, with the losses to be determined in subsequent decisions. This adjustment will have a negative impact on the Federal deficit through 1985.

Cumulative Effect of Energy Plan on
Federal Expenditures and Tax Revenues - Fiscal Years 1978-1985
(Billions of Current Dollars)

	Budget Outlays[1]	Revenue Impact[1]	Net Impact
I. President's Energy Plan			
Conservation:			
Energy Conservation Retrofit	- 2.25	- 3.94[2]	- 6.19
Additional Revenue Costs to Meet 90 Percent Insulation Coal	-	- 2.94[2]	- 2.94
Tax Credit for Commercial/ Industrial Efficiency	-	- 2.20	- 2.20
Tax Credit for Solar	-	- 0.55	- 0.55
Tax Credit for Geothermal	-	- 0.18	- 0.18
Cogeneration	-	- 0.73[3]	- 0.73[3]
Standby Gasoline Tax	-	+ 7.70[4]	- [4]
Auto Efficiency Tax	- 7.70	+13.39[4]	- [4]
Crude Oil Tax	-13.39	+ 0.50	+ 0.47
Tax on Motorboat/Aviation Fuels	- 0.03	-	- 2.67
Federal Building Retrofit	- 2.67	-	- 0.10
Solar Heating in Federal Buildings	- 0.10		
Oil and Gas Pricing	- 0.38[5]	-	- 0.38
Increased Federal Fuel Costs	- 2.90	-	- 2.90
Increased Coal Use:			
Electric Utilities	-	+ 0.31	+ 0.31
Industrial	-	+40.34	+40.34
Energy R&D	+ 2.03	-	+ 2.03
Strategic Petroleum Reserve	-11.03	-	-11.03
Assistance to Poor	- 0.40[6]	-	- 0.40
Indexing - Federal Program Payments			
Tied to CPI[7]	-11.15	-	-11.15
Other	- 0.40[8]	- 0.45[8]	- 0.85
Total President's Program	-50.37	+51.25	+ 0.88
II. Other Energy Impacts			
Naval Petroleum Reserves:[9]			
(low estimate)	- 1.90		- 1.90
(high estimates)	- 5.86		- 5.86

Footnotes attached

Footnotes

1/ Conventions used for amounts shown under the budget outlays column are that a minus sign indicates increase in total outlays; under the tax receipts column, a minus sign indicates lower tax receipts; and under net impact, a minus sign indicates an adverse impact on the budget. These are tentative estimates which will subsequently be subject to a detailed budget review. This review could result in changes. The amounts shown are in addition to the President's budget estimates transmitted to Congress in April 1977.

2/ As reflected in the first entry, the tax incentive may prove inadequate to achieve the conservation goal. As reflected in the second entry, a mandatory program initiated later may be necessary to achieve the President's goal.

3/ If triggered, the tax revenues would be fully rebated. In the worst case and the full 50 cents came into effect over ten years, $152.8 billion would be collected and rebated.

4/ There would be no net budget effect since tax revenues offset the outlays. The crude oil tax amounts are the portion of that tax to be returned to the public through direct Federal payments. The remainder will be returned via tax credits. Total revenues collected through 1985 are estimated to be $86.6 billion.

5/ Previous budget estimates assumed end of all regulation and are now not budget consistent with President's recommendations.

6/ Estimate assumes occasional emergencies of a regional character due to serious weather or spot shortages; but estimate does not assume a major embargo or repetition of 1976-77 severe winter.

7/ Includes effect of the energy program initiatives on Federal pay and on Federal programs indexed to the cost of living including social security, civil service and military retirement, food stamps and school lunch programs. Price increases beyond 1981 not included.

8/ Includes utility pricing, interconnections and wheeling, information systems, appliance efficiency, mandatory building standards, fuel efficiency standards, fuel economy for the Federal fleet, fuel economy for light-duty trucks, removal of excise taxes on intercity buses, and repeal of minimum tax in IDC's.

9/ Estimated receipts from production of oil at Elk Hills will be lower than indicated in previous budget estimates, the extent of which will be determined by future decisions. This is necessary to reduce the surplus of oil on the West Coast. The low estimate shown is based on NPR production resuming at the minimum economic recovery rate in FY 1981. The high estimate is based on not resuming production at the minimum economic recovery rate through FY 1985.

Mr. DINGELL. Our next witness is Mr. William D. Nordhaus, Member, Council of Economic Advisers.

If you would, like your brother who sat here first.

STATEMENT OF WILLIAM D. NORDHAUS, ACCOMPANIED BY PHILIP K. VERLEGER, JR., PH.D., COUNCIL OF ECONOMIC ADVISERS, EXECUTIVE OFFICE OF THE PRESIDENT

Mr. NORDHAUS. The first question I would like to raise is, Have you asked the right Nordhaus to testify before you this morning?

Mr. DINGELL. I think the White House has straightened that out.

Mr. NORDHAUS. A member of our staff was supposed to have sent up 100 copies of our testimony. In any case, I have a handful for any members who don't have them.

Mr. DINGELL. The Chair does observe that you have an associate. Will you identify him?

Mr. NORDHAUS. With me is Dr. Philip Verleger. He is with me today to help answer the tough questions which this committee is reputed to ask.

Mr. DINGELL. In view of time constraints, we would be agreeable to placing your full statement in the record, which you may summarize, if you will.

Mr. NORDHAUS. I would like to highlight a couple of the points in my testimony that were not included in earlier testimony of Chairman Schultze. If I may take leave to discuss that I will do that at this time.

In my prepared testimony I discuss three aspects of the energy program, focusing mainly on the economic questions. The subject is not only the effects of passing the President's program but, in addition, I tried to say something about the potential economic problems if we don't have an effective program.

In the first section I review the overall economic impacts we have put together for the short run. These are, I think, at this point, pretty well known. I will pass over those at this time. But the estimates we have made give predicted effects on the economy assuming, contrary to the usual expectation, that no adjustments will be made during the period under consideration.

As we noted, we expect there to be modest impacts on the economic condition of the country because of the various tax and rebate provisions. But let me remind the committee, we have counteracted the effects of the higher taxes by offsetting or, the word you have often heard, recycling. We have reduced other taxes with the increase in wellhead and potential gasoline taxes and, therefore, because of this, the Federal taxes in 1981 will be essentially unchanged. That is a point I think worth stressing.

Another question I would like to point out to you is a question which has been asked of the CEA. Why do we accept an energy plan which is inflationary? I would think we have to be quite open about this. The answer is that one of the cornerstones of the plan is conservation, and to make conservation effective we must raise oil and gas prices so that various consumers, industry, and government as well, will have incentives to reduce their consumption. However, the higher prices are a one-shot adjustment. They have been phased

in a way that is consistent with the twin goals of conservation and economic recovery, goals that are shared by the administration and the Congress. We very much hope, and I can't emphasize this enough, that no one will mistake this one-shot inflation for an inflation caused by excess demand for goods and services. They are very different.

I will pass over the effects on investment and imports and comment on something which I think has not received enough attention; that is, the question of the effect of the plan on the potential output or high employment output of the economy.

It should be noted that most of the economic impact estimates which have been put forth by the administration and private forecasters refer only to the impact of the plan as to the overall demand for goods and services and not supply. There is a wide margin of error in these forecasts.

It is misleading to talk only about short-term circumstances. A sound energy policy is necessary to insure that we have a continued healthy recovery, that we don't curtail the output of our factories or compel our members to remain idle because of the need for fuel. This is the most wasteful of restraints, rather, the program is designed to lay the foundation for smoother, more secure, sustainable, less risky, and more efficient economic growth over the coming decades.

I think I will pass over in my verbal remarks the discussion of coal conversion as one of the cornerstones for the medium-term policy. This committee is fully aware of the provisions of the bill and the incentives, which will be in place if the bill is passed as proposed, to convert from oil and gas to alternative energy sources, coal being the example I have used. What I have tried to do in the two tables on pages 17 and 19 is to show what will happen to the total cost for selected products with and without the President's program. These are techniques vitally different than those used before, but which may be more useful.

If you look at table 1 you will see that if the President's program is passed there will be significantly lower costs for products if all industries convert to coal than if they do not. This is because of the combination of oil and gas conservation taxes and conversion credits built into the program.

So, roughly speaking, if you look at what happens to costs of major industries in 1985, relative to 1975, if you convert to coal, the price increase due to higher energy prices will be roughly half than if you do not convert.

Page 19 of the testimony shows the same calculations with current law and it shows no incentive to convert to coal, roughly speaking, under the assumptions we use. If you convert to coal you have costs almost three times higher than if you don't. I think these tables could help us clear up some of the questions in many people's minds as to why coal conversion didn't occur earlier.

In short, the systems of taxes and tax credit on industrial energy consumption is designed to encourage strongly the use of coal. It uses market incentives as a way of ensuring that the medium term objective of coal conversion is attained.

Finally, I refer to a question I have heard many times: Why the urgency? Why is the President asking sacrifice? And why now?

There are two parts to this. The first part of the answer is that the economy of the United States is becoming increasingly exposed to future oil shocks. If we are to have a healthy economy over the time to come this risk should be reduced. I have heard little debate and there are few people who would question that premise. The second part is an economic fact of life: The sooner we act the lower the costs of converting from oil and gas.

Turning to the first point on the question of exposure, you are, I am sure, familiar with the projections of the National Energy Plan as to imports. The National Energy Plan estimates the share will rise from 19 percent in 1976 to 24 percent in 1985. That is a considerable increase in the import share of our consumption. I think this is not poetic license. In a recent review of five medium term projections for 1990, I calculated that on average they predicted no fall in the share of imports over the foreseeable future. With the measures the President has proposed, however, the National Energy Plan projects a fall from 19 to 14 percent.

You might ask why is this such a big deal, and it's tempting to paint a lurid picture of the future catastrophes. But I think these must either give bad ideas to those who might be tempted to help bring on the catastrophe, or else they sound a little far-fetched. So I am going to put it slightly differently.

I will simply ask what has happened over the last 4 years? Remember that our exposure will be increasing during the next 10 years unless we act, so let's just ask what has happened over the past 4 years as a result of the considerable exposure we have had to oil shocks.

First, in 1973, a short oil embargo, and it was relatively brief, against the United States, curtailed millions of barrels of imports. According to one study, an FEA study, this led to a loss of $20 billion, just that embargo, of GNP in 1974—in 1972 prices.

Second, in 1973-74, as you know, oil prices quadrupled, sending the world economy into the worst recession since the Great Depression. According to the last Council of Economic Advisers, the United States has produced $375 billion less in output in this recession, in the 1974 to 1976 period, than our potential GNP, and those are in 1976 prices.

Mr. DINGELL. Did you say $375 billion or millions?

Mr. NORDHAUS. Billion, as in bill. That would be approximately 30 percent higher in current prices. It is projected by most analysts that we will not regain our productive potential until the early 1980's. Those are very big numbers.

Third, I am sure I don't have to remind this committee about the winter of 1977, and of the cumulative effects of natural gas shortages which, at the peak, laid off nearly 2 million workers. And I think it is not widely recognized that the winter was not that severe a winter. I don't think that is widely known. It had approximately 10 percent more degree days than normal. I was at the meeting that Mr. Krueger referred to a few minutes ago of the American Geophysical Union yesterday afternoon, at which there was considerable discussion of the global cooling problem. It is clear that we are on a down trend as is the rest of the world. It is not a precipitous drop in world temperatures, but this is superimposed on the normal weather variation.

I would say 1977 is a one in three or four winters, it's not a 1 in 200 or 1 in 100, as has often been suggested.

The fourth point is that in 1976 we spent $32 billion for imported oil and in 1977 we were running almost 50 percent above the same period last year. Our oil imports contribute to a significant imbalance in the global balance of payments.

Without asking what is going to happen over the next 10 years, I would say just what has happened in the last 4 years and the four points I mentioned should be enough to convince most people that we are in an exposed position, and that the sacrifices and structural changes asked for by the President pale beside the enormous and unforeseeable risk we run if we do not act.

Finally, I would just summarize the last point: Why don't we wait a bit longer? I think the answer both from technical studies and economic studies is that it is cheaper to convert now or to change our ways now rather than in the future.

There are some examples in there. So to summarize the major points: First, the energy plan is designed to lay the foundation for an economic growth path based on energy supplies which are secure, clean, and economic. At the same time, however, the taxes and rebates are designed to minimize any negative impact on the economy in the short run.

Second, one cornerstone for reducing consumption of oil and gas is the coal conversion program. By raising oil and gas prices to their replacement cost to the Nation, and using some of the proceeds as rebates for conversion, powerful incentives will be put in place for industry to decrease its utilization of oil and gas.

Finally, if we are to ensure an orderly and efficient transition from the area of cheap oil and gas, we must act now. Failure to do otherwise would increase our exposure to energy shocks and increase the cost of transition at that point when delay is no longer possible.

Mr. Chairman, that summarizes my summary of the testimony which I will submit for the record.

[Testimony resumes on p. 114.]

[Mr. Nordhaus' prepared statement follows:]

EXECUTIVE OFFICE OF THE PRESIDENT
COUNCIL OF ECONOMIC ADVISERS
WASHINGTON, D.C. 20506

TESTIMONY OF

William D. Nordhaus, Member
COUNCIL OF ECONOMIC ADVISERS

BEFORE THE

SUBCOMMITTEE ON ENERGY AND POWER
HOUSE OF REPRESENTATIVES

June 1, 1977

Mr. Chairman, I am particularly pleased to appear before you today. I would like to use this chance to explain the economic impacts of implementing the Energy Program. I would also like to say something about the potential economic problems of not having an effective Energy Program.

My testimony will cover three separate aspects of the energy program. First, I will review with you the Administration's projection of the impact of the Energy Plan on the overall economy over the next four years. Second, I will discuss one of the cornerstones of the medium-run strategy, the coal conversion program. Finally,

I will end by discussing the costs and benefits of having an effective energy program over the long run.

Overall economic impact in the short-run.

Our short-run assessment of the overall impact of the President's program on the economy focuses upon the impact during the period out to approximately 1981. We will give an estimate of the effects on the economy assuming, contrary to the usual expectation, that no adjustments will be made to economic policy over this period. We perform this exercise mainly to examine what, taken by themselves, are the consequences of the energy program.

1. Output. We expect the plan, excluding the gasoline tax, to have no significant impact on the growth of real GNP or upon unemployment over the next four years. We estimate that the effect will range from minus 0.1 percent to plus 0.1 percent on the annual growth of real GNP. The impact on real output is so small because the program changes the prices of energy products relative to non-energy products without changing the overall level of demand for goods and services.

If the gasoline tax is triggered every year, it would have a slight contractionary effect over the period 1977 to 1981. Our analysis indicates that, taken by itself, it would tend to lower the annual growth rate of real GNP by somewhere between 0.0 and 0.2 percent. This results from a projected reduction in vehicle miles driven, which extends the life of the automobile stock and lowers automobile sales.

2. Prices. The major foreseeable impact of the program on the economy as a whole is the effect of the increased prices for petroleum, petroleum products and natural gas. The first effect of the higher prices, as we learned in the 1973-74 period with the OPEC price increase, is to drain off purchasing power from consumers. The resulting decline in real income leads to a reduction in consumer purchases of other goods and services. Should these cascade through the economy as a whole, there would be a reduction in total output and employment.

In the President's program, we have counteracted this effect by providing that the increased revenues of the wellhead and gasoline taxes be offset (or "recycled") by reductions in other taxes or increased transfer payments.

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Because of the offsets, the total Federal taxes (net of transfers) will be unchanged, and the real incomes of consumers will remain unchanged, or will increase slightly. Therefore, the potential decrease in consumer expenditures will be avoided. Over the next two years, the only major price-raising aspect of the program is the wellhead tax on crude oil, which comes at the beginning of 1978. After 1978, there are additional increases in the wellhead tax, conservation taxes on large users of oil and gas, and possible gasoline taxes.

As a result of these measures, and without the gasoline tax, from 1977 to 1979, we expect that the annual rate of inflation would be 0.3 to 0.4 percent higher with the program than without it. In the subsequent two years, the price impact under the program would be smaller, with an increase in the annual rate of inflation of between 0.1 and 0.3 percent.

It would be fair to ask, why do we accept an energy plan which is inflationary? The answer is that the most important part of the plan is conservation, and that to make conservation effective

we must raise oil and gas prices so that consumers will reduce their consumption. We have been postponing this unpopular consequence of the new era of expensive energy, but we can no longer bury our heads in the sand: energy prices must go up. The higher prices are, however, a one-shot adjustment. They have been phased in at a pace consistent with our twin goals of conservation and maintaining a healthy economic recovery. We hope that no one will mistake the one-shot adjustment for an inflation caused by excess demand for goods and services.

3. Investment. The provisions of the energy plan contain a number of measures that affect the outlook for investment. There are some sectors of the economy in which the plan will result in additional investment, and others in which investment will be decreased.

We expect that the recent, relatively low levels of investment in new capacity on the part of electric utilities will continue. The reason for this is that the peak load provisions of the energy plan, as they are implemented by State public utility commissions, will allow electrical utilities to flatten the peaks and raise the troughs of electricity consumption, reducing the need for new capacity. By smoothing loads

the same electrical energy can be produced with less generating capacity. We must emphasize that this development is one which should be encouraged, as it implies a much more efficient utilization of our capital stock, and lower costs of electricity.

In addition, as we will show below, industries which are energy-intensive will find their costs and prices increasing faster than average. Growth in these industries may be slowed, and investment reduced.

On the positive side, there are a number of areas in which investment will be encouraged. Consumers have very strong incentives to insulate and weatherize their houses, and we expect a strong increase in this sector. Similarly, there will be a considerable increase in expenditures on facilities to produce, transport, and cleanly burn coal. These will be induced by conservation taxes on oil and gas, rebates and investment tax credits on coal conversion equipment, and more favorable relative prices of coal in general. Industry generally will be given an additional tax credit for investment in energy saving processes and equipment.

Summing all these factors, we anticipate that the positive impacts of the program will outweigh the negatives during the early years. For the period through 1980, we expect a net stimulus to investment to be in the range of from $0 to $2 billion a year. After 1980, however, the positive impacts may taper off as conservation expenditures stabilize while other types of investment, especially the investment by electric utilities in new capacity, begin to decrease.

4. Imports. One of the major goals of the program is to reduce imports of oil and gas. According to the projections of the White House Office of Energy Policy and Planning the program should reduce imports by approximately 4-1/2 million barrels a day in 1985. If by 1981, the program cuts U.S. oil imports by 1 million barrels per day, expenditures on foreign oil will be reduced by $6 billion a year. In effect, we can be spending $6 billion more on domestically produced goods and services -- such as coal and home insulation -- and $6 billion less on foreign oil. As a consequence, GNP will rise.

5. Potential Output. It should be noted that the effects on output discussed up to this point refer to the impact of The Energy Plan on the overall demand for goods and services. Our analysis indicates that the impact on overall demand will be essentially zero. We recognize that the projections are subject to a wide margin of error, as in all exercises of this nature. But it is not essential that our projections be accurate to the last decimal point. If the economy is off the desired path, we will recommend midcourse corrections.

The discussion about the short-run macroeconomic consequences can, however, be quite misleading. The purpose of the plan is not to undermine the recovery -- quite the contrary. A sound energy policy will ensure that we need not curtail the output of our factories and compel our workers to remain idle to restrain oil imports -- surely the most wasteful form of restraint of all that have been suggested. It is designed instead to lay the foundation for a smoother, more secure, sustainable, less risky, acceptable, and more efficient economic growth over the coming decades.

- Smoother, because the inevitable transition from oil and gas will start before the last moment.

- More secure, because the energy will come from reliable sources.

- Sustainable, because it will be based on resources which are abundant.

- Less risky, because the economy's vulnerability to "oil shocks" will be reduced.

- Acceptable, because we will make a transition to fuels and utilization processes which are relatively clean and reduce dangers of degradation or proliferation.

- More efficient, because the price of our scarcest energy resources -- oil and gas -- will be priced at levels which more closely approximate their true value.

While it is extremely difficult to quantify these considerations in terms of real income, it must be emphasized that the purpose of the Energy Program

is to increase, not diminish, the well-being of the American consumer.

We have been asked whether The Energy Plan will lead to a loss in the productivity of our economy. This would be true only if it is believed that the true cost of oil and gas will return to a much lower level than its present level.

More important, however, is what has happened to productivity over the last three years. In general, after correcting for cyclical movements, the economy's productivity grows at a fairly steady rate, immune to microeconomic shocks. The one major exception of the postwar period is the "oil shock" which is estimated to have lowered productivity by 2 percent in 1974. Only by putting our growth path on a more secure basis can we reimmunize our economy to such shocks.

Coal conversion as a cornerstone for the medium-run.

In 1976, crude oil and natural gas constituted 74 percent of energy consumption, yet most analysts predict that this share must fall drastically by the

end of the century. The National Energy Plan expects that if the President's program is enacted the share of oil and gas would fall to 59 percent of total consumption in 1985.

The transition from an economy based on oil and gas requires that we use alternative fuels which are abundant, clean and economical. For the rest of the century, the only large-scale alternatives to oil and gas are electricity and coal. The form of coal conversion will differ between industries, whether it is direct burning, gasification, or--around the turn of the century--liquefaction, or in the next century some undreamt-of process.

Conversion would go on in any case, but the process is slow, costly, and difficult. More important, given the fact that we are subsidizing imported oil and holding oil and natural gas prices below their replacement cost, unless we change the present price structure we will actually impede conversion to alternative fuels.

We have received many questions about the coal conversion program. What will it cost? How would it work?

How fast will it work? Will it work? What I would like to do with you is to explain the major provisions of the coal conversion program, then to show how it gives powerful market incentives for industry to convert. Finally, I will suggest that if we do not take strong policy measures such as those the President suggested industry will definitely not have incentives to switch from oil and gas to coal.

The simplest way to see what will be the effect of the coal conversion program is to take a few products and show how they will be affected by the program.

I will go through some illustrative calculations to show you how this process works. It must be emphasized that--although the exact figures I will use are as carefully compiled as is possible given the constraints of time and availability of data--they are only order of magnitude estimates rather than exact predictions.

Sections 1501 to 1503 of the proposed National Energy Act establish a system of taxes on industrial and utility

uses of oil and natural gas. These taxes are designed to assure that industry pays the true cost to the Nation of oil and gas instead of the subsidized prices currently paid. In addition, it provides for rebates in the form of tax credits to industrial users of oil and gas who invest in "alternative energy property." Thus, the legislation penalizes the consumption of our increasingly scarce oil and natural gas resources. As much of the costs to a firm of converting a plant to coal operation would qualify for the credit, it encourages the use of our abundant coal resources.

In 1975, American industry paid an average of about $1.40 per million BTU (all figures are in 1975 dollars) for oil and natural gas. This is well below the current world price of imported oil, currently about $2.50 per million BTU for distillate fuel oil (inclusive of transportation costs and tariffs). By 1985, with the proposed industrial oil and gas taxes, the cost of the same amount of oil and natural gas to large users will rise to about $2.70 per million BTU. Therefore, firms that choose <u>not</u> to convert their operations to the use of coal or some other alternative energy source will experience real energy costs in 1985 that are almost double those in 1975.

On the other hand, if industrial users of natural gas and oil choose to make the necessary investments to convert to coal use, their unit energy costs would be significantly reduced in 1985. After accounting for the fuel cost of coal and the annualized capital costs of conversion, adjusted for the tax credit or rebate, we estimate the cost of the equivalent per million BTU of coal in 1985 to be around $2.05 in 1975 dollars--41 percent more than the 1975 cost of oil and gas, but only 76 percent of the 1985 costs of oil and gas. We expect that the lower fuel cost of coal will result in a substantial shift of energy consumption toward coal. According to The National Energy Plan, the program will lead to approximately five quadrillion BTU of coal conversion more than would otherwise occur.

These higher costs of energy will, of course, result in higher costs and prices for industrial products. The extent to which an industry's price is affected will depend upon both the increase in costs, the importance of oil and natural gas in the industry's production process, and the extent of conversion in the industry. To illustrate these effects we have

estimated the cost impacts on selected major products first assuming conversion does not occur and then assuming conversion occurs with the tax credit on coal conversion capital costs.

Let me say a word about the calculations. These estimates calculate the effect on the cost of the output of individual products using the technique known as "input-output analysis." It is important to understand how this works: we cannot simply ask, how much oil and gas does the apparel industry buy, and figure the effects on clothing by this route. We must take into account the fact that the apparel industry buys inputs from the textile industry, whose costs also will be affected by a rise in oil and gas prices. Similarly, textiles buy some cotton, which has fertilizer and on and on. By using input-output analysis we can ask how much oil is there in a shirt, tracing it all the way back through the system.

There are also a number of technical assumptions which go into the analysis, on which there is a large technical literature. In addition we have been forced to make a number of simplifying assumptions. I must stress, however, that without such assumptions I simply could not ask, how will individual products be affected? and what are the incentives for conversion?

The products presented in Table 1 below fall into two categories--large or intensive users of oil and natural gas and non-intensive users of oil and natural gas. For products in the former category, expenditures on oil and natural gas are high relative to the market value of the goods they produce. Among these energy-intensive products, price increases by 1985 will be significant in the case of no conversion. For illustrative purposes we assume all oil and gas is subject to the conservation taxes, and that all can be converted. In the chemical industry, for example, prices in 1975 dollars would rise by 11.2 percent between 1975 and 1985 if no conversion took place. Food and kindred products would rise by 2.3 percent in this case.

The last column in Table 1 shows the effect on product prices if all firms convert all their oil and gas use to coal and receive the proposed rebate. As can be seen in the case of conversion, cost increases are estimated to be only half of what they would be with no conversion. For chemical products the cost increase would be cut from 11.2 to 5.5 percent while in plastics the rise would be 3.7 instead of 7.5 percent.

TABLE 1

ILLUSTRATIVE CALCULATIONS OF REAL COST CHANGES, 1975 to 1985, SELECTED PRODUCTS, WITH THE PRESIDENT'S PROGRAM

[Percent change, 1975 prices]

Industry	No Conversion to Coal	Conversion to Coal
Large or Intensive Uses		
Food and Kindred Products	2.3	1.2
Chemicals, selected chemical products	11.2	5.5
Plastics, synthetic materials	7.5	3.7
Stone and clay products	3.7	1.8
Fabric, yarn, thread	3.7	1.8
Paper, allied products	2.7	1.3
Non-intensive Uses		
Footwear, other leather	1.5	0.8
Materials handling equipment	1.4	0.7
Office computing, accounting equipment	1.5	0.7
Radio, television communications equipment	1.1	0.6
Electronic components, accessories	2.0	1.0

A second category of products represent non-energy intensive products, i.e. they have expenditures on energy that are low relative to the value of the goods they produce. As Table 1 illustrates, cost increases for the goods produced by these industries are estimated to be much lower, on the order of 1 to 2 percent without conversion. As in the energy-intensive industries, expected price rises are much lower if conversion occurs.

To see why the President's program is necessary, we next examine what happens to fuel and product costs assuming the program is not adopted. Without the program we estimate the 1985 price (again in 1975 dollars) per million BTU's of oil and natural gas to be about $1.80. The comparable 1985 price of converting to coal would be around $2.50 per million BTU's. Without the program, an industry would rather fight conversion than switch.

Table 2 shows exactly the same calculation as in Table 1, except the former assumes the President's program is not passed.

TABLE 2

ILLUSTRATIVE CALCULATIONS OF REAL COST CHANGES, 1975 to 1985, SELECTED PRODUCTS, WITHOUT THE PRESIDENT'S PROGRAM

[Percent change, 1975 prices]

Industry	No Conversion to Coal	Conversion to Coal
Large or Intensive Uses		
Food and Kindred Products	0.7	1.9
Chemicals, selected chemicals products	3.3	9.3
Plastics, synthetic materials	2.2	6.2
Stone and clay products	1.1	3.1
Fabric, yarn, thread	1.1	3.1
Paper, allied products	0.8	2.3
Non-intensive uses		
Footwear, other leather	0.5	1.3
Materials handling equipment	0.4	1.1
Office computing, accounting equipment	0.4	1.2
Radio, television communications equipment	0.3	0.9
Electronic components, accessories	0.6	1.7

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A comparison of Tables 1 and 2 reveals an important fact: without the programs the increase in real product prices in these industries is expected to be higher if firms choose to convert to coal than if they continue to consume the Nation's scarce oil and natural gas resources. For chemicals, without the program real costs are expected to rise 3.3 percent by 1985 if conversion does not occur, compared to an increase of 9.3 percent if conversion does occur. Similar results hold for other industries.

In short, the National Energy Plan's system of taxes and tax credits on industrial energy consumption is designed to encourage strongly the use of coal. It uses market incentives as a way of ensuring that the medium-term objective of coal conversion is attained.

What's the Rush?

Finally, I would like to turn to a question that has been on the minds of many thoughtful people: What is the urgency of the energy program? Why is the President asking sacrifice? And why now?

There are really two parts to the answer to these questions. First, the economy of the United States is becoming increasingly exposed to future "oil shocks," and this exposure must be reduced. Second, the sooner we act, the smaller are the economic costs of converting.

First, let us ask what will happen if we do not implement an effective Energy Program quickly. According to The National Energy Plan, without the initiatives the share of our energy that we import will rise from 19 percent in 1976 to 24 percent in 1985. This is not poetic license. In a recent review of five medium-term projections for 1990, I calculated that on average they predicted no fall in the share of imports even with strong policy measures. With the measures the President has proposed, The National Energy Plan projects that we will reduce our import dependency to about 14 percent of energy consumption. If we do not reduce our oil consumption now but let oil exporters reduce it for us in the mid-1980's by a sudden price rise, we could easily relive the history of the 1970's.

It is tempting to try to paint a lurid picture of future catastrophes. This has the aura of unreality, so I will approach the problem differently. It is clear that over the next four years we will be more dependent than we were over the last four years. But let us simply remind ourselves of what happened over the last four years:

- In 1973, a short oil embargo against the United States curtailed millions of barrels of imports. According to one study, this led to a loss of $20 billion of GNP in 1974.

- In 1973-74, oil prices quadrupled, sending the world economy into the worst recession since the Great Depression. According to the last Council of Economic Advisers, the United States has produced $375 billion less in output in the 1974-76 period than our potential GNP. The economy will probably not regain the level of potential output until the early 1980's.

- In the winter of 1977--not that severe a winter, incidentally--the cumulative effects of the natural gas shortage led to the emergency and, at the peak, nearly two million workers were laid off.

- In 1976 we spent $32 billion for imported oil, while in the first four months of 1977 were running almost 50 percent above the same period last year. Our oil imports contribute to a significant imbalance in the global balance of payments position.

What does the next decade portend if we do not act swiftly and decisively? I do not pretend to know, but I would simply note that unless we act our position will almost certainly become more exposed. The sacrifices and structural changes asked for by the President pale beside the enormous and unforeseeable risks we run if we do not act.

Why not wait a bit longer? It is generally acknowledged that the transition from an economy based largely on natural oil and gas is inevitable. If we plan for the transition now, it will be cheaper than if we wait until the last minute.

We are today building capital equipment which will last anywhere from ten to fifty years. In some cases, as in automobiles, it is essentially impossible to "retrofit" the capital to make it more fuel-efficient after it is built. Therefore, if we are to proceed on a trajectory with a lower growth rate of energy use for the 1980's and 1990's, we must start to build more efficient capital equipment today.

Putting this proposition in another way, we might ask how painful or costly it is to reduce energy consumption. From all we know about technology and economic behavior, it is many times more painful to reduce energy consumption immediately than over a long period of time. Take residential heating as an example. The only way that we can reduce energy use over night is to turn the thermostat down--to freeze in the dark. In the medium run, as insulation occurs, we can heat with less fuel. In the long run as houses with higher thermal integrity are built, we can reduce energy consumption by 20 or 50 percent per dwelling without reducing the internal temperature 1 degree. It requires simply somewhat modified design and more costly construction.

It is hard to know how to quantify the timing factor, but the results of a recent survey of the literature by Lester Taylor of the University of Arizona suggests that the short-run costs or discomfort of cutting energy consumption may be from 2 to 6 times larger than the long-run costs.

Summary

To summarize the major points:

- The Energy Plan is designed to lay the foundation for an economic growth path that is based on energy supplies which are secure, clean, and economical. At the same time, the taxes and rebates are designed to minimize any negative impact on the economy.

- One cornerstone for reducing consumption of oil and gas is the coal conversion program. By raising oil and gas prices to their cost to the Nation -- and using some of the tax proceeds as rebates for

coal conversion--powerful incentives will be in place for industry to increase its use of coal.

. If we are to ensure an orderly and efficient transition from the era of cheap oil and gas, we must act now. Failure to do otherwise would increase our exposure to "energy shocks" and increase the costs of transition at that point when delay is no longer possible.

Mr. DINGELL. You have done very well by the committee, and we certainly thank you for your kindness to us and your very helpful testimony.

The Chair will recognize members for questions now.

The Chair recognizes the gentleman from Texas, Mr. Krueger.

Mr. KRUEGER. Thank you, Mr. Chairman.

Thank you, Mr. Nordhaus for your testimony.

I am wondering, Mr. Nordhaus, whether the Council of Economic Advisers is responsible for some of the figures we were just given by Mr. Schlesinger or whether you plead innocent of those figures?

Mr. NORDHAUS. I heard probably 1,000 figures in the last hour and a half, Mr. Krueger.

Mr. KRUEGER. I was thinking particularly of the imaginative figures we had with regard to cost of deregulation, $120 billion. Did that come out of the Council of Economic Advisers, $120 billion by 1985 in net producer revenues?

Mr. NORDHAUS. No. We were not the source of origin of those numbers. However, I would like to suggest those must be the right order of magnitude.

Mr. KRUEGER. I think we will get the assumptions on them later, and I think that has already been requested in the record. I was just wondering whether the Council would also have any forecasts since, current producer revenues for interstate gas are $5 billion and the Department of Energy has a $10 billion budget, if we could assume a rate of growth comparable to the Department of Energy, whether we could not expect that the Department of Energy, by 1985, would have cost the American taxpayers a great deal more than $120 billion.

Mr. NORDHAUS. I think on budgetary questions I will defer to OMB and the Department itself.

Mr. KRUEGER. I thought we would find a graceful maneuver; that is fine. I should like to ask with regard to insulation, which is one of the expectations of the Carter proposal, it's my understanding that currently 80 percent of the insulation comes from fiberglass, and we

have received testimony from people who manufacture fiberglass insulation that there are now only four companies in the United States that manufacture fiberglass. Two of these were shut down at least for part of the time last year because of the natural gas shortages.

I am wondering whether the administration has any plans on how to deal with the supply constraints on fiberglass, given the fact that we have had supply constraints because of energy shortages in the past, and the administration bill gives no allocation authority, as I understand it, to the administration to allocate gas from one industrial use to another.

Mr. NORDHAUS. On the fiberglass question, we did spend some time during the first 90 days of this administration explicitly considering what is going on in the fiberglass industry.

As you probably know, the recession which I referred to earlier led to considerable recession in the home insulation industry. In fact, much of the capacity utilization there was even lower than American industry as a whole. The reason, of course, being that most of insulation—I don't know the exact number, I guess it would be in the order of 75 percent of the insulation—is used in new construction, and since the housing starts and the construction were very depressed, the industry itself was quite depressed.

This is true as late as 1976, and I would suspect part of the shutdowns were simply due to reallocation of production among different plants, although I don't have any data on that.

I heard of no stories on inability of the construction industry to get materials of that kind. There have been other shortages mentioned, but that is one that has not been mentioned to me. So I think the major point is that there is ample room at the present time for retrofitting houses. It is much less fiberglass intensive than new construction, and there appears to be ample capacity for the next couple of years.

There are also a number of plans to expand construction. My understanding is, unlike the energy industry, the lead time for construction of these plants is in the order of 18 months.

Mr. KRUEGER. If I may get a question in before my time runs out, that doesn't concur with the testimony we received; I would just like to pose one more question, and that is the Carter proposal forecasts a total net energy use in this country of 40 million barrels a day of oil equivalent by 1985. As I look at the Carter proposal, I only find them coming up with something like 30 million barrels a day of oil equivalent energy sources, and I am wondering what we do with the gap?

Mr. NORDHAUS. Those are not the numbers that are contained in the National Energy Plan, and I refer you to page 96 of the National Energy Plan. In 1985, with the plan, it's expected that you get 46.4 million barrels of oil equivalent a day, with imports being 6.4 million barrels of oil equivalent per day. So those are the numbers, in fact, I refer to in my testimony.

Let me say on those particular numbers, the Council did have a considerable discussion and input, and I think we are fairly confident that those are good order of magnitude estimates.

Mr. KRUEGER. Would you feel that the increase in coal production of 84 percent by 1985 and of nuclear production of 380 percent by that time are realistic?

Mr. DINGELL. The Chair observes that the time of the gentleman has expired, and you may answer the question.

Mr. NORDHAUS. Unfortunately, the end of that sentence did not reach my ear.

Mr. KRUEGER. I wonder whether the increases between 1976 and 1985 of an increase in nuclear production of energy of 380 percent and coal production of 84 percent are, in your judgment, realistic?

Mr. NORDHAUS. I don't pretend to be an expert on either of those industries. My understanding is the nuclear projections are essentially plants on order or under construction, and I think the real question there is whether there will be slippage, but that is a question I think you should address to the electric utilities.

On the question of coal, I think there are a number of uncertainties on both sides, that certainly the numbers projected are below the technological capabilities of our economy. On the other hand, there are a number of measures which influence that, in particular environmental questions, transport, and so on. We looked at that earlier, and those look to be a good order of magnitude estimate, but whether you are going to reach that goal by 1984 or 1986 or 1985, I certainly couldn't testify one way or the other.

Mr. DINGELL. The time of the gentleman has expired. The Chair next recognizes the gentleman from Colorado, Mr. Wirth.

Mr. WIRTH. Thank you, Mr. Chairman.

First, Mr. Nordhaus, are there any other Nordhauses the committee ought to know about?

Mr. NORDHAUS. I don't know what you mean by know about. I could name about 10 more, but I think for this purpose——

Mr. WIRTH. Any other brothers?

Mr. NORDHAUS. No more currently in this city. All of my family is arriving next week.

Mr. WIRTH. That is a very impressive display of family unity and talent, I must say.

Let me ask you to start with the statement on the bottom of page 252, where you talk about raising oil and gas prices to their cost to the Nation. We might just talk a little bit.

How do gas prices under the President's proposal get raised to their cost to the Nation? I assume you mean replacement cost by that.

Mr. NORDHAUS. That is correct. That is one of the most explicit things in the bill. The price of natural gas to industrial users will be essentially set by the gas conservation tax, the boiler tax as it is sometimes known. That tax will be set at such a level that the acquisition costs for natural gas by large users will be on a Btu basis equivalent to the price of distillate. Going back one step, what sets the price of distillate in this program? Because of the combination of wellhead tax and other taxes, the price of distillate is certain to be at or maybe even slightly above the world price level. So I think there is no question that from the user point of view—I want to emphasize from the user point of view—the price will be at approximately the replacement costs in terms of imported distillate.

Mr. WIRTH. Why not, say, both on oil and gas, why not just charge the replacement costs to that industrial user, and then tax back what you might feel is a windfall?

Mr. NORDHAUS. I think these are equivalent, Mr. Wirth. I think this may be slightly easier to administer, but not being in FEA I couldn't testify on that. But from an economic point of view, which I can testify to, they are essentially equivalent.

Mr. WIRTH. Doesn't the approach of charging the tax, which gets passed on whether you tax it at the front or the end, doesn't that have the same economic impact as was suggested by Mr. Schlesinger that decontrol would have on the consumer?

Mr. NORDHAUS. It does, with one major exception. Here I would like to speak to the major economic consequences of using taxes which are recycled versus market clearing prices as a way of getting those user prices up.

Mr. WIRTH. Let's take the latter, though, the taxing at the end. In that, you would charge the replacement cost and then tax it back.

Mr. NORDHAUS. Let me just explain: If you look at current prices of oil and gas, versus what are estimated to be replacement costs, the current prices are on the order of $40 billion lower than the replacement costs, that is for both oil and gas, and about two-thirds of that is natural gas.

Now, the problem is, of course, there are many marginal decontrol schemes between imposing taxes and having complete decontrol. I think there are no advocates around or very few for complete decontrol of old and new oil and gas.

Consider the $40 billion of rents that would accrue to someone, if the replacement cost of all oil and gas were set at the world price level. The problem from such a large price increase from the macroeconomic point of view, is that the rents flow into corporate profits, and, as we saw in the 1973-74 era, the propensity to consume out of corporate profits is relatively low.

Therefore, we would be headed for a repeat, on a smaller scale, of the 1973-74 recession. So I think—without even getting into equity arguments, which we might also feel strongly about—from the macro-economic point of view there is a very important difference between the two approaches.

Mr. WIRTH. I think I understand that and I am sympathetic with that in terms of not wanting to bludgeon the economy as we did with the quadrupling of oil prices. But I am concerned about the need to make a distinction between what is defined as between new and old gas, and new and old oil, for the purposes not of providing that kind of massive windfall but providing the kind of a balance we are looking for between production and the replacement cost impact on consumption.

Mr. DINGELL. The time of the gentleman has expired.

The gentleman can finish his question.

Mr. WIRTH. Thank you very much.

This morning Mr. Schlesinger talked about the administration's offering exemptions for hard to get natural gas versus what would be, I suppose, not hard to get new natural gas. Do you have any estimate as to what the difference in volume is or percentages that we are talking about between hard to get new natural gas and not

hard to get new natural gas, and following what the assumptions that Mr. Schlesinger was referring to this morning.

Mr. NORDHAUS. I think there may be estimates, not using the same labels as you have used, of the increase in gas which is at the higher price level from, let's say, frontier gas, deep formations, tight formations, geopressurized on the one hand, and new gas which receives approximately $1.75. I think there are estimates, but my impression is in both cases for the next couple of years they will be relatively small. We could try.

Mr. WIRTH. They are very small.

Mr. NORDHAUS. My impression is that new production is going to be relatively small, but I can get my staff to track that down and try and get an answer.

Mr. WIRTH. If you could, I would appreciate it.

Thank you very much, Mr. Chairman.

Mr. DINGELL. The time of the gentleman has expired.

The Chair recognizes the gentleman from Michigan, Mr. Stockman.

Mr. STOCKMAN. I would like to follow up on the discussion, because at page 14 you indicate that the price per Btu would be about $2.70 when the oil or gas is taxed up to the world price through the plan, either taxed up or priced up, and that the current price is $1.40 on average to the industry per million Btu's. By converting to coal the average price to the user is going to be $2.05.

Mr. NORDHAUS. Right.

Mr. STOCKMAN. I am wondering, are you responsible for those calculations, your shop, yes or no, and if you are——

Mr. NORDHAUS. Absolutely, I stand by them.

Mr. STOCKMAN. Then we can pursue that, good.

Mr. NORDHAUS. There is a typographical error on line, I think it's 10 of page 14, and that should be 46 percent instead of 41 percent.

Mr. STOCKMAN. Fine. So I would assume then that all of the numbers you have in table 1 are calculated on the basis of the $2.05 for conversion to coal, and the $2.70, which would be the taxed price or priced up price for oil and gas.

Mr. NORDHAUS. That is correct.

Mr. STOCKMAN. What we have heard in the testimony thus far, I assume the $2.05 is based on direct conventional gas combustion, it is not based on coal gasification because any figures we have heard are in the range of $3 to $6 per million Btu. What we have heard in the testimony I think is opportunities over the next 10 or 15 years for direct conventional combustion in industry are far more limited than your assumption. The only place that can be successfully done are for very large boiler users and as a result it seems to me you ought to blend into your figures these two factors:

One, that if you are displacing oil and gas with conventional oil and gas, some of that displacement is going to be direct coal combustion, and we can argue the $2.05 figure but some of it is going to be converted gas or LNG and it seems to me you need to rule that in.

Secondly, I have gross doubts about your $2.05 figure because as I read what you have indicated here, you are only counting the cost of conversion of the boiler itelf, minus any tax credits, and the fuel cost or the fuel acquisition cost of coal.

I think there is much more to that than that. We have discovered you can't convert an oil or gas boiler to coal; you have to replace it, and you are going to have a much higher acquisition, plus in some cases you are going to be scrapping relatively new boilers, oil and gas, and that's an economic loss that has to be figured into the calculation.

Second, we have discovered you are going to have much higher costs for storage, and for space requirements for coal. In fact, the people from the boiler industry indicated to us last week that the storage space requirements and the use space requirements are on the order of 10 to 1 between coal and gas or oil fired boilers simply because you have to store the coal, and you have all of that space for the present combustion items, or machinery that you need, stokers and so forth, and again that is going to be a cost in a lot of industrial situations because they don't have the space available.

We have also learned you have much higher operating costs. The boiler people tell us a guy who has been running a gas or oil fired boiler for the last 10 or 15 years can't run a coal fired boiler simply because it's a totally different process that requires different kinds of knowledge and skills about the combustion process. So again you are going to have more people, higher paid people and more costs, you are going to have tremendous costs for SO_2 control, NOx control and other emissions from the combustion process, and you are going to have tremendous disposal costs as well, because over the next 10 to 15 years we simply don't have the technologies that would allow for regenerative control or for fluidized bed combustion and so forth.

It seems to me that those are all costs to the user that he has to figure into the Btu that he is trying to convert into heat or work, and that you really haven't figured those into the $2.05 figure, and that the numbers, therefore, that you have in chart 1 or table 1 are dubious at best, and probably irrelevant in the most likely case.

Do you have ay response to that?

Mr. NORDHAUS. My major response is that I think what you have done is made a very good case for the coal conversion rebate provisions that are considered in the bill, and in particularly in section 1502.

Mr. STOCKMAN I would accept that. But let me make a case for the unrealism of the $2.05 figure.

Mr. NORDHAUS Let me carry on. The $2.05 figure takes into account not the acquisition costs of the equipment that you have mentioned, which I think are quite considerable. In fact, we may have underestimated that, but I think something you have not factored into your analysis, unless I misheard you, was the fact that I think almost all of the items that you mentioned, with perhaps the exception of some of the building and the land, are eligible for the conversion credit for alternative energy property. In particular, let me remind you, that included for this coal conversion credit in section 1502, are coal fired boilers, boilers in general, facilities for conversion into low Btu gas and so on.

Now, let me explain a little bit more about how that works.

When an industry currently is burning oil and gas and will be paying the boiler tax upon them, according to the proposed legisla-

tion, the proceeds of the oil and gas boiler tax can be used to pay for conversion equipment into coal. So with the exception of land, and also the labor, that means that you get essentially a complete offset for the purposes of private calculation of the costs of this.

Now, we used a rather pessimistic or conservative assumption in these numbers, that there is essentially a 50 percent, equivalent tax credit due to the rebate provision. When you actually feed that through in the economic calculations, it means from a private point of view, not from the point of view of the Nation as a whole or the point of view of the Treasury, that the capital costs of conversion into coal are really quite small.

When you add together the rebate, the normal investment tax credit and the depreciation provisions, it isn't free, but it's very close. The capital costs of conversion are very small, and, in fact, the main thing that you would then start arguing about is what are the fuel costs, the transportation costs of the coal itself, in addition to the operating costs and the labor that is involved.

I am not going to the stake over the $2.05 figure, and probably should have rounded to the nearest dollar because of the uncertainties about what equipment, coal prices, and technology are going to be in 1985. I think that it's the right order of magnitude.

I think what you have done, however, is emphasize that the second table, which shows what happens if we do not have the program, underestimates the conversion costs to coal and shows, in fact, how much less coal conversion we are going to have in 1985 than even the pessimistic assumptions of the National Energy Plan suggest.

In fact, if you mark those up a little bit, this means the cost of conversion is instead of two and a half maybe four times the cost of staying with oil and gas.

So to summarize, I don't argue with your basic assumption. We have used, in fact, a number on the order of $6 billion of capital cost per quad of conversion costs. Many numbers I have seen are lower, some higher, but I don't think it really invalidates the basic conclusion that you need some strong measures to get industry off oil and gas.

Mr. DINGELL The time of the gentleman has expired.

The Chair observes there is a vote on the floor. We have approximately 5 minutes to get over and vote.

Mr. Nordhaus, could you wait just a minute because the staff has a few questions, and I have a few questions and I think Mr. Brown has a few questions, and perhaps Mr. Madigan, who is also our colleague here, has some, and we should be back in about 5 to 10 minutes.

I apologize for having to go. We will return as quickly as we can.

The committee will stand in recess until that time.

The Chair should note that it is the Chair's intention to reconvene for the next panel of witnesses at 1:30 instead of at 1:00 o'clock. So the committee will be in recess for about 5 or 10 minutes while we run over and vote and come back.

[Brief recess.]

Mr. DINGELL. The subcommittee will come to order.

Mr. Nordhaus, we apologize to you for the delay. We recognize now the gentleman from Illinois, Mr. Madigan.

Mr. MADIGAN. Mr. Nordhaus, there have been various estimates given of the total revenue yield for the President's energy program.

In terms of taxes, as I understand the program, we are dealing with four things: A stand-by tax on gasoline, a crude oil tax, a gas guzzler tax on certain kinds of automobiles, and an incentive tax to help implement coal conversion.

One estimate for the total of those four taxes is $140 billion annually by 1985.

Curiously enough, the total individual income tax payments to the Government in 1976 was $140 billion. Should anyone advocate the doubling of the Federal income tax on individuals? I should think they would be condemned as advocating very inflationary action, and an action that would have severe economic impact, and severely impact upon the people on the low end of the income spectrum.

How is it that the same kinds of criticisms do not apply to the President's energy program?

Mr. NORDHAUS. I mentioned and referred to this in my oral remarks, but in the prepared testimony I said a couple of things about that.

I have a little trouble with the view that we are raising $150 billion in new taxes. From an economist's point of view, I view it slightly differently.

The tax structure of the United States over the last 15 years has been one in which we have had considerably more reliance upon individual income taxes and on social security taxes. At the same time excise taxes and corporation taxes have declined as a share of the total Federal tax take.

We have on the books now certain tax laws; as you know, the administration has in progress a very comprehensive set of tax proposals which we are considering and which will be submitted to the Congress later this year.

The way I would like to view the energy tax legislation is that we are changing, to a certain degree, the way we raise our Federal revenues. We are now turning around the decline in the use of indirect taxation, which is now virtually zero on the Federal level, and are going to increase that over the next 8 years. We are going to lower personal income taxes by almost exactly an equal amount. So I don't find it helpful to say we are raising so much extra revenue. Rather I look at it as raising the revenues we need to pay for our Federal purchases through a different mix of the four different basic tax systems we use.

Mr. MADIGAN. If what you say is correct, you said we are going to lower individual income taxes by the same amount, and you used the figure $150 billion.

Mr. NORDHAUS. That is a cumulative number.

Mr. MADIGAN. If the taxes paid by individuals through the income tax were $140 billion last year, then did I understand you to say you are going to eliminate individual income tax payments?

Mr. NORDHAUS. I think the number you were using was more of a cumulative number, if I am not mistaken.

Let me just give you an example which would refer to the crude oil equalization tax, just to make it concrete. According to numbers

which have been worked up in the administration, we expect that the total revenues that will be raised by the wellhead tax in 1985 are on the order of $10 billion for lower tier.

Mr. MADIGAN. May I interrupt?

Mr. NORDHAUS. Let me just finish. I want to make this point more explicit. Adding the $2 billion for the upper tier, we have a total of both tiers of about $12 billion. Now at the same time we are going to lower personal income taxes and raise transfer payments by almost exactly the same dollar amount. So what we are doing is raising excise taxes and lowering individual taxes. But, the total tax take of the Federal Government, due to this measure, will be almost exactly the same.

Mr. MADIGAN. The thing I have a problem with is the $10 billion figure, because I have studies from three different associations that all come closer to $50 billion. As a matter of fact, the low figure is $49.4 billion in 1985 for the crude oil tax.

How can there be such a difference, a difference of $40 billion?

Mr. NORDHAUS. I was referring only to the wellhead tax, Mr. Madigan. Now, there are other taxes that you would probably want to mention. One would be the boiler tax on oil and gas. The other one would be the standby gasoline tax.

Mr. MADIGAN. Isn't the crude oil tax the difference between the controlled price, the domestic price, and the world market price.

Mr. NORDHAUS. That is correct.

Mr. MADIGAN. By 1985 is it not possible that the world market price will be substantially more than it is in 1977?

Mr. NORDHAUS. Oh, no. I was just talking about some base line assumptions which went into our projections, which are that the import price would go up at essentially the same rate of increase as the GNP deflator. If, in fact, it goes up faster, as some forecasters think, then you would have a higher wellhead tax take. If it goes up slower then you would have a lower wellhead tax take.

Mr. DINGELL. The time of the gentleman from Michigan has expired.

The Chair recognizes the gentleman from Ohio, Mr. Brown.

Mr. Nordhaus, I apologize; had you completed your answer? I am going to call time on the Member, but you have time to complete your answer.

Mr. NORDHAUS. I think I got the major points.

Mr. DINGELL. All right. The Chair recognizes the gentleman from Ohio, Mr. Brown.

Mr. BROWN. Thank you, Mr. Chairman.

Mr. Nordhaus, the FEA and USDA have variously estimated that the cost of energy and products of agriculture, food and fiber products, is somewhere between 6-1/2 percent and 8-1/2 percent.

If you had a 100-percent increase in these products, the price presumably of the cost of food would go up, say, to as high as 108-1/2 percent. That would be a scenario, for instance, where there might be some very sharp increases in price as a result of decontrol of the cost of these energy inputs. A sharp reduction in production would result, if we run short of energy in agricultural areas.

That is a real problem that we faced in the question of fertilizer and natural gas, which is going to be more inflationary with

adequate supplies of natural gas at a decontrolled prices, or an inadequate supply of natural gas. For instance, you can't produce a sufficient amount of food in this country or you can't make the glass to employ the people who work in the glass industry or some of the other needs for energy that cannot be changed.

Mr. NORDHAUS. I would think that to be the kind of question that is difficult to answer, because it involves things that are both difficult to measure and intangible, but I would guess that most analysts would feel that the most costly possible form of energy problem is the curtailment of a critical industry, or critical product.

So I have no hesitancy to say that one of the cornerstones of this plan is to make sure that people who really need fuel supplies have them.

If the cost of that is that they have to pay a slightly higher price, then within reason, and making sure there are no windfalls, again, then we are willing to pay that.

Mr. BROWN. Did I mishear the comment made by Secretary Schlesinger, that if you decontrol the price of natural gas and natural gas would increase, it impacts on the economy by $120 billion? Did I mishear that?

Mr. NORDHAUS. We had some earlier discussion of that, I don't know if you were here, Mr. Brown, with other members of the committee, and I will be glad to repeat the comments I made at that time.

Mr. BROWN. Don't repeat them. Just answer the question as to whether or not I misheard that. Is that an estimate that you have made, that $120 billion would be the cost of deregulation of natural gas?

Mr. NORDHAUS. I heard the same number and as I said earlier----

Mr. BROWN. Can it be justified?

Mr. NORDHAUS. I think so, yes.

Mr. BROWN. Could you provide that for the record, the justification?

Mr. NORDHAUS. I will tell you what I will do; I guess Mr. Schlesinger was also asked if he would provide that. I will make sure our staff looks and checks those numbers very carefully.

Mr. BROWN. Yes. I wish you would be sure to send that to me separately, because I am just absolutely startled at that figure, and feel that it must mean deregulating all of the previous contracts of natural gas up to a current market price, and, of course, nobody has proposed that, which I know of, although I must say that the administration program is somewhat more generous than the legislation suggested by Mr. Krueger and myself in that regard.

We were going to freeze the price of current contracts.

Could you tell me why the administration chooses to go with taxes on processed fuels?

Mr. NORDHAUS. Could I just respond?

Mr. BROWN. If I can go ahead and ask the question, could you tell me why the administration chooses to go with a tax on processed fuels that cannot be reduced, can only be passed on?

Mr. NORDHAUS. Yes. I think that is very easy. The easiest way to see that is let's pretend just for the moment, just take a hypothetical example where you have an industry----

Mr. BROWN. Don't make it too long because I have other questions I want to ask.

Mr. NORDHAUS. Do you want any answers?

Mr. BROWN. Yes, but I would like to have them as brief as possible.

Mr. NORDHAUS. Give me 60 seconds to answer your question.

If you take industry that is using subsidized fuel, say an imported fuel at a price which is say $2 or $3 a barrel lower than the actual cost to the Nation——

Mr. BROWN. Let's take natural gas, because that is what I am concerned about. I mentioned the glass industry, and food processing.

Mr. NORDHAUS. Let me finish the example . . . then simply exporting that abroad. We are simply subsidizing consumption of of our trading partners.

Mr. BROWN. Let's talk about domestic energy sources if we could. That is the area of my concern in terms of taxes on processed fuels.

Mr. NORDHAUS. Okay. From an economic point of view I think it's the same point, because when you are using fuel, it doesn't matter whether you use a barrel of oil or gas to produce whatever that product was. The marginal source today, I think everybody agrees, for energy use of oil and gas, is imported oil, and therefore, from the point of view of the Nation as a whole, we are paying the world price, $13.50 in goods and services, but we are subsidizing that end use to producers. That is the economics behind why we think users should pay the true cost of oil and gas.

Mr. BROWN. So that everybody should have to pay more for the food, for instance, by placing an additional tax on processes in food production that use natural gas, but we should not pay full price for the production of that natural gas. That is where I am lost. You make the consumer pay; you add to his cost, but you don't encourage his supply, and if that results in the shortage that you said, it would be economically deleterious. Then you really present the consumer with the worst of both problems.

Mr. NORDHAUS. No, I think there are a number of steps in this. The first is in each process you would ask that users pay what is a replacement cost for the inputs they use——

Mr. BROWN. But that money is——

Mr. NORDHAUS. Whether labor or capital. Secondly, that will be passed on to consumers in the form of higher prices. But, third, the important point of the program is that if you are worried about consumers, we are rebating the proceeds so that low income individuals will actually have higher real income than before. And, fourth, because of the industrial tax on oil and gas, we are trying to ensure that we don't have the perennial curtailments in the natural gas supply.

Mr. BROWN. That is the part that is missing in the program. Why then, do we not encourage production with that, rather than face the consumer with the shortage of supply which will run up the cost of the product in addition to what is happening to the industrial tax?

Mr. NORDHAUS. There are two answers to that. One is that we think that in the time horizon to 1985, if you look at most of the

actual econometric, technical, and statistical work, the difference between the program we are proposing and a very generous, complete decontrol, throw-it-to-the-market——

Mr. BROWN. That is not proposed.

Mr. NORDHAUS. No, but that is the one where you get the most production incentive, I guess everybody would agree.

Mr. BROWN. No, I don't agree with that.

Mr. NORDHAUS. If you look at the difference between those two, it makes a fairly small impact on gas production by 1985. On the other hand, by raising the price to users, and particularly industrial users, we think you can get a fairly significant backing out of that market because of raising the price. Those are industries where alternative processes exist, where——

Mr. BROWN. Which is not what we are discussing.

Mr. NORDHAUS. That is what we are discussing because by freeing up the natural gas which is now used by industry, a large fraction of our gas, this will then make it available for high priority users.

Mr. DINGELL. The time of the gentleman has expired.

Mr. BROWN. Thank you. I want to remind the witness we are talking about processing fuels——

Mr. NORDHAUS. May I comment on this, because I think it is very difficult to separate out, the way Mr. Brown was, individual industries and individual processes. The economy is tied together through a number of different channels. If you free up the demand by having conversion or conservation in one industry, that essentially frees up resources for the economy as a whole, and I think that is the kind of conversion program we are looking for over the next 10 years.

Mr. DINGELL. The Chair recognizes Mr. Schroeder, of the staff, for questions.

Mr. SCHROEDER. Thank you, Mr. Chairman.

Mr. Nordhaus, you indicated in response to an earlier question that you weren't particularly concerned about shortages in the insulation industry as affected by the insulation provisions of the plan. The way you responded to the question suggested that perhaps you were concerned about other shortages. You didn't go into those, and I wonder if you could highlight, if there are concerns on your part that some shortages elsewhere in the economy might develop, what might those shortages be?

Mr. NORDHAUS. The concerns I had were just based on very informal reports I have had at the Council from builders around the country and in particular in areas where speculative fever is running very high. My understanding is that some builders have reported spot labor shortages, in particular for certain kinds of skilled labor. I was just noting that I have heard no report, so far, of shortages of fiberglass.

Let me amplify the remarks a little. If we think of what the implication of a shortage is, say, that we have 10 percent of our demand for retrofits in a given year which can't be met because of insufficient capacity, although I think that is something that is a shame, it is not a disaster. It simply means that our targets will be off by 1.2 months. I would like to have the capacity, of course, but I don't think it is a disaster if we are off one side or the other a little in some of the projections.

Mr. SCHROEDER. You indicated, also, I believe in the early part of your statement, that the total impact of tax collections and rebates would be roughly neutral in 1981. I think that was the year you made reference to. Perhaps I heard you wrong.

Mr. NORDHAUS. The comment I made was exclusive of the—just to make it absolutely clear—gasoline tax. Assuming it is not triggered, we expect that the impact of the program as a whole will be essentially neutral on the economy, plus or minus a tenth of a percent per year in the real growth of GNP.

Mr. SCHROEDER. By 1981, was that the target year you made reference to?

Mr. NORDHAUS. That was the terminal year of our forecast.

Mr. SCHROEDER. By that date certainly the oil and gas consumption taxes will begin to have substantial effect. I presume by your statement that your feeling is that most, if not all, of any tax credits or rebates to be gained by virtue of qualified investments in coal conversion would keep pace with those tax penalties?

Mr. NORDHAUS. No. In the first place, there are substantial coal conversion taxes in 1981. In fact, that is the major inflationary and contractionary force——

Mr. SCHROEDER. Do you have a rough value for that tax in 1981?

Mr. NORDHAUS. You want that net or gross of the rebate?

Mr. SCHROEDER. Gross.

Mr. NORDHAUS. I can give you net easily; gross will take me a second.

Let me answer the question, and I will give you that in a minute. So there is a significant effect on the rate of price increase from the industrial boiler tax.

I think, however, our assumptions overestimate the inflationary impact in two respects. The first is we did not fold into our forecast any incremental pricing estimates, and, as this committee knows, having studied that in some detail, that can make a whale of a difference in the actual outcome. In fact, a quick calculation would say if $5 billion of those boiler taxes were removed by incremental pricing, that you would reduce the inflationary impact of the oil and gas taxes by 50 percent, and they would have a substantial lower impact on the rate of inflation.

Mr. SCHROEDER. Wouldn't it also, not to interrupt you——

Mr. NORDHAUS. The other conservative consumption was that business did not pass through the rebate fully into the lower prices.

Mr. SCHROEDER. You raise an interesting point. Isn't there a significant interaction between the incremental pricing of natural gas and the efficacy of the coal conversion program, the boiler tax, in that that money which would otherwise be a carrot for industrial conversion instead goes to producers of natural gas?

Mr. NORDHAUS. No, it goes to consumers. In no case does it go to producers.

Mr. SCHROEDER. In incremental pricing, the extra payment that the industrial customer has to make goes to the producer.

Mr. NORDHAUS. That is a very important point. Under the provision of the law, assuming the same quantity of gas flows, what it would mean is that you have the replacement cost of the gas you are now burning is x million dollars higher, that you would pass

that first through to industrial customers, and not through to residential customers, and the total take of producers and distributors of gas would be the same.

Mr. SCHROEDER. I understand that.

Mr. NORDHAUS. You redistribute the cost of the gas.

Mr. SCHROEDER. Let me give you two scenarios. One, no incremental pricing. The oil and gas consumption tax draws up the industrial price to some amount, all of the amount above the natural gas base price, basically stays in a Federal pool that the converting industrial owner can go after.

In the second scenario where the price is, let's say, 75 cents per Mcf higher, the amount of money that can be put into the pool and therefore the amount of money he can go after in the form of the tax rebate is lessened by precisely the amount he has paid incrementally for his natural gas. This incremental payment goes to the producer rather than to the tax pool.

So is there not at least, other goals aside, at least an apparent inconsistency between the goals of the coal conversion program and the effects that superimpose themselves on that program from incremental pricing of natural gas?

Mr. NORDHAUS. You are absolutely right but let me point out two factors that mitigate that. The first is if you look at the actual revenues that are projected for the oil and gas conservation taxes, the rebates that are being projected are slightly more than half of those, and this leaves in the order of $5 billion, say, in 1981, of unused taxes, so to speak, that would flow to the Federal Government. So if you take the hypothetical example of a while back, that incremental pricing actually allocated $5 billion more to industrial and $5 billion less to consumers; then this would say there is none left over, but there is a little bit of a gap there between the revenues and rebates in our estimate.

Secondly, there is a fallback strategy if you started bumping that constraint of having insufficient taxes paid, and that is there is still a 20 percent investment tax credit in addition to the usual depreciation provisions. So obviously there is a tradeoff there, as in most things, but I think the most you could possibly lose is the difference between the 50 and the 20 percent investment tax credit in the worst case scenario.

Mr. SCHROEDER. One final brief question. The oil and gas consumption tax overlaps with the regulatory coal conversion initiatives in the ESECA amendments. Can you give us a sense whether you see any important economic interplay between the regulatory and the tax-incentive double-pronged attack on coal conversion?

Mr. NORDHAUS. I think there are a couple of things. First, the ESECA amendments essentially strengthen ESECA as it now stands to be allowed to use regulatory powers to nudge large users away from oil and gas. I think that is the basic point. And you might ask why do you want to use regulatory sticks in addition to financial carrots? The answer I would give, and I am sure this committee is probably fully aware of the general reason, is that industry has shown a certain reluctance to undertake certain regulatory measures when it did not pay them to do that. They have often found that a day or a year or a decade in court fighting

particular regulations was cheaper than to go along with a regulatory proposal and to convert.

I think those tables that I used in my prepared testimony show if, in fact, we don't have some kind of provision for getting oil and gas prices up and having some kind of rebate or credit for conversion that we are going to find that any regulatory measures to have large users convert are going to be fought tooth and nail. If the economic incentives are there, I think large users will go along. My understanding—I may be wrong—is that the FEA has had power to order utilities to convert, and my understanding is there hasn't been 1 megawatt converted under that law, so I think that is able testimony to the necessity of having carrots as well as sticks in this kind of program.

Mr. SCHROEDER. You have explained why you need the carrot in addition to the stick. But why do you need the stick if you have the carrot?

Mr. NORDHAUS. I think the reason is that in the case of large users there are a few hundred large users that you might want to target, and with those you can look carefully at the environmental aspects of the question, and at the economic questions. Let's take a simple case where on the private economic point of view it might be a very close call between conversion and not conversion, whereas from the social point of view there might be big advantages to having conversion. Management might take the easy route and not do anything. You might want to tip the balance in favor of conversion.

I would trust that the regulatory powers will be sparsely used, but I think they are necessary to make sure that the general thrust of the program to reduce oil and gas consumption in the industrial sector is pursued and effected.

Mr. SCHROEDER. Thank you. And thank you, Mr. Chairman.

Mr. DINGELL. Mr. Nordhaus, we thank you. You have been very patient, and we are grateful to you for your assistance.

The subcommittee will stand adjourned until 1:30.

[Whereupon, at 1:15 p.m., the subcommittee adjourned, to reconvene at 1:30 p.m. this same day.]

[AFTER RECESS]

[The subcommittee reconvened at 1:30 p.m., Hon. John D. Dingell presiding.]

Mr. DINGELL. The subcommittee will come to order. This afternoon, we have Dr. Alice M. Rivlin, Director, of the Congressional Budget Office, accompanied by members of her staff.

Doctor, if you would identify yourself for purposes of the record and your associates at the table, we would be pleased to receive your statement.

STATEMENT OF DR. ALICE M. RIVLIN, DIRECTOR, CONGRESSIONAL BUDGET OFFICE, ACCOMPANIED BY DR. RAYMOND C. SCHEPPACH, ASSISTANT DIRECTOR, NATURAL RESOURCES AND COMMERCE, DR. DAMIAN KULASH, DEPUTY ASSISTANT DIRECTOR, NATURAL RESOURCES AND COMMERCE, AND DR. RICHARD D. MORGENSTERN, PRINCIPAL ANALYST, NATURAL RESOURCES AND COMMERCE

Dr. RIVLIN. Yes, Mr. Chairman. On my right is Dr. Raymond Scheppach, Assistant Director for Natural Resources at the CBO.

On his right is Dr. Scheppach's deputy, Dr. Damian Kulash, and on my left, Dr. Richard Morgenstern, senior economist at the CBO.

Mr. DINGELL. Doctor, we have admired greatly your work over the years, and I want you to know how grateful we are you are with us. We are pleased you are here, and thank you for coming to assist us.

Dr. RIVLIN. Thank you, Mr. Chairman.

We have recently prepared a report on President Carter's energy proposals, which is being released today. Unfortunately, we don't yet have printed copies. They are at the Government Printing Office and should arrive momentarily, but this is a copy of the report. It is not extremely bulky.

Mr. DINGELL. Without objection, that will be inserted in the record.

Dr. RIVLIN. Mr. Chairman, I am happy to be with you today to comment on President Carter's energy proposals. In response to requests from committees in both Houses of Congress, the Congressional Budget Office has begun to examine and evaluate these proposals. Today we are releasing a staff working paper that provides a preliminary analysis of the proposed legislation. More detailed analyses of the President's proposals and alternatives will be made available to the Congress as soon as they can be completed.

Today I would like to touch briefly on five points: (1) the need for an energy plan; (2) the general orientation of the Carter plan; (3) the preliminary results of our analysis of the impact of the President's proposals on energy consumption; (4) the impact of the proposed plan on the economy; and (5) the distributional effects of the plan across households.

THE NEED FOR AN ENERGY PLAN

The need for a national energy plan arises from both immediate and long-run problems. The long-run problem is simply that the growth in consumption of oil and gas exceeds the growth in proven reserves—both domestic and foreign. Before long we will have to shift to new energy sources or face drastic reductions in our standard of living. The more immediate problem is that our imports of oil have increased substantially—from 3.5 to 7.3 million barrels per day between 1970 and 1977. The fact that almost one-half of the oil consumed in the United States is now imported creates national security risks and makes our economy highly vulnerable to outside shocks, especially because the supply and price of oil is largely dictated by an international cartel.

A major reason for the substantial increase in our dependence on imports is the current system of price controls on oil and gas that have kept the domestic price of these fuels artificially below world levels. Over the past 4 years, this regulatory system has served to cushion Americans from the dramatic adjustments in consumption and lifestyles that might otherwise have taken place due to the abrupt quadrupling of world oil prices by the OPEC cartel in 1973-74. It has also tended to encourage energy consumption and discourage the search for and production of new domestic resources—thereby further increasing our dependence on potentially unreliable foreign suppliers.

To reduce import dependence the President has proposed three major strategies:

Reduce the long-term growth in energy demand by imposing various excise taxes that would serve to raise the price of petroleum and related products to world or near-world levels. New regulatory standards are also proposed and special efforts are taken to reduce the growth in demand for gasoline.

Increase large industries' and utilities' use of coal instead of oil or natural gas by taxing their use of oil and natural gas. Regulations are designed to prohibit most new industrial and utility use of oil and natural gas.

Increase domestic supplies by reintroducing market pricing, or near-market pricing, for truly new energy supplies. Accelerated development of new energy sources, however, is not stressed.

In evaluating these overall strategies and the goals of the President's program, it is important to keep in mind several points. First, an important theme of the proposed program is that the transition to a less energy intensive economy is a long and complex process. Incentives established now to alter consumption and investment decisions regarding energy use will begin to yield significant savings within the next few years. But large-scale savings will not show up until the middle of the next decade and beyond. Of critical importance is the fact that most of the costs of such a program will be paid between now and 1985, while most of the benefits will occur beyond 1985.

A second major point is that the goals and energy savings incorporated in the National Energy Plan may not be fully achieved by the National Energy Act as introduced. While the administration hopes that the act will attain the stated goals, it recognizes that the hope may not be realized and that additional legislation or regulations will be required. Indeed, the administration seems to be viewing the energy plan in two steps, that is, this initiative and then more severe measures if this legislation does not reach the specified goals. Many of these more severe measures are included in the plan, but are not incorporated into the act.

The size of this potential gap between the energy savings of the plan and the act would depend significantly on a number of additional regulatory decisions, such as exemptions from mandatory coal conversion, over which the administration would have control. Strict enforcement would increase the likelihood of attaining the goals. Consequently, the commitment of the Administration to the goals is critical in determining the efficacy of the overall plan.

Finally, the President's proposals are highly interdependent. To a large degree, there is a "carrot and stick" philosophy. For example, the tax credits given to industry to encourage investments would be made more effective by the increase in petroleum and natural gas prices. Either of these two proposals independently might yield only marginal energy savings, but combined, the effect might be substantial.

CONCLUSIONS OF THE CBO STUDY

The CBO analyses to date have concentrated on five major sets of proposals in the administration's plan: Pricing of crude oil; pricing of natural gas; conversion to coal; automobile-related proposals; and tax credits for home insulation and solar heating equipment.

The administration estimates that altogether, these proposals would achieve a reduction in oil imports of approximately 3.2 million barrels a day by 1985. The analysis conducted by the Congressional Budget Office, however, indicates that this estimate of the savings is over-optimistic and that the proposals would save closer to 2.3 million barrels a day. About 0.6 of the 0.9-million-barrel discrepancy is due to different estimates on the coal conversion potential, while the remaining difference results from different estimates from the home insulation and solar equipment tax credits. The administration asserts that an additional savings of 1.3 million barrels a day (over and above the savings from the five main proposals) can be expected to result from various proposals such as new building standards; these have not been analyzed by CBO. On the assumption that these unanalyzed savings will be realized, however, the total oil import savings achieved by the administration's plan are estimated by CBO to be about 3.6 million barrels a day, rather than the administration's estimated 4.5 million barrels. The administration's plan leaves open the possibility of future measures not included in the present proposed legislation that could help close this gap.

CRUDE OIL PRICING

The administration's plan would retain controls on prices received by domestic oil producers, but it would allow the controlled price of newly discovered oil to rise over 3 years to the 1977 world price with subsequent adjustments for domestic inflation. This price would offer substantial incentives to increase production of domestic oil, but actual increases in production are likely to be relatively small. CBO estimates that the rise in price for newly discovered oil would increase production by about 100,000 barrels a day by 1985; the administration's estimate of increased production is slightly higher.

To discourage consumption of oil, the plan would raise prices paid by domestic consumers to world levels by imposing a "crude oil equalization tax" equal to the difference between world and domestic prices. This tax would capture for the public the windfall profits associated with higher prices on already discovered oil and would return those profits to consumers in the form of rebates.

The equalization tax on crude oil would increase the price of petroleum products by an estimated 4 to 5 cents per gallon (in current dollars) by 1980; this amount is in addition to the increase of 4 to 5 cents per gallon projected under existing legislation. The tax would also lead to the elimination of the so-called "entitlements program," and would thereby reduce some of the regulatory burden on the industry. The equalization tax appears to be an effective mechanism for equalizing foreign and domestic oil prices and capturing windfall profits. It would provide a slight incentive for consumers to reduce consumption or convert to alternative sources. Proposed user taxes on oil provide additional incentives for industry and utilities to convert to coal.

NATURAL GAS PRICING

The pricing proposal for natural gas eliminates the current distinction between interstate and intrastate markets by placing all gas under Federal jurisdiction; it places a cap on the price of new

gas at $1.75 per 1,000 cubic feet. In addition, a special excise tax is placed on use of natural gas by industries and public utilities. The purpose of these proposals is three-fold:

To protect residential consumers against high prices and shortages; to make gas expensive for industries that can convert to coal; and to increase new supplies but reduce the possibilities of producers gaining excessive profits on previously discovered gas.

With the exception of the extent of coal conversion by industry, CBO finds that the natural gas proposals are likely to attain the stated objectives. The proposals would generally reallocate the existing supplies of natural gas; no energy savings would therefore be attributable to this proposal according to either the administration or our analyses.

COAL CONVERSION

Since the goal for conversion of utilities from oil and gas to coal is generally consistent with current trends, CBO concurs with the administration's conversion estimates in this area. A major discrepancy exists, however, in estimates of the likelihood of attaining the goal for industrial conversion. If present policy were continued to 1985, only 12 percent of new industrial demand would burn coal. The President's plan envisions that industrial consumption of coal would more than double by 1985. Accomplishing the administration's goal would require that 10 percent of all existing oil and gas used for industry be converted to coal and that 44 percent of all new potential users would convert to coal. The CBO analysis agrees with the President's 10-percent conversion of existing industrial use but projects only 33 percent of new uses to be converted to coal. The reasons for this lower estimate include the logistics of transporting coal, concerns about protecting the environment, and problems of scheduling new coal facilities to maximize the benefits of rebates, all of which will impede new conversion. This would result in total coal consumption by industry of 360 million tons by 1985—50 million tons below the administration's estimate.

In terms of equivalents in barrels of crude oil, CBO's estimate translates into a savings in imported oil of 1.8 million barrels a day, which is 0.67 million below the administration's figure. To some extent, however, the attainment of the goal would depend upon the future actions of the administration, since it could control both the specification of coal regulations and their subsequent enforcement.

AUTOMOBILE-RELATED PROPOSALS

The automobile-related provisions of the President's energy package are aimed at reducing gasoline consumption through production and sales of vehicles with greater fuel efficiencies, and through price-induced reductions in the number of miles driven. The goal of the plan is to reduce total gasoline consumption by 10 percent from current levels by 1985. This is an ambitious goal, considering that motor gasoline consumption has increased 4.5 percent per year between 1965 and 1975, but its attainment would be aided substantially by existing legislation. In particular, the Energy Policy and Conservation Act of 1975 set fuel economy standards for new cars under the threat of civil penalties. While CBO does not expect these standards to be met in every year, it does anticipate that they would have significant effects on automobile gasoline use. In 1985,

these standards would hold consumption within 1 percent of the present level. CBO estimates that adoption of the President's plan would reduce automotive gasoline consumption further, but to 5 percent beneath its present level, not 10 percent below, which is the goal of the administration.

Three programs in the President's plan contribute to gasoline savings. More than half of the savings come from the President's proposed "gas-guzzler" taxes and rebates based upon a new car fuel economy. This program is estimated to yield fuel savings of 215,000 barrels a day in 1985. Second, the standby gasoline tax could be triggered as early as 1982 according to CBO projections, and assuming that it is triggered then, it would produce gasoline savings of 65,000 barrels per day in 1985. Finally, the crude oil equalization tax is expected to contribute an additional 25,000 barrels a day of gasoline savings in 1985. Taken together, these three programs would yield total gasoline savings of 305,000 barrels a day in 1985, less than a tenth of the energy savings produced by the President's plan as a whole.

CBO's estimate of the fuel savings for the gas-guzzler excise tax and rebate program is slightly higher than the administration's, and the administration has not yet computed comparable estimates for the standby gasoline tax and crude oil equalization tax. The administration has indicated, however, that without the standby gasoline tax, 1985 gasoline consumption would be 350,000 barrels per day above target. While CBO expects that 1985 gas consumption would most likely exceed the target by more than this, the excess above target in both sets of projections is greater than the estimated 65,000-barrel savings of the standby gasoline tax, implying that the President's goal of a 10 percent gasoline reduction by 1985 appears unlikely.

Future gasoline consumption by trucks introduces considerable uncertainty as to whether or when the President's goal would be met. At present, trucks account for more than 20 percent of the Nation's gasoline consumption, and their future share of gasoline use could rise if their fuel economy improvement does not keep pace with that of autos. The fuel economy of light trucks is expected to improve as a result of existing legislation as well as through the President's gas-guzzler proposal as it would apply to light trucks. But both existing and proposed legislation in this area are keyed to a set of standards that have not yet been specified, so that assessment of their conservation impact is impossible at this stage. CBO analysis indicates that these future developments in the fuel economy of trucks would have a major effect on the triggering of the standby gasoline tax and could delay it from 1982, as projected above, to 1983 or 1984. Policies related to trucks play a key role in shaping an effective and even-handed policy for transportation fuel conservation.

INSULATION TAX CREDIT

The proposed insulation tax credit is likely to encourage some additional homeowners to upgrade the insulation in their homes. With sharp rises in fuel prices since 1973, however, many homeowners have already reinsulated or have decided to do so in the future. For example, about 3 million homeowners chose to

upgrade their insulation in 1976. With current energy prices, insulation is already a good investment since the savings in fuel bills average about three times the cost of the insulation. The proposed credit would increase this ratio of savings to cost to four to one.

Between now and 1985, an estimated 24 million homeowners and renters are likely to reinsulate their dwellings. CBO estimates that nearly 8 million of the 24 million would be attributable to the tax credit. The 24 million translates into a total of 70 percent of all residential homeowners as opposed to the 90 percent projected by the President. CBO estimates the energy savings attributable to these nearly 8 million households would be approximately 120,000 barrels of oil a day.

The administration, on the other hand, estimates that a savings of 480,000 barrels would be due to the credit and related programs. The major difference is that CBO estimates that an additional 280,000 barrels a day will be saved by reinsulation that people would do anyway without the Carter plan, adding up to a total of 400,000 barrels per day from all insulation. The administration assumes that a total of 480,000 barrels a day savings would be induced by the plan.

SHORT-RUN IMPACTS ON THE ECONOMY

President Carter's package would have a major impact on energy markets, a noticeable but small impact on the overall rate of inflation, and only a minor impact on total output and employment. CBO estimates that the President's plan would add about 1.6 percent of the level of consumer prices by 1980 or about half a percentage point a year to the rate of inflation from 1978 through 1980. The output effect is estimated to reduce constant dollar Gross National Product by no more than 0.7 percent by the end of 1980, thus adding 0.2 percent to the unemployment rate. These estimates do, however, assume that there will be no new investment for conversion during the next 2 years. The total impacts on unemployment and real growth could therefore be partially offset if additional investment is forthcoming.

DISTRIBUTION EFFECTS

A final issue I would like to address is the combined impact that the energy proposals and tax rebates would have on consumers. Assuming that the crude equalization and natural gas and oil excise taxes are passed on almost entirely to consumers, approximately $15 billion will be paid in 1980 (in 1977 price levels) in terms of higher energy prices, and this will increase to about $25 billion in 1985. While the rebate provisions of the President's plan would refund almost all of these additional energy payments back to the American people, the energy proposals will generally redistribute purchasing power from persons at upper income levels to persons at lower levels of income. Other transfers are likely to take place. For example, nonautomobile owners stand to gain at the expense of automobile owners. Homeowners would gain at the expense of renters, and persons living in cities with access to public transportation would gain at the expense of persons in suburbs and rural areas.

Thank you, Mr. Chairman.

Mr. DINGELL. Doctor, yours is a most impressive statement for which the committee thanks you.

At this time the Chair recognizes my colleague from Michigan, Mr. Stockman.

Mr. STOCKMAN. Dr. Rivlin, I highly regard your economic expertise and the work that you do at the CBO. Therefore, I would like you to comment as an economist on a couple of things that I find in the overall plan that really do not seem very consistent or that do not seem to have a very solid economic rationale.

The one that pops out first is the reference price for new natural gas and new petroleum or oil. The reference price for natural gas is tied to the refiner's acquisition cost for domestic crude, which includes the various tiers and so, therefore, is going to be about $10 a barrel now, but the reference price for new oil after a 3-year phase-in is going to be the world price adjusted for inflation, and so what you have is a premium fuel, natural gas referenced to a lower price than new oil, although the definitions for both are the same, 2-1/2 miles from existing wells, 1,000 feet below a current producing zone.

Since natural gas is a relatively more valuable commodity or fuel because it costs less to burn and you don't have all of the associated costs, what real sense does it make to have this differentiation in the reference price, particularly with the downward bias in the case of natural gas? On any reasonable economic basis you would probably do it the other way if you were going to do that.

Dr. RIVLIN. I think the basic rationale is: There is a world price of oil that can be fairly easily determined, and this price is the real cost to the American economy of importing oil. Natural gas is a little different. The supply factors are a little different, and if the price were allowed to rise to something close to its natural price, whatever that is——

Mr. STOCKMAN. I am not necessarily saying its natural price, but it is tied to the controlled domestic acquisition cost, which is much lower than the incremental supply, alternative supply. If you can't get natural gas, you might use fuel oil and that is going to be tied to the world price, but I don't really see the rationale for using two different reference prices for the new oil and for the new gas when in terms of the field level activity, they are defined exactly the same.

Dr. RIVLIN. Let me ask some of my colleagues to comment on that.

Ray, would you like to, or Dr. Morgenstern?

Dr. MORGENSTERN. I agree with Dr. Rivlin's statement that essentially there is a well-defined market in the case of oil. In the case of gas, of course, it is a different situation. I think there is some fear that were gas prices to have either no cap or a much higher cap, there would be very little pressure to keep them down, that is, to keep them away from what might be $4 or $5 per thousand cubic feet. This is because of the long-term contracts for gas and the nature of rolling in prices. I think that would be the justification.

Mr. STOCKMAN. What I am saying is if you tied the cap that they are proposing to the world price for oil, like you are doing with new oil, instead of $1.79 it would probably be in the range of $2.05, $2.10,

or $2.15 and I can't really see the rationale for the distinction, but since apparently we don't agree, or we don't see the point, maybe we will go on to another question.

Dr. MORGENSTERN. There is one final point, namely, that, of course, the cap is permitted to rise over time.

Mr. STOCKMAN. Both of them rise with domestic inflation, so once the initial level of the cap is set on the basis of this reference price, since they would both be allowed to rise with domestic inflation, that differentiation would be maintained but this leads to the second question.

In the case of natural gas the alternative supply for those end users who do not have the flexibility, at least in the medium term, to go directly to coal combustion, the alternative supply to conventionally produced natural gas is either going to be synthetic gas at $4 a million Btu's, or LNG at $4 to $5 or coal, gasified coal, that will come in at $3 to $6 depending on whether it is high Btu or low Btu and so forth or Canadian imports that are certainly going to be in the range of $2 to $3 or even more.

Now what sense does it make to charge the economy anywhere from $3 to $6 for these alternative or supplemental supplies when we are unwilling to allow the economy to pay more than $1.79 for conventionally produced gas, because, it seems to me, that unless you have that flexibility, which I don't think you have, and I don't think it has been demonstrated in the hearings, to go off gas over the next 10 years and immediately to direct coal combustion what is really going to happen in the economy is that you are going to go off conventionally produced gas and to high cost methane that would be in costs way above what anyone would suspect the uncontrolled or decontrolled price of natural gas to go. I can't see the economic logic in it but maybe you can see something that I don't.

Dr. MORGENSTERN. I believe the reason that would be consistent with our view is that the supply response resulting from higher domestic prices is expected to be rather small.

Mr. STOCKMAN. But for every increment you produced if you got it at $2.50 per thousand cubic feet that is a lower total cost to the economy than the increment that would be produced at $4 in the synthetic plant. I fail to see why it is bad to pay $2.50 for that incremental supply produced conventionally when it is all right to pay $4 for the alternative.

Dr. RIVLIN. I think possibly these are questions that would be well addressed to Mr. Schlesinger, if you haven't so addressed them already. There is really a different view of what is going on in gas, I think, from what is going on in oil; in oil it is appropriate to use the free market, and in gas there is an objective of protecting the residential user and of using regulation and nonprice methods over time to phase out other uses. This may explain part of what seems to be superficial noneconomics.

Mr. STOCKMAN. You were talking about the equity impacts, and there may be some transfers from rural residents to urban and from auto drivers to nonauto drivers and so forth, but what about the household sector, where you have maybe 40 million are on natural gas and we are going to preserve for them a cheap supply for the next 10 or 15 years because of the incremental pricing

provisions and because of the reallocation of gas to the household sector from industry. But then you have another 20- or 30 million who are either on electric heat or who are on fuel oil which is going to cost two to five times more.

Mr. DINGELL. The time of the gentleman has expired.

Mr. STOCKMAN. It seems to me there are serious equity problems there.

Mr. DINGELL. You may respond to the question, Doctor.

Dr. RIVLIN. Well, there may be some equity problems here. I am not quite sure that we guarantee equity among all household uses, depending on what one started with in heating a house. The cost for a household of changing over is very considerable.

Ray?

Dr. SCHEPPACH. Households are protected too because taxes on home fuel heating are rebated directly to the distributor and thus do not show up as higher price there. Even on electricity, I think they are attempting to switch the rate regulations so that large consumers do not benefit at the expense of small consumers of electricity. In sum, I think there are several things in the plan which attempt to isolate the household from the price increases.

Mr. DINGELL. The time of the gentleman has expired.

Doctor, you said at page 3 of your statement "This potential gap between the energy savings of the plan and the act depend significantly on a number of additional regulatory decisions" and then you cited exceptions for mandatory coal conversion over which the administration would have control.

Would you amplify on that, not at this time, but for the record, if you please?

Dr. RIVLIN. Certainly, Mr. Chairman. [See pp. 39-51 of CBO report.]

Mr. DINGELL. You stated, I think, in your very excelllent study at the bottom of page 4, that "The Administration estimates that altogether, these proposals would achieve a reduction in oil imports of approximately 3.2 million barrels a day by 1985."

Then you indicated that the savings you felt were over optimistic, and that the savings would be closer to 2.3 million barrels a day.

Could you, first of all, tell us why, and, second of all, indicate to us what you meant when you said below, that 0.6 of the 0.9 million barrel discrepancy is due to different estimates of the coal conversion potential while the remaining discrepancy results from different estimates of home insulation and equipment tax credits?

Can you tell us what those assumptions are, please? First, why the difference in your estimates, and, second, what are the differences in your assumptions? If you wish, you may submit those for the record.

Dr. RIVLIN. We could do it either way, but we would be happy to submit those for the record. The reasoning is amplified in the report itself.

Mr. DINGELL. You might just indicate the reasoning to us at this time, because I think it would be helpful to us to have that, and then you can amplify on it if you please.

Dr. RIVLIN. The major differences, as we said, are with respect to industrial uses of coal and the effect of the home insulation credit.

With respect to industrial use of coal, which accounts for a major part of the savings that the administration claims the plan would generate, the administration is assuming that 44 percent of new industrial uses of fuel would be coal. Under present policy it would only be about 12 percent.

We think that getting to 44 percent is extremely optimistic and that only about a third would actually be new uses of coal.

Mr. DINGELL. Can you advise me why you make the assumption that the coal conversion estimates of the administration are optimistic?

Dr. RIVLIN. A variety of factors, Mr. Chairman.

Mr. DINGELL. Environmental?

Dr. RIVLIN. One of them would be environmental. Another would be the problems of transporting coal to factories. Another would be the nature of the tax and rebate system itself, which does provide an incentive for those who are converting to stretch out their conversion over a period of time; this means that the full effects probably wouldn't be seen until after 1985. Indeed if one looks beyond 1985 to, say, 1990, then we think that the administration's estimates are more realistic.

Mr. DINGELL. Doctor, in other words, you are saying they move their effective period forward.

Dr. RIVLIN. Yes. It is closer than we feel is realistic.

Mr. DINGELL. You indicated that you had not, at the top of page 5, analyzed the savings which could result from the various proposals such as new buiding standards. I recognize we are asking you to do a great deal for us. Can you give us whatever tentative analysis you can give us with regard to these points, please, not at this time but if you can for the record?

Dr. RIVLIN. Yes. We will be working on some of the other proposals in the plan to the extent that we are able to. The plan has a large number of different proposals—about 100 of them—and we will endeavor to look at as many of them as we can before the Congress is forced to make its decision. [See pp. XIII-XXI of CBO report.]

Mr. DINGELL. You indicated that you thought the total oil import savings to be achieved by the administration's plan are estimated by CBO to be 3.6 million instead of 4.5 million.

Can you indicate to us for the record why you make that statement, and what is the breakdown of those figures? You don't need to do it now, Doctor, but just for the record.

Then you said the administration's plan leaves open the possibility of future measures which could close the gap and which are not included in the present proposed legislation.

Could you indicate to us at this time what you feel these to be, please?

Dr. RIVLIN. They would probably be regulatory devices designed to hasten coal conversion, for instance, or to improve the effectiveness of home insulation. The possibility of a transfer regulation on homes is one that has been talked about and and that I believe is alluded to in the President's proposal; namely if the tax credit on home insulation doesn't do the trick, that is, if it does not bring the reinsulation of existing housing stock up to 90 percent, another

possibility would be a regulation that no one could sell his house unless it had been reinsulated. That is an example of the kinds of things that are possible.

Mr. DINGELL. You have indicated a little later on the page that CBO estimates that the price rise for newly discovered oil would increase production by 100,000 barrels a day by 1985. "The administration estimate of increased production is slightly higher." Could you tell us, do you find any significant differences between the two elements?

Dr. RIVLIN. No, I don't think they are very important. Nobody thinks that it is going to be a huge increase.

Mr. DINGELL. On page 9, you said that the gas guzzler tax would save 215,000 barrels of petroleum per day in 1985. How would this figure change, if you assume that the current standards in EPCA would be met?

Dr. RIVLIN. Let me see if Dr. Morgenstern can answer that one.

Dr. MORGENSTERN. I think I will defer to Dr. Kulash.

Dr. KULASH. We didn't analyze that case in particular, but I think we could predict that the savings would be less than 215,000 barrels per day. The cost of making fuel economy improvements tends to increase as more and more of these improvements are incorporated into vehicles. Thus, if the current standards were met or some other incentives were established to insure their being met by 1985, continuing to achieve further improvements through economic incentives applied to manufacturers would get harder. So our estimate would come down from 215 to some lower number; we haven't worked out what the lower number would be.

Mr. DINGELL. Could you tell us what that lower number is, please, sir?

Dr. KULASH. We haven't analyzed that case.

Mr. DINGELL. Isn't your statement on this point based on the fact that you don't believe EPCA standards could be met?

Dr. RIVLIN. Yes, that is right. We are assuming they will not be fully met by 1985 without additional measures.

Mr. DINGELL. Can you tell me why not? How do you come to this assumption?

Dr. RIVLIN. Well, just analyzing what is happening, it seemed unlikely that they would be met, but perhaps Dr. Kulash would like to amplify that.

Dr. KULASH. There are two major reasons why we don't think they will be met. The first one is that our projection of the cost of improving fuel economy to the degree called for in the standards is so prohibitive that it would simply be more economical for the manufacturers to pay the penalties than to try to improve vehicles up to that point.

Mr. DINGELL. You are aware of what the level of the penalty is, aren't you?

Dr. RIVLIN. Yes.

Mr. DINGELL. $50 a car, isn't it?

Dr. RIVLIN. Before taxes, and it is, of course, even greater if you look at it in terms of the after tax effect.

Mr. DINGELL. $50 per mile per car?

Dr. RIVLIN. Yes.

The second reason, which is closely tied to that, is that we do not foresee a major shift in purchasing patterns by consumers toward smaller vehicles either as a function of the current law or as a function of the provisions in the Carter package. As a result, the saving has to come almost entirely out of technological improvements. There is very little change in market composition, in terms of the types of vehicles sold, that aids the manufacturers in meeting that goal. I think our projections differ from some others in that respect.

Mr. DINGELL. I find myself hard put to see how an automobile firm would be delighted to pay $50 additional on its automobile. Maybe you can explain that to me. That is a subtlety of economics and finance that escapes me, I must tell you.

Dr. KULASH. Under the provisions of the Carter package, we project that there will be somwhere between $400 and $600 of additional machining that goes into each vehicle in order to produce more fuel efficient vehicles than would be produced otherwise. The $50—or looked at after taxes, approximately $100—effect per mile per gallon is of the same order of magnitude, and there are tradeoffs that the manufacturers face between adding more fuel economy, which costs more than $100 per mpg to produce, or simply paying the penalties, which you know peak out at $100.

Mr. DINGELL. As I understand it, the tax is on the manufacturer, is it not?

Dr. KULASH. Under the Carter——

Mr. DINGELL. Under the Carter proposal, yes.

Dr. KULASH. It is paid by the manufacturer.

Mr. DINGELL. Paid by the manufacturer. The manufacturer also gets a rebate, does he not?

Dr. KULASH. Yes.

Mr. DINGELL. How does this impel him to assess it, given the freedom he has to price his automobiles against any particular class of consumers who might purchase a particular category of automobile?

Dr. KULASH. As far as I know, there is no provision in the law that compels him to change his prices in such a way as to avoid having these payments.

Mr. DINGELL. Let's just take a well known manufacturer, General Motors, which manufactures both Cadillacs and Vegas. They are taxed on the Cadillacs. Let's assume that the Cadillac doesn't meet the test. They get rebates on the Vegas. Let's assume that the Vega does meet the test. What is the assurance that, given the pricing freedom that the manufacturer has under that bill, that he would necessarily assess the tax against the Cadillac and give the rebate to the Vega and not do the other way around, if he has got a whole lot of Vegas sitting on his lots?

Dr. KULASH. There is no legal assurance in the bill. The only incentive in that direction is the economic one: That manufacturers who produce fewer of the Cadillac-type vehicles would not have the penalties, which they have to write off, and that the rebates would be passed through on all or a greater percent of their products. Thus a firm like GM would have to compete with a manufacturer that produced a greater proportion of fuel efficient cars.

Mr. DINGELL. Would I be fair in assuming that this is not an assumption that you would regard as being cast in rock or constructed of armor plate?

Dr. KULASH. Which assumption, Mr. Chairman?

Mr. DINGELL. The one that we are now discussing, that you are making, with regard to the tax and rebate as to how the manufacturer would follow it?

Dr. KULASH. I believe that there is a considerable uncertainty as to exactly how they would pass this through.

Mr. DINGELL. Thank you.

The time of the Chair has expired.

The Chair recognizes the gentleman from Indiana, Mr. Sharp.

Mr. SHARP. Thank you, Mr. Chairman.

I will be brief. I unfortunately missed the first part of the presentation here, and I just wondered if CBO has done any work on other options on natural gas, either deregulation, some version on new natural gas, or other caps.

Do you have a different analysis of the impact on that for producers or for production or for the cost to consumers?

Dr. RIVLIN. We have not looked explicitly at other proposals, though we have some idea of the direction in which they would take us.

Mr. SHARP. But you wouldn't have judgments independent of those we get from FEA, FPC, and the administration?

Dr. RIVLIN. No. If there were a specific set of alternatives that you would want us to examine, we might be able to give you some judgment.

Mr. SHARP. I did have a question though I can't think of it at the moment, Mr. Chairman, on the automobile thing.

I yield back my time.

Mr. DINGELL. Does the gentleman from Michigan have further questions?

Mr. STOCKMAN. I want to follow up on the question that the chairman opened up on the fuel economy standards. I direct this to the CBO's fuel economy plan. We have discussed the rule of essential equivalency, that is, as we try to close the gap between supply and demand in the 1980's it is whether we do it on production side or conservation side or whether we try to conserve in one sector of the economy or another will depend on the cost of doing it, the real cost to the economy of doing it. What that means is that if it is going to cost $30 or $35 per barrel to save one more mile per gallon as you get up the ladder, maybe that isn't a very sensible thing to do.

What I am asking, I guess, is has anyone really done any detailed analysis on the marginal costs for increasing fuel economy on cars? Common sense would tell you when you go from 18 to 19 miles a gallon it is probably pretty cheap to do that in terms of additional capital costs on the car. When you go from 25 to 26 it is going to become more expensive, but how about when you get up into the upper 20s and the 30-mile range, in terms of constant carrying capacity and load space and that sort of thing? Do you have any information on that or is work being done that might be useful to the Congress as we look at the various places that we can get conservation and at what cost?

Dr. KULASH. There has been a lot of work done on which specific technological changes to cars could be made and estimates of what various devices or alterations, made on a change-by-change basis would bring about in terms of improved fuel economy.

Our own projections are based on one synthesis of this kind of literature, which was done for us—actually for the Federal Energy Administration—by an engineering firm that attempted to go through and look at four different vehicle-size classes at different points in the future. The examination was made under various assumptions about environmental regulations and safety regulations. It tried to narrow down some of the very disparate estimates in the literature.

I know of this one study, but I really do not know of any more recent ones that have attempted to synthesize all the various possibilities and try to see how much additional fuel economy an additional $50 or $100 would buy.

Dr. RIVLIN. That synthesis does confirm the Congressman's common sense. However, it gets more expensive as you go along.

Mr. STOCKMAN. The reason I asked that, as you indicated, you felt unless we go to some very coercive tactics or strategies in terms of telling consumers what they have to buy, the structure of market demand is not likely to change very much, and therefore you indicated that any fuel economy gains are going to have to come from technological improvements and basically capital substitution.

If that is the case, it seems to me that we need to have some information as to what the cost of that capital substitution or technological improvement is going to be and, if it is prohibitive, then you might have to think about more coercive strategies in terms of vehicle miles that can be driven and the kinds of cars that people can buy, which I do not think this Congress is in any mood to consider at the moment.

We ought to know that that is one of the more drastic actions that we might be facing, if this first-round plan is not as successful or as effective as expected and, as you have indicated today, in your own opinion it probably will not be.

Dr. KULASH. One estimate that we have not made—but could furnish for the record—would be to look at the total of an additional investment in the auto manufacturing industry, which would be stimulated by this provision in the Carter package. It would be possible to compare the results to the net fuel savings produced by that same provision.

Mr. STOCKMAN. Have you done any work on net fuel savings by moving away from the engine in the automobile and looking at vehicle miles?

I did one rough calculation which indicated if you had a 1 percent vehicle mile growth rate in the 1980's as opposed to a 3 percent growth rate, which is about the historical average, the net difference in annual consumption by 1990 would be 880,000 barrels, which is far more than we are talking about with any of the measures that are included in the plan.

The only thing I do not know is how you get from 3 percent to 1 percent in terms of what it requires of people.

Dr. KULASH. Under our projections, continuing growth in the vehicle miles of travel shows up, and also a substantial increase in the vehicle miles of travel per household. The latter is partly due to the fact that, even under the provisions of the Carter plan together with the fuel economy expected under existing legislation, we anticipate that the cost per mile of fueling a car will fall in the future. It would fall fairly substantially under the EPCA provisions and somewhat less under the Carter plan, but in either case, we expect the average miles traveled per household to rise from about 15,000 miles per year as it now is to about 17,000 miles per year under the Carter plan in 1985. This figure is in contrast to about 18,000 miles per year projected under the EPCA alone.

Mr. DINGELL. The time of the gentleman has expired.

The Chair recognizes the gentleman from Indiana, Mr. Sharp.

The Chair recognizes the gentleman from Pennsylvania, Mr. Walgren.

Mr. WALGREN. No questions, Mr. Chairman.

Mr. DINGELL. Doctor, in your statement you said:

> A major discrepancy exists, however, in estimates of the likelihood of attaining the goal for industrial conversion. If present policy were continued to 1985, only 12 percent of new industrial demand would burn coal. The President's plan envisions that industrial consumption of coal would more than double by 1985.

Could you indicate, not now but for the record, why you make that statement, please?

Dr. RIVLIN. Yes, Mr. Chairman. [See pp. 39-51 of CBO report.]

Mr. DINGELL. A little later on page 7 you said the following:

> The CBO analysis agrees with the President's 10 percent conversion of existing industrial use but projects only 33 percent of new use to be converted for coal.

Then you go on to say:

> The reasons for this lower estimate include the logistics of transporting coal, concerns about protecting the environment, and problems of scheduling new coal facilities to maximize the benefits of rebates, all of which impede new conversion.

These are points that are of much concern to the committee and if you could give us a rather clear and concise statement as to each of these, it would be much appreciated, and also describing the reasons for the lower estimate. You can do that for the record.

Dr. RIVLIN. We will certainly try to do that, Mr. Chairman. [See pp. 39-51 of CBO report.]

Mr. DINGELL. You said on page 8, I thought it was an excellent point:

> To some extent, however, the attainment of the goal would depend upon the future actions of the administration since it could control both the specification of coal regulations and their subsequent enforcement.

Would you amplify on that for the record, please?

Dr. RIVLIN. Yes. [See pp. 39-51 of CBO report.]

Mr. DINGELL. Then you went on, and we discussed this, but you said:

> While CBO does not expect thse standards to be met in every year, it does anticipate that they would have significant effects on automobile gasoline use,

referring to the automobile efficiency, and at page 9 at the top you went on to say:

CBO estimates that adoption of the President's plan would reduce automotive gasoline consumption further, but to 5 percent beneath its present level, not 10 percent below, which is the goal of the admiistration.

For the record, when you find time, would you give us the explanation on that particular point if you please. [See pp. 61-67 of CBO report.]

Mr. DINGELL. You said a little further down at page 9:

Standby gasoline tax could be triggered as early as 1982 according to CBO projections, and assuming that it is triggered then, it would produce gasoline savings of 65,000 barrels per day in 1985.

Could you submit for the record why you feel that the gasoline tax could be triggered at that point, and give us also, if you please, a statement as to why you assumed it would produce gasoline savings in the order of 65,000 barrels a day? That again, Doctor, for the record. [See pp. 61-67 of CBO report.]

Mr. DINGELL. Continuing at the top of page 10, you discussed 1985 gas consumption, which would likely exceed the 350,000 barrels per day target by more than this.

Could you submit the date for the assumptions that went into that paragraph and the paragraph at the bottom of the prior page? [See pp. 61-67 of CBO report.]

Mr. DINGELL. At the middle of page 10 you state:

The fuel economy of light trucks is expected to improve as a result of existing legislation as well as through the President's gas-guzzler proposal as it would apply to light trucks.

This brings to mind two questions.

One, you have indicated a lack of adequate faith in the requirements of EPCA, and the question I would like to ask is, do you have some suggestions for us as to how we can tighten those standards to assure that the goals of EPCA are met in an appropriate fashion?

Could you do that for us, please, Doctor?

Mr. SHARP. Will you yield?

Mr. DINGELL. Yes, I will be glad to yield to my friend.

Mr. SHARP. I wonder if the gentleman dealing with the automobile section would be able to provide us perhaps even now an indication of what civil penalties would be necessary to begin to make it economically—so they would not engage in a trade-off of accepting the penalty rather than making the improvement. There is the possibility that that is where the adjustment needs to be made, or there are other possibilities.

Dr. RIVLIN. That is an amplification of the chairman's basic question.

Mr. DINGELL. That is a concern of mine. I am not lightly disposed to pass laws that are going to be ignored by anybody. That is not our function up here.

You discussed the question of trucks, both with regard to light duty trucks, and also with regard to heavy trucks. Could you give us some suggestions about how this could be tightened up?

Your statement indicates to us that the question of gasoline and diesel consumption by trucks may be a substantial problem, and may not be addressed in either EPCA or in the administration bill which we are considering.

If you could give us that statement it would be helpful.

Dr. RIVLIN. For light trucks, Mr. Chairman, we do not yet have any standards. It would be a question of tightening up somewhat.

Mr. DINGELL. You are suggesting then we ought to get hold of the Department of Transportation and inquire why they rest so lightly by their duties.

Dr. RIVLIN. I think that is a possibility.

Mr. DINGELL. That will be done.

You referred at page 11 here, you said:

> Between now and 1985, an estimated 24 million homeowners and renters are likely to reinsulate their dwellings.

Then you went on and made a number of estimates. Would you submit to us the data for the assumptions that went into that? I think those would be most helpful to the committee. [See pp. 84-89 of CBO report.]

Mr. DINGELL. You discussed distribution effects on page 12. The last paragraph, I thought, was extremely useful. Can you describe for us the level of taxes and rebates on a year-by-year basis with regard to this matter?

We have had a great controversy as to how much would be extracted in taxes under the administration's, different tax proposals and how much would be rebated to the consumers. I think it would be very helpful if you told us your beliefs on this matter as best you might at this particular time, with possibly a later amplification for the record.

Dr. RIVLIN. On a year-by-year basis, yes, I think we can do that, or maybe Dr. Morgenstern would like to talk to that right now. We can amplify later.

Dr. MORGENSTERN. Yes, Mr. Chairman. I am referring to page 130 of our report just published.

What we have done here for the 2 years 1980 and 1985 is, we have broken out the net gain or loss stated in real terms for various quintiles of the income distribution. What we find is that for 1980, the bottom two quintiles are net gainers as a result of the higher prices and of the rebates. The middle quintile breaks even, and the top two quintiles respectively lose .1 percent and .4 percent of real income.

For 1985 the situation is similar. For that year the losses begin at a slightly lower level than the income distribution, and we find that the bottom two quintiles gain and the upper three quintiles lose, moving up to a maximum of 0.6 percent of income for the upper quintile.

Mr. DINGELL. Could you give us that figure?

We have heard figures as high as $100 billion coming out of the economy, and $50 going back. I just recall hearing that. Can you give us an idea of what the levels of income flows in and out will be from the tax and rebate proposal?

Dr. RIVLIN. Mr. Chairman, are you really talking about the total effect on the budget?

Mr. DINGELL. Yes.

Dr. RIVLIN. How much comes in and how much goes out?

Mr. DINGELL. Yes.

Dr. RIVLIN. I am not sure that we have done an independent estimate of that.

Mr. DINGELL. I think the best way, Doctor, you could help us would be if you take a look at those figures and perhaps give us your judgment as to whether they are valid and what they in fact do mean.

Dr. RIVLIN. We will do that.

Mr. DINGELL. If you do that for the record, I think that will be very helpful. [See pp. 97-100 of CBO report.]

Mr. DINGELL. The Chair recognizes Mr. Potter for questions.

Mr. POTTER. With respect to your coal conversion estimates, Dr. Rivlin, I am wondering how sensitive are your conclusions of the trajectory of potential conversions to the state of the economy.

The administration assumes that with a 2 percent energy growth you will find in the neighborhood of a 4 to 5 percent of growth in GNP. If that assumption is incorrect—if for some reason the GNP rate of growth is not so high—it seems to me that this might substantially inhibit the rate at which we convert existing plant to coal.

Does your analysis encompass this kind of concern, and how do you react to it?

Dr. RIVLIN. I would think your assumption or your speculation is approximately right, although of course, if the economy does not grow as rapidly, we will use less energy overall. But let me see if someone would like to comment on that. I do not think we have looked at the sensitivity question to alternative growth paths.

Mr. POTTER. That is all the questions I have.

Mr. DINGELL. The Chair recognizes Mr. Schroeder.

Mr. SCHROEDER. Thank you, Mr. Chairman.

I wonder if we could talk briefly about the concept of market clearing prices, particularly for natural gas. Market clearing, as I understand it, is basically the situation in which the price reaches a level where long run demand and supply are brought into balance. Is that right?

Dr. RIVLIN. Yes.

Mr. SCHROEDER. The argument seems to be pretty much pervasive these days that the market clearing price for new natural gas will be somewhere in the order of $2.50 per Mcf. I think the basis for that is the argument that people will switch to oil or to other substitutes if the price gets much above that, the $2.50 being the Btu equivalent price of imported oil.

Right now we are presently consuming roughly 20 Tcf a year of natural gas. Presumably demand is at least that high, if not higher. Additions to reserves of natural gas are running somewhere in the range of 10 Tcf a year, so that in effect, but for what is sitting in the pool of proven reserves, our supply is about 10 Tcf a year and our demand is twice that.

My concern arises from the tact that gas sales, under long-term contracts, will "mash" the effect of high priced new gas on marginal demand. Therefore, on the supply side, would not someone who tries to make the case that a market clearing price for natural gas is $2.50 have to make the case that we would double our supply of natural gas, that is double the rate of reserve additions, if the price rose to $2.50, or roughly 25-percent over the current intrastate price of roughly $2.

Simply stated, to obtain a market clearing price of $2.50, you have to elicit, would you not, twice as much reserve addition as you presently do, at a price increase of roughly 50 cents, or 25 percent above the current margin price?

Is that a proper statement of the economic issue?

Dr. RIVLIN. It is awfully hard to talk about market price with natural gas, because the arrangements are such that it all gets mixed up together. But let me ask Dr. Morgenstern to comment on that.

Dr. MORGENSTERN. Mr. Schroeder, you have very eloquently described the process by which increases in price may or may not bring forth additional supplies. I believe you are perfectly correct, that the implied, as we say, elasticity of supply is far greater than most experts feel would be the case.

Mr. SCHROEDER. In the scenario that I have just laid out, the supply elasticity would be 4, that is a 100 percent increase in supply at a 25 percent increase in price. What is the range of conventional estimates of the supply elasticity for natural gas? Is it anywhere near 4?

Dr. MORGENSTERN. Mr. Schroeder, the scientific literature is very diverse in this field, as you are aware, but I have never seen a supply elasticity as high as 4. I believe that most studies with which I am familiar conclude that the elasticity is below 1.

Mr. SCHROEDER. So would that not therefore suggest that at least in the near term, the market clearing price for natural gas would be much higher than $2.50?

Dr. MORGENSTERN. I believe that is correct.

Mr. SCHROEDER. Thank you.

I wanted to elaborate briefly on one of the aspects of the coal conversion program that the Chairman asked for clarification on earlier. I think this will be part of your response, but I wonder if we could probe it briefly now. The administration staff, through a fairly complicated model, came up with an estimated volume of coal conversion based on the incentives created by the oil and gas consumption taxes, creating a certain magnitude of economically justified conversion to coal.

They then said that environmental restrictions would reduce this economically justified volume of conversion by 25 percent. 25 percent of the total would not occur. I wonder if one of the reasons why your conclusions about coal conversion are less optimistic, is that perhaps you assume that greater than 25 percent of economically justified conversions would be barred by environmental restrictions.

Is that a source of any difference between the two studies?

Mr. MORGENSTERN. Yes, I believe that is true. There are other factors as well. There are problems of transportation and problems of optimizing the time one chooses to install the equipment because of the mechanics of the tax.

Mr. SCHROEDER. Thank you, Mr. Chairman.

Mr. DINGELL. Doctor, we thank you for your help. You and your associates have given us most valuable testimony. I want to say that I realize that I have laid a great deal upon you, but your assumptions here will be most valuable to us.

Thank you all very much.
[Testimony resumes on p. 289.]
[The CBO report referred to follows:]

PRESIDENT CARTER'S ENERGY PROPOSALS: A PERSPECTIVE

Staff Working Paper

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PREFACE

One of the major issues to be decided by the 95th Congress is that of a national energy plan. Decisions on energy policy will affect virtually every household and business in the United States, with direct impacts on patterns of consumption and investment practices, and indirect effects on unemployment and economic growth. The complex proposed system of energy-related taxes and rebates may also be felt--often unevenly--by different income groups, regions, and economic sectors.

At the request of the Senate Energy and Natural Resources Committee and the Ad Hoc Committee on Energy of the House of Representatives, the Congressional Budget Office has prepared this preliminary evaluation of the Administration's proposed National Energy Plan. While it is impossible at this stage to provide a comprehensive analysis, the information presented here may assist in focusing the Congressional debate. In keeping with CBO's mandate to provide objective analysis; this report contains no recommendations. More detailed analysis of specific proposals will be prepared over the next several months.

The report was prepared under the supervision of Raymond C. Scheppach of CBO's Natural Resources and Commerce Division with the assistance of Richard D. Morgenstern, who also contributed to individual chapters. Major contributors included Damian Kulash, Lawrence Oppenheimer, Richard M. Dowd, and Reginald Brown of the Natural Resources Division; Peter Karpoff of the Tax Analysis Division; Frank de Leeuw of the Fiscal Analysis Division; and June O'Neill of the Budget Analysis Division. The authors received valuable assistance from Craig Roach, Richard Mudge, Mike Owen, Ron Hoffman and other members of the CBO staff as well. Katharine Terrie Bateman, Patricia A. Knapick, Patricia H. Johnston, and Johanna Zacharias each edited portions of the manuscript. The task of typing the several drafts was shared by Barbara M. Bishop, Angela Z. Evans, Janet L. Fain, Shirley G. Hornbuckle, Dorothy J. Kornegay, Connie S. Leonard, and Cheryl L. Miller.

Alice M. Rivlin
Director

June 1977

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SUMMARY

The energy plan submitted by President Carter to the Congress contains more than 100 interdependent proposals aimed at reducing consumption of petroleum, converting from oil and natural gas to coal as an energy source, and increasing domestic supplies of energy. These proposals are designed to reduce imports of crude oil from a potential 11.5 million barrels a day to 7.0 million barrels by 1985. Of these projected 4.5 million barrels a day saved, the Administration estimates that approximately 2.1 million would be attributable to conservation and 2.4 to the substitution of coal for oil and gas.

This report analyses five major sets of proposals in the Administration's plan:

- Pricing of crude oil,
- Pricing of natural gas,
- Conversion to coal,
- Automobile-related proposals, and
- Tax credits for home insulation and solar heating equipment.

The Administration estimates that altogether, these sets of proposals would achieve a reduction in oil imports of 3.2 million barrels a day by 1985. The analysis conducted by the Congressional Budget Office and presented in this report, however, indicates that this saving is overoptimistic; CBO estimates that the proposals would be likely to save closer to 2.3 million barrels a day. About 0.6 of the 0.9-million-barrel difference results from lower estimates of coal conversion potential; the remaining 0.3-million-barrel discrepancy is due to differing estimates of the results from the home insulation and solar equipment tax credits. The Administration asserts that an additional savings of 1.3 million barrels a day (over and above the savings from the five main proposals) can be expected to result from various proposals such as new building standards; these have not been analyzed by CBO. On the assumption that these unanalyzed savings will be realized, however, the total oil import savings achieved by the Administration's plan are estimated by CBO to be about 3.6 million barrels a day, rather than

the Administration's estimated 4.5 million barrels. The Administration's plan leaves open the possibility of future measures not included in the present proposed legislation that could help close this gap.

THE NEED FOR AN ENERGY PLAN

The need for a national energy plan arises from both immediate and long-run problems. The long-run problem is simply that the growth in oil and gas consumption exceeds the growth in proven reserves--both domestic and foreign. Before long, we will have to shift to new energy sources or face drastic reductions in our standard of living. The more immediate problem is that U.S. imports of oil have increased substantially--from 3.5 to 7.3 million barrels per day between 1970 and 1977. The fact that almost half of the oil consumed in the United States is now imported creates national security risks and makes our economy highly vulnerable to shocks from outside, especially because the supply and price of oil are to a great extent dictated by an international cartel.

The major reason for the substantial increase in our dependence on imports is the current system of price controls on oil and gas, which have kept the domestic price of these fuels artificially below world levels. Over the past four years, this regulatory system has served to cushion Americans from the dramatic shifts in consumption, and in turn in lifestyles, that might otherwise have been caused by the abrupt quadrupling of world oil prices by the OPEC cartel in 1973-1974. Artificially low prices have also tended to encourage energy consumption and discourage the search for and production of new domestic resources--thereby further increasing our dependence on potentially unreliable foreign suppliers.

THE ADMINISTRATION'S STRATEGIES

To reduce our dependence on imports, the President has proposed three major strategies:

- Reduce the long-term growth in energy demand by imposing various excise taxes that would serve to raise the price of petroleum and related products to world levels or near world levels. New regulatory standards are also proposed, and special efforts are made to reduce the growth in demand for gasoline.

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- Increase large industries' and utilities' use of coal instead of oil or natural gas by taxing their use of the latter two fuels. Regulations are designed to prohibit most new industrial and utility use of oil and natural gas.

- Increase domestic supplies by reintroducing market pricing, or near market pricing, for truly new energy supplies. Accelerated development of new energy sources, however, is not stressed.

A critical element in the President's proposal is the effort to raise the price of petroleum and natural gas by predictable increments so that consumers and businesses can begin to make decisions on the basis of higher future energy prices. The theme of the plan is that the transition to a less energy-intensive economy is a long and complex process. Incentives established now to alter consumption and investment decisions regarding energy will only begin to yield significant savings within the next few years. Truly large-scale energy savings will not show up until the middle of the next decade or later.

Energy price increases under the plan would be achieved mainly by a system of taxes to be rebated to consumers. Such taxes are preferred to simple increases in private-sector prices because the taxes capture windfall profits for the public rather than for industry. These tax revenues would then be rebated in order to maintain the real purchasing power of consumers. Since the taxes would have raised energy prices relative to others, however, it is expected that most of the rebates would be spent on other goods; energy would thus be saved.

CONCLUSIONS OF THE STUDY

The general conclusion of the CBO analysis is that the strategies proposed by the Administration would be effective in reducing energy use and dependence on oil imports, but that the Administration's estimates of the magnitudes of import savings are overoptimistic.

One of the costs of the plan would be a rise in the general price level, but the inflationary effect would be small and gradual compared to that of the OPEC price increases of 1973-1974. The plan would redistribute real income from some groups to others, but on the average, lower-income people would be protected. The shift to a more energy-efficient economy envisioned by the plan would not involve dramatic adjustments in American lifestyles; for example, the increase in miles driven per household would be slowed but not reversed.

Crude Oil Pricing

The Administration's plan would retain controls on prices received by domestic oil producers, but it would allow the controlled price of newly discovered oil to rise over three years to the 1977 world price with subsequent adjustments for domestic inflation. This price would offer substantial incentives to increase production of domestic oil, but actual increases in production are likely to be relatively small. CBO estimates that the rise in price for newly discovered oil would increase production by about 100,000 barrels a day by 1985; the Administration's estimate of increased production is slightly higher.

To discourage consumption of oil, the plan would raise prices paid by domestic consumers to world levels by imposing a "crude oil equalization tax" equal to the difference between world and domestic prices. This tax would capture for the public the windfall profits associated with higher prices on already discovered oil and would return those profits to consumers in the form of rebates.

The equalization tax on crude oil will increase the price of petroleum products by an estimated 4 to 5 cents per gallon (in current dollars) by 1980; this amount is in addition to the increase of 4 to 5 cents per gallon projected under existing legislation. The tax would also lead to the elimination of the so-called "entitlements program," and would thereby reduce some of the regulatory burden on the industry. The equalization tax appears to be an effective mechanism for equalizing foreign and domestic oil prices and capturing windfall profits. It would provide a slight incentive for consumers to reduce consumption or convert to alternative sources. Proposed user taxes on oil provide additional incentives for industry and utilities to convert to coal.

Natural Gas Pricing

The pricing proposal for natural gas eliminates the current distinction between interstate and intrastate markets by placing all gas under federal jurisdiction; it places a cap on the price of new gas at $1.75 per thousand cubic feet. In addition, a special excise tax is placed on use of natural gas by industries and public utilities. The purpose of these proposals is threefold:

- To protect residential consumers against high prices and shortages,
- To make gas expensive for industries that can convert to coal, and
- To increase new supplies but reduce the possibilities of producers' gaining excessive profits on previously discovered gas.

With the exception of the degree of coal conversion, CBO finds that the natural gas proposals will attain the stated objectives. The proposals would generally reallocate the existing supplies of natural gas; no energy savings would therefore be attributable to this proposal according to either the Administration or CBO.

Coal Conversion

Since the goal for conversion of utilities from oil and gas to coal is generally consistent with current trends, CBO concurs with the Administration's conversion estimates in this area. A major discrepancy exists, however, in estimates of the likelihood of attaining the goal for industrial conversion. If present policy were continued to 1985, only 12 percent of new industrial demand would burn coal. The President's plan envisions that industrial consumption of coal would more than double by 1985. Accomplishing the Administration's goal would require that 10 percent of all existing oil and gas used for industry be converted to coal and that 44 percent of all new potential users would convert to coal. This report agrees with the President's 10 percent conversion of existing industrial use but projects only 33 percent of new uses to be converted to coal. (The reasons for this lower estimate include the logistics of transporting coal, concerns about protecting the environment, and problems of scheduling new coal facilities to maximize the benefits of rebates,

all of which will impede new conversion.) This would result in total coal consumption by industry of 360 million tons by 1985--50 million tons below the Administration's estimate.

In terms of equivalents in barrels of crude oil, CBO's estimate translates into a savings in imported oil of 1.8 million barrels a day, which is 0.6 million below the Administration's figure. To some extent, however, the attainment of the goal would depend upon the future actions of the Administration since it could control both the specification of coal regulations and their subsequent enforcement.

Auto-Related Proposals

The automobile-related provisions of the President's energy package are aimed at reducing gasoline consumption through production and sales of vehicles with greater fuel efficiencies, and through price-induced reductions in the number of miles driven. The goal of the plan is to reduce total gasoline consumption by 10 percent from current levels by 1985. This is an ambitious goal, considering that motor gasoline consumption has increased at 4.5 percent per year between 1965 and 1975, but its attainment would be aided substantially by existing legislation. In particular, the Energy Policy and Conservation Act of 1975 set fuel economy standards for new cars under the threat of civil penalties. While CBO does not expect these standards to be met in every year, it does anticipate that they would have significant effects on automobile gasoline use. In 1985, holding it within one percent of the present level. CBO estimates that adoption of the President's plan would reduce automotive gasoline consumption further, but to 5 percent beneath its present level, not 10 percent below as projected by the Administration.

Three programs in the President's plan contribute to gasoline savings. More than half of the savings come from the President's proposed "gas-guzzler" taxes and rebates based upon a new car fuel economy. This program is estimated to yield fuel savings of 215,000 barrels a day in 1985. Second, standby gasoline tax could be triggered as early as 1982 according to CBO projections, and assuming that it is triggered then, it would produce gasoline savings of 65,000 barrels per day in 1985. Finally, the crude oil equalization tax is expected to contribute an additional 25,000 barrels a day of gasoline savings in 1985. Taken together, these three programs would yield total gasoline savings of 305,000 barrels a day in 1985, less than a tenth of the energy savings produced by the President's plan as a whole.

CBO's estimate of the fuel savings for the gas-guzzler excise tax and rebate program is slightly higher than the Administration's, and the Administration has not yet computed comparable estimates for the standby gasoline tax and crude oil equalization tax. The Administration has indicated, however, that without the standby gasoline tax, 1985 gasoline consumption would be 350,000 barrels per day above target. While CBO expects that 1985 gas consumption would most likely exceed the target by more than this, the excess above target in both sets of projections is greater than the estimated 65,000-barrel savings of the standby gasoline tax, implying that the President's goal of a 10 percent gasoline reduction by 1985 appears unlikely.

Future gasoline consumption by trucks introduces considerable uncertainty as to whether or when the President's goal would be met. At present, trucks account for more than 20 percent of the nation's gasoline consumption, and their future share of gasoline use could rise if their fuel economy improvement does not keep pace with that of autos. The fuel economy of light trucks is expected to improve as a result of existing legislation as well as through the President's gas-guzzler proposal as it would apply to light trucks. But both existing and proposed legislation in this area are keyed to a set of standards that have not yet been specified, so that assessment of their conservation impact is impossible at this stage. CBO analysis indicates that these future developments in the fuel economy of trucks would have a major effect on the triggering of the standby gasoline tax, and could delay it from 1982, as projected above, to 1983 or 1984. Policies related to trucks play a key role in shaping an effective and even-handed policy for transportation fuel conservation.

Insulation Tax Credit

The proposed insulation tax credit is likely to encourage some additional homeowners to upgrade the insulation in their homes. With sharp rises in fuel prices since 1973, however, many homeowners have already reinsulated or have decided to do so in the future. For example, about 3 million homeowners chose to upgrade their insulation in 1976. With current energy prices, insulation is already a good investment since the savings in fuel bills are about three times the cost of the insulation. The proposed credit would increase this ratio of savings to cost to 4 to 1.

Between now and 1985, an estimated 24 million homeowners and renters are likely to reinsulate their dwellings. CBO estimates that nearly 8 million of the 24 million would be an increase attributable to the tax credit. The 24 million translates into a total of 70 percent of all residential homeowners as opposed to the 90 percent projected by the President. CBO estimates the energy savings attributable to these nearly 8 million households would be approximately 120,000 barrels of oil a day.

The Administration, on the other hand, estimates that a savings of 480,000 barrels would be due to the credit and related programs. The major difference is that CBO estimates that an additional 280,000 barrels a day will be saved by reinsulation that people would do anyway without the Carter plan, adding up to a total of 400,000 barrels per day from all insulation. The Administration assumes that a total of 480,000 barrels a day savings would be induced by the plan.

Short-Run Impacts on the Economy

President Carter's package would have a major impact on energy markets, a noticeable but small impact on the overall rate of inflation, and only a minor impact on total output and employment. CBO estimates that the President's plan would add about 1.6 percent of the level of consumer prices by 1980 or about half a percentage point a year to the rate of inflation from 1978 through 1980. The output effect is estimated to reduce constant-dollar gross national product by no more than 0.7 percent by the end of 1980, thus adding 0.2 percent to the unemployment rate. These estimates do, however, assume that there will be no new investment for conversion during the next two years. The total impacts on unemployment and real growth could therefore be partially offset if additional investment is forthcoming.

Distribution Effects

A final issue addressed in this study is the combined impact that the energy proposals and tax rebates would have on various groups of Americans. Assuming that the various taxes would be passed on to consumers almost entirely, close to $13 billion would be paid by 1980 (in 1977 price levels) in higher energy prices.

In addition to this total effect, the energy proposals would redistribute purchasing power from persons in the upper three income quintiles to the two lowest quintiles in 1980 and from the upper three quintiles to the lowest two in 1985.

Other shifts are likely to take place as well. For example, people who do not own automobiles would gain at the expense of automobile owners. Homeowners would gain at the expense of renters, and city dwellers with access to public transportation would gain at the expense of persons in suburbs and rural areas.

CHAPTER I. SCOPE OF THE REPORT

President Carter's energy proposals focus on one of the most critical issues to be debated by the 95th Congress. They address a problem that has become progressively acute and then promises to get still worse. If the proposals are enacted, they will affect every household and business in the United States. It is essential, therefore, that the Congress be able to debate the major issues and decisions quickly.

This working paper is intended to assist in the Congressional debate by offering an independent evaluation of the proposed energy program. Because of the timing of this response, however, its scope must be restricted. Accordingly, the report focuses on the major energy initiatives of coal conversion, the crude oil equalization tax, natural gas pricing, home insulation and solar equipment tax credits, and the two automobile-related proposals. Secondary proposals, such as standards on new appliances and buildings, which altogether the Administration estimates account for less than 30 percent of the potential savings, are not addressed in this report.

Essentially, the paper has five major objectives:

- To give an overview of the general strategy,
- To provide analysis of the major initiatives,
- To convey information about the incentive mechanisms,
- To indicate short-run macroeconomic impacts, and
- To specify possible changes in the distribution of income.

Chapter II offers a general orientation, describing the overall philosophy of the President's approach and its critical features, and placing it in the spectrum of possible alternatives. Perhaps more important, however, it specifies a framework for evaluating the individual proposals that is used throughout the subsequent chapters. Chapters III through VII evaluate and analyze the major energy initiatives within the package. Chapters VIII through X attempt to assess the general costs and benefits of the major proposals. Budget costs, macroeconomic effects, and distributional impacts are addressed in these final three chapters.

CHAPTER II. A GENERAL ORIENTATION

The President's energy plan contains a variety of interlocking pricing policies, regulatory mechanisms, and administrative actions designed to accomplish two goals: to reduce the nation's reliance on imported oil, and to speed the transition toward an economy that consumes less energy. This chapter presents an overview of the general direction of the plan, contrasting its emphases with those of alternative approaches. It outlines the principal costs and benefits of the plan; it also examines some general characteristics of the nation's consumption of energy, which must be understood in order to develop a balanced and effective energy policy.

THE PRESIDENT'S STRATEGY

Artificially low prices for oil and natural gas have contributed to putting the United States in a precarious position. The complex system of controls on oil and gas prices now in force in the United States has kept the domestic price of these fuels below world levels. This regulatory system has cushioned Americans against the dramatic changes in consumption, and in turn lifestyles, that might have been caused by the abrupt quadrupling of oil prices by the cartel of Oil Producing and Exporting Countries (OPEC) in 1973 and 1974. Artificially low prices have also tended to encourage energy consumption however, and to discourage the search for and production of new domestic resources. The indirect effect, therefore, has been to increase our dependence on foreign suppliers. With energy consumption continuing to grow, and proven reserves of oil and natural gas not keeping pace, the potential impact on the United States of another disruption like that of the OPEC oil embargo of four years ago is great.

To solve the problem that has been partly caused by these artificial energy prices, the Administration has put forth three major strategies:

- Reduce the long-term growth in energy demand by imposing various excise taxes to raise the price of petroleum and related products to world or near world levels. New regulatory standards are also proposed and special efforts are taken to reduce the growth in demand for gasoline.

- Shift large industries and utilities to burning coal (of which domestic supplies are abundant) instead of oil or natural gas by taxing the use of the latter two fuels. Regulations are designed to prohibit most new industrial and utility use of oil and natural gas.

- Promote the increase of domestic supplies by reintroducing market pricing, or near market pricing, for truly new supplies of oil and natural gas.

An underlying theme of President Carter's program is that the transition to a less energy-intensive economy is a long and complex process. Incentives set in motion now to alter consumption patterns and investment decisions will begin to yield significant savings only after a few years. Genuinely large-scale energy savings will not begin to show up until the middle of the next decade.

To avoid uncertainties about future shortages and disruptions, however, major changes in incentives and in patterns of energy use may have to start now. A clear set of signals with respect to future energy prices is essential. Future price uncertainties must be minimized; this, in turn, should encourage both consumers and businesses to begin the long, gradual process of changing their capital purchases to reflect higher energy prices over the long term. Use of a more efficient capital stock should substantially curb the growth in energy demand.

Market incentives are not the only consumption-curbing devices in the Administration's program. The plan also uses taxes to capture most of the windfall gains that would otherwise go to energy-producing industries and returns these tax revenues to the public by means of a system of rebates. Higher prices for energy are phased in over several years, and fuels

for certain uses (e.g., home heating) are effectively excluded from the price increases. The use of gasoline is particularly discouraged, as is the use by large industrial consumers and utilities of oil and natural gas instead of coal. Certain direct monetary inducements are offered for particular types of energy conservation (e.g., home insulation). And, regulations are designed to reduce consumption in other areas (e.g., home appliances).

Producers of oil and natural gas are allowed price increases of 20 to 30 percent for truly new production and for tertiary recovery (i.e., third-time use of a given well), and prices are protected from future domestic inflation. Should the rate of growth in world prices exceed the rate of domestic inflation, oil prices received by domestic producers will be limited to the growth in the general inflation rate. Thus, future actions of OPEC will not necessarily determine prices charged by domestic producers, but unless they are excessive, future OPEC actions will affect prices paid by American consumers.

ALTERNATIVE APPROACHES TO NATIONAL ENERGY POLICY

In view of the numerous, highly specialized components required in a national energy plan, there can be many alternative programs. While the number of combinations of elements is limitless, there are three general directions against which it is useful to compare the President's plan:

- Set more ambitious conservation goals,
- Rely more heavily on free market mechanisms to increase supply of oil and gas, or
- Undertake crash programs for new technologies.

More Ambitious Conservation Goals

The belief that a severe energy crisis is close, or the belief that the hazards to the environment and to health associated with a continuation of present levels of energy consumption are unacceptable, might lead one to advocate more ambitious conservation goals than those put forth by President Carter.

Energy conservation is to be brought about largely by gradual changes in the type and efficiency of consumer durable and of producer's investment goods. Such changes would inevitably be slow. Therefore, the argument goes, in order to have any real impact, a program must set more ambitious goals.

The implementation of such a strategy might involve either a more complete and less gradual reliance on the price mechanism; alternatively, it might involve direct controls and regulations. If the latter approach were followed, production subsidies might be required. The immediate sacrifices required of both individuals and businesses would be greater than those called for by the President's plan.

Greater Reliance on Market Mechanisms

Underlying the free market emphasis is the belief that government intervention in energy markets distorts the desired economic signals to both consumers and producers. The logic of this approach is that, if domestic production is inadequate and dependence on imports too great, domestic prices should be allowed to rise to stimulate new production; presumably, this increased production would boost the demand otherwise inhibited by higher prices. In fact, to a large extent this is the approach of the President's plan, but mainly on the demand reduction side. Rather than extending the incentives of higher prices to potential producers, the plan uses taxes to raise prices to consumers--and continues many price controls.

Opposition to extending the market approach has developed on several grounds. First, the OPEC cartel is just that, a cartel. The prices it sets do not necessarily imply "market justice." Second, opinion varies widely about the ability of the U.S. resources to meet domestic energy needs--even if prices were allowed to rise to world levels. Many experts believe that freeing prices from all controls would yield little additional domestic supply; others contend that higher prices could induce both the discovery of new resources and substantial additional production from existing reserves. Third, there are questions about the extent of economic disruption that the higher prices would cause. Finally, feeling among Americans is widespread that the producers are not entitled to the large windfall profits associated with higher prices.

Crash Programs for New Technologies

A crash program for new energy technologies is often compared with the Manhattan project, which developed the first atomic bomb, or with the Apollo program, which succeeded in landing a man on the moon. In both of these programs, massive federal funding was used to accelerate the research, development, and demonstration (termed R, D, and D) process. Some observers argue for a similar program in the energy field, focusing efforts on new energy technologies and on attempts to reduce the health and safety risks of known technologies, especially those involving plutonium and the completion of the nuclear fuel cycle.

It is probably true that massive new federal spending (beyond the $3 billion allocated to the Energy Research and Development Administration--ERDA--in 1977) would accelerate the R, D, and D process. But even the most optimistic scientists indicate that new technologies could not be developed and adopted before 1990. Consequently, in the short to intermediate term, the crash program appears not to be a reasonable substitute for a conservation plan.

BENEFITS AND COSTS OF THE NATIONAL ENERGY PLAN

The President and members of his Administration credit the national energy plan with several major benefits, among them reduced reliance on imported oil, an orderly transition toward an energy scarce economy, and insulation from future energy shocks. The Congressional Budget Office is in general agreement that the plan would make progress toward achieving these benefits. In some important instances, however, CBO's numerical estimates of savings and related magnitudes are smaller than the Administration's.

Reduced Reliance on Imported Oil

The principal benefit attributed to the President's energy plan is that it would reduce U.S. dependence on oil imports. The Administration estimates a reduction of 4.5 million barrels a day by 1985; CBO estimates are closer to 3.6 million barrels per day. Even in the lesser case, however, such a reduction in imports is translated into a reduction in the economic and national security risks associated with a critical natural

resource, the supply and price of which may be dictated by an international cartel. Not only does the Administration's program offer some insulation from both short-run supply interruptions and long-run curtailments; it may also increase the ability of the United States to exercise some influence over the OPEC price.

Smooth Transition to an Energy Efficient Economy

A principal potential benefit of the plan is that it will help steer an orderly transition from what now appears to be an energy-rich economy to one that is generally expected to be more energy-poor. Since the use of energy is closely tied to the efficiency of equipment in factories and farms, the transition to a less energy-intensive economy involves considerable time while capital stock is replaced with energy-efficient substitutes. A gradual move toward greater efficiency, as opposed to a crash program at some later date, will help prevent excessive capital losses by individuals or businesses, and will help to avoid general economic disruptions.

Insurance Against Future Energy-Shock

Because there is so much uncertainty about energy futures, the President's energy plan can be viewed as a type of insurance policy. By reintroducing market or near-market price incentives for both consumers and producers, the plan attempts to discourage consumption and encourage domestic production, thereby reducing doubts about the ability of the U.S. economy to survive any energy crisis that may develop.

Costs Of the Plan

The Administration's energy policy would also impose several major costs on the nation, however. First, modes of living and working are likely to change as a result of higher fuel prices and therefore many people may be inconvenienced.

Second, many individuals and businesses may incur capital losses on their consumer durables and investment goods that are inefficient in energy use and that become obsolescent.

Third, the macroeconomic effects would be small but noticeable. If the President's plan is enacted, the rate of inflation is expected to increase by an annual rate of about 0.5 percent over the next several years. The growth rate of the gross national product (GNP) is likely to be slowed slightly and the unemployment rate increased by a small amount. If increases in the demand for new (energy-efficient) investment goods is only slightly larger than anticipated, however, this increase could more than wipe out the expected GNP and employment losses, making the macroeconomic impacts of the President's plan negligible.

Fourth, although the plan would use rebates to cushion the losses in purchasing power associated with the overall increase in energy prices, these rebates would not be distributed evenly. Families in upper-income classes would generally pay a higher absolute amount of their incomes for energy, while lower-income families would receive a disproportionately large share of the rebates. Any individual's automobile ownership and place of residence, however, would produce a different effect.

THE PRESIDENT'S PLAN IN CONTEXT

Before analyzing individual programs within the President's plan, it should be helpful to examine several features of the plan as a whole in the context that surrounds it. Specific features include:

- The differences between the President's plan and his proposed energy act,
- The expected future growth in petroleum consumption,
- The nature of the much-discussed "sacrifices,"
- The importance of regulatory measures,
- The interdependence of proposals within the plan, and
- The timing of costs and benefits.

The Plan and the Proposed Legislation

A key feature of the President's energy plan is that the goals and energy savings incorporated into it may not be fully achieved by the National Energy Act as introduced. While the Administration hopes that the act will attain the stated goals, it recognizes that this hope may not be realized and that additional legislation or regulations may be required later. Indeed, the Administration seems to be viewing its plan in two stages: the initiative contained in the proposed act first, then more severe measures if the legislation does not accomplish the specified goals. Many of these more severe measures are included in the plan, but are not incorporated into the legislation now before the Congress.

The potential gap between the energy savings of the plan and the act depend significantly on a number of additional regulatory decisions, such as exemptions from mandatory coal conversion, over which the Administration would have control. Strict enforcement would increase the probability that the goals would be attained. Consequently, the commitment of the Administration to the goals is critical in determining the efficacy of the overall plan.

Energy Savings and Rising Consumption

Because the nation's population is expected to grow and the standard of living is expected to rise, the nation's use of energy in 1985 is anticipated to be 30 percent greater than it was in 1976 if present policies and practices continue. Similarly, the nation's use of petroleum products in 1985 is projected to be almost 23 million barrels per day--again, about 30 percent greater than it was in 1976. While the President's plan would reduce this petroleum use (by 3.6 million barrels per day according to CBO estimates and by 4.5 million barrels per day according to the Administration), the reliance of the United States on petroleum in 1985 will, in absolute terms, still be greater than it is now. Thus, the savings reflect reduced growth in energy consumption, rather than absolute declines. This should be kept in mind, since all the estimates of energy savings provided by the President's plan are analyzed relative to expected outcomes under present policy, that is, assuming the extension of the Energy Policy and Conservation Act (EPCA) through 1985. Although both CBO and the Administration have worked with this baseline,

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savings would be overestimated if, in fact, EPCA were not extended and prices were allowed to approach the world market levels after 1981.

The "Sacrifices"

Much of the discussion of the plan describes reductions and substitutions in consumption that will be made by the American people in response to the President's plan. By and large, these adjustments are really slowdowns in the rate of the rise of the standards of living between now and 1985. But even with the rate slowed, the standard in 1985 would still be higher than it is now. For example, the average American family now drives slightly less than 15,000 miles per year. Under the plan, they would likely drive 17,000 miles in 1985, which is more than they drive now even though it is less than the 18,000 miles they would drive without the plan.

Regulatory Measures

The major thrust of the President's package appears to be one of increasing energy prices to consumers so that they will make their normal market adjustment of decreased consumption. But, a relatively high proportion of the estimated energy savings comes from the implementation of new standards on appliances, on new commercial and residential buildings, and so forth. These features represent an extremely important part of the program.

Interdependence of the Proposals in the Act

The plan embodies a set of proposals that are very interdependent. To a large degree, there is a "carrot and stick" philosophy. An example of this principle is the extension of tax credits to industry. Firms, which would already benefit to some extent from raising the prices of their products, would be further induced to increase their output of energy-efficient items by the reward of a tax credit. The importance of this reward would rise over time as increased costs threatened to erode profits. Taken one by one, either of these two proposals might yield only marginal energy savings, but combined, the effect may be substantial.

Timing of Costs and Benefits

Finally, the costs of the plan--higher taxes and the like --would begin immediately upon adoption, but most large-scale benefits would not become apparent until the latter part of the next decade and beyond. Further, like many national defense expenditures, the benefits are likely to accrue to the nation as a whole and not necessarily to individuals. The costs, however, are likely to be experienced first, more directly, and by more people.

CHAPTER III. THE CRUDE OIL PROPOSAL

The President's proposals on crude oil pricing are intended to accomplish several objectives:

- o to increase incentives for domestic oil production by raising the price received by producers of newly discovered oil;
- o to prevent the petroleum industry from gaining windfall profits on already discovered oil;
- o to discourage consumption of crude oil by raising the prices paid by domestic consumers to world levels;
- o to discourage consumption further by imposing a tax on industrial and utilities users of petroleum products.

The plan would retain controls on prices received by domestic producers of oil, although it would allow the controlled price of newly discovered oil to rise. It would raise the price of oil paid by consumers to the world level by imposing "a crude oil equalization tax" equal to the difference between world and domestic prices.

Incentives for new production under the plan are where they would be most effective--on newly discovered oil. Although domestic production costs are high, the producer revenues permitted for new oil would be among the highest in the world. In addition, large users of petroleum would be taxed in order to encourage them to convert to coal. The revenues from the tax would be available as rebates to be used to defray the costs of conversion. This chapter projects the total revenues of the tax while the success of this tax on coal conversion is addressed in Chapter V.

The conclusions presented in this chapter are that the equalization tax is an effective mechanism to equalize crude

oil prices and capture the potential windfall profits. It also will lead to elimination of the entitlements program and thereby reduce some of the regulatory burden on industry. The crude oil equalization tax also increases prices to consumers by between $0.4 and $0.5 per gallon (in current dollars) over the increase that would occur under current legislation between 1978 and 1980, thereby providing a small incentive to consumers to reduce consumption or convert to alternative energy sources.

With respect to the effects of the plan on energy supply and demand, CBO is close to the projections claimed by the Administration. Production is likely to increase as projected, although somewhat less than forecast by the Administration. Furthermore, the plan effectively reduces pricing inequities, and increases producer incentives relative to present policy. The nation would be in a decidedly better economic position during the 1980s if the Administration's crude oil proposals were implemented than it would be with a continuation of present policies.

PROPOSED POLICY

The crude oil pricing proposals are particularly relevant to the Administration's conservation objectives because the current regulation of domestic crude oil prices contribute to continually increasing consumption. Most domestic oil is currently priced well below the world market price which represents the replacement cost of oil to this country. Existing legislation limits the price of lower- and upper-tier oil to $5.25 and $11.28 per barrel respectively. 1/

Under the Administration's pricing proposals, the price of previously discovered oil (discovered prior to April 20, 1977) would remain subject to price controls, but the controlled price would be allowed to increase at the general rate of inflation. The price of oil discovered after April 20, 1977 (called

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1/ Lower tier prices apply to oil produced from wells that were in operation during 1972 or prior; while upper- tier prices apply to new oil from wells that were completed after 1972, but prior to April 20, 1977. The definition of new oil also encompasses increased production from old wells (production above the "decline rate").

"newly discovered" oil) and oil from tertiary recovery from existing wells will be allowed to rise over a three-year period to the 1977 world price, adjusted for inflation.

Should the rate of growth of world prices exceed the rate of domestic inflation, however, domestic oil prices paid to producers would be limited to the growth in the domestic price level. Thus, future OPEC actions would not necessarily determine prices received by domestic producers.

From the consumers' point of view, the most important facet of the Administration's crude oil pricing proposals is that the price of domestic crude oil will be raised to the world price level. The mechanism by which this price increase is achieved is a crude oil equalization tax which is applied to all domestically produced oil in three stages, so that by the end of the third year, the price paid for all domestic oil is equal to the world price. The first tax would go into effect on January 1, 1978. It would increase the price of lower-tier oil by $3.50 in nominal terms, or by about half the difference between its level and the upper-tier level. The second stage (January 1979) would equalize all controlled domestic production at the upper-tier level and the last stage would move all domestic prices to the level of world prices.

Thus the American consumer of crude oil would pay the world price of oil, not the present artificially low price. To keep the American consumer from being totally at the mercy of the pricing decisions of an international cartel, however, the plan provides that the rate of price increase can be controlled to match the rate of domestic inflation.

ENERGY IMPACTS

In order to evaluate the proposals related to crude oil pricing, two possible cases have been constructed. The first--the present policy case--assumes that the pricing provisions of the Energy Policy and Conservation Act (EPCA) of 1975 and the Energy Conservation and Production Act (ECPA) of 1976 continue in effect indefinitely. The alternative case represents the President's proposals.

The major impacts of the crude oil proposals are summarized in Table III-1. All prices are expressed in 1977 dollars. As shown in the table, the President's proposals will affect both the price and amount of crude oil which will be available to consumers.

TABLE III-1. PROJECTED COMPARISON OF PRICES AND QUANTITIES OF OIL a/: PRICES IN 1977 DOLLARS PER BARREL: QUANTITIES IN MILLIONS OF BARRELS PER DAY

		1980		1985	
	1977	Present Policy	Carter Plan	Present Policy	Carter Plan
Quantity of Oil Demanded	17.9	19.7	18.9	22.8	18.9 b/
Average Price per Barrel	$11.56	$12.67	$14.69	$13.55	$14.69

SOURCE: Congressional Budget Office.

a/ Prices are refiner acquisition costs and are equal to about $0.35-$0.45 per barrel more than wellhead prices. Quantities are in barrels of refined products and therefore the totals are about 0.4 million barrels per day above the demand equivalent crude oil.

b/ This is a minimum estimate. Since this report did not address all the parts of the President's proposals, it is possible that actual petroleum demand will exceed this number.

Prices of Petroleum

The 1980 prices for the various sources of crude oil that would be charged under the two cases described above are shown in Table III-2. These prices are refiner acquisition costs as defined by FEA and are about 40 cents per barrel above the wellhead costs. The prices also are national aggregates and therefore take no account of sulfur content, gravity, viscosity, or location.

The assumptions on which the present policy prices are based is that price controls under the terms of EPCA are continued indefinitely, allowing for an increase in real crude prices of 2.5 percent per year.

The prices established for the President's proposals are based on the assumption that: wellhead prices of upper- and lower-tier oil and natural gas liquids would be held constant in real terms; a tax (of about $3.29 per barrel in 1977 terms) would be imposed on lower-tier oil in 1978 and would be doubled in 1979, in order to bring lower-tier oil up to the level of upper-tier oil; and that all domestic oils would be taxed to bring their prices up to world levels starting in January 1980.

An important assumption in the CBO analysis of the President's plan is that the price of imported oil rises at about the same rate as inflation. If the price were to increase faster than inflation, there is a provision in the President's crude oil proposals to limit prices to a level below the world price. If world prices fall, there is no provision proposed to support domestic prices; thus they would fall accordingly.

As a result of the proposed pricing policies, the average price of domestic and imported crude oil paid by refiners in 1978 would be about $0.95 per barrel (8 percent) greater than it would be under present policy. By 1980, the difference would be about $2.00 per barrel (16 percent).

The crude oil equalization tax would be rebated to consumers. This mechanism and its impacts on the consumers are discussed in Chapter X. In 1980 the total amount of tax revenues should be about $15.8 billion in 1977 dollars. This estimate assumes that taxes would be collected on 7.3 million barrels per day of domestic crude. In 1985, the tax revenues would be about $11.2 billion on 5.4 million barrels per day.

TABLE III-2. PROJECTED CRUDE OIL PRICES a/: IN 1977 DOLLARS PER BARREL

	1977	1980		1985	
		Present Policy	Carter Proposal	Present Policy	Carter Proposal
Lower Tier	5.65	5.65	14.69	5.65	14.69
Upper Tier (to 4/20/77)	12.05	13.72	14.69	14.69	14.69
Newly Discovered (after 4/20/77)	12.05-12.71 b/	13.72	14.69	14.69	14.69
Stripper Wells	14.69	14.69	14.69	14.69	14.69
Alaskan North Slope	12.05-1469 b/	14.69	14.69	14.69	14.69
Naval Petroleum Reserves	12.05	13.72	14.69	14.69	14.69
Special and Tertiary Production	14.69	14.69	14.69	14.69	14.69
Natural Gas Liquids	8.33	8.33	14.69	8.33	14.69
Total Average (including imports)	11.56	12.67	14.69	13.55	14.69

SOURCE: Congressional Budget Office.

a/ These are prices paid by refineries after transportation costs. Wellhead prices are about 35 to 45 cents lower, except in the case of Alaskan oil.

b/ The lower figure is for the Current Policy Case, the higher is for the Carter proposal.

Prices of Refined Products.

Refineries produce literally dozens of products; however, the primary products are gasoline, diesel fuel, distillates (home heating oil), and residual fuel (industrial fuel oil). The present and future prices of these fuels under the two cases are presented in Table III-3.

Administration estimates indicate that if domestic oil prices are increased to world levels in 1980, only two-thirds of this increase will be passed through to consumers in the form of higher prices. The Administration believes that approximately one-third of the higher price would be absorbed in the profits of refiners. This would result from the fact that the lower price on imported refined products charged by some foreign refiners would tend to exert a downward pressure on domestic prices.

Unfortunately, little solid evidence is available to support any assumption on the magnitude of the price increase which will be passed on to consumers. 2/ In the view of the Congressional Budget Office, the two-thirds assumption is very optimistic. Our estimates are based on the assumption that virtually all of the tax will eventually be passed through to consumers.

2/ The Administration projects that several prices of refined products will be limited by international market prices, just as is residual fuel. This analysis agrees that such is possible particularly with respect to heating oil in New England and the Mid-Atlantic regions. However, competition with refined imports is not expected to be an important factor in other regions or with other products. This projection has been made because the price differences are small domestic refineries are very efficient producers of all products other than residual fuel, and existing transportation systems favor domestic refineries. The home heating oil rebate will reduce the competitive position of foreign refiners further.

TABLE III-3. PROJECTED PRICES OF REFINED PRODUCTS: CENTS PER GALLON; IN 1977 DOLLARS

Products	1977	1980		1985	
		Present Policy	Carter Plan	Present Policy	Carter Plan
Gasoline (Unleaded regular at the pump, full service stations)	65.5	68.5	73.5	71.0	73.5
Diesel Fuel (No. 2 at truckstops)	55.0	58.0	63.0	60.5	63.0
Distillates (Retail)	44.0	47.0	46.5	49.5	48.0
Residual Fuel (Retail)	29.0	29.0	29.0	29.0	29.0

SOURCE: Monthly Energy Review, March 1977, Federal Energy Administration, pp. 12-20, 58-69, 79, and Congressional Budget Office estimates.

The proposed crude oil equalization tax is, in general, an effective mechanism for raising consumer prices of petroleum products to equal their replacement costs (i.e., imports) without allowing the producers to collect windfall profits; however, some regulatory problems will continue.

- Definition of which specific types of oil receive what price will remain an issue as long as the definitions determine the price.
- Some incentive will remain for producers to reduce production from old wells so that they can receive the higher stripper oil prices.
- If world prices change rapidly, in either direction, executive decisions might be necessary to maintain prices.

As Table III-3 indicates, the prices of gasoline, diesel fuel, and home heating fuels will rise in real terms in both cases, but that by 1980 the prices estimated under the President's proposals will more than double the increase expected under present policy. The prices of residual fuels, however, will not rise, because they are dominated by international market prices. Slightly over 50 percent of the residual fuel consumed in this country is imported. Almost 70 percent of this residual fuel is consumed where the price is largely determined by the price of imports. The assumption in this chapter is that international prices do not increase in real terms over time and therefore residual fuel prices are projected to be constant through 1980. Domestic refiners will, therefore, allocate their increased costs of residual fuel to other products.

Consumption of Petroleum

In Table III-4 the effects of the President's proposals on consumption of refined products are displayed. As a result of the crude oil equalization tax, the automobile related proposals, the insulation tax credit and the coal conversion program, consumption in 1980 would be 4 percent lower in the President's plan than under present policy. By 1985 the difference is estimated to be 17 percent. Because the crude oil equalization tax would operate in tandum with many of the other proposals within the plan, however, no independent estimates are made of this particular proposal.

Generally, the impact of all the proposals by 1980 is uniform among the sectors--the Carter plan decreased consumption in each sector in comparison with a continuation of present policy. The plan would decrease consumption in the residential and commercial sector in absolute terms. After 1980, the plan would also lead to the reduction of the amount of oil used by electrical utilities.

An important point in this regard is that the industrial consumption of oil continues to grow from present levels in both cases. Under the President's plan, industrial consumption in 1985 is 44 percent above consumption for 1977. This implies an average annual growth rate in the industrial sector of 4.6 percent per year. By 1985, however, the number of industrial

TABLE III-4. PROJECTED CONSUMPTION OF REFINED OIL PRODUCTS: IN MILLIONS OF BARRELS PER DAY

		1980		1985	
	1977	Present Policy	Carter Plan	Present Policy	Carter Plan
Residential/Commercial (90 percent distillate)	3.4	3.4	3.3	3.2	2.8
Industrial (70 percent residual)	3.2	4.2	3.8	7.0	4.6
Transportation (70 percent gasoline)	9.7	10.3	10.2	10.6	10.2
Utilities (90 percent residual)	1.6	1.8	1.6	2.0	1.3
Total Refined Products	17.9	19.7	18.9	22.8	18.9
Equivalent Amount of Crude Oil	17.5	19.2	18.4	22.3	18.4

SOURCE: Congressional Budget Office.

boilers burning oil would decline, whereas consumption of petroleum as feedstocks would continue to expand.

Since most of the oil price increases in the residential sector will be rebated, the President's plan will not substantially affect residential consumption of oil. However, implementation of the home insulation tax credits would reduce consumption in this sector. But because increased use of insulation is cost-effective, with or without the proposed tax credit, demand for residential fuel would decline after 1980 in both cases.

The largest use of petroleum is for transportation. As is explained in Chapter VI, demand for all fuels for transportation expand slowly in both cases, but reach a plateau in the early-1980s under the President's proposals. Demand for gasoline for automobiles may then start declining between 1982 and 1984.

The Petroleum User Tax

The Tax On Industry. The President's plan proposes a tax on industrial consumers of petroleum products that would go into effect in 1979. A similar tax on utilities would be implemented in 1983. The user tax is graduated according to consumption, so that consumers of less than 500 billion BTU of oil per year pay no tax and consumers of more than 1,500 billion BTU pay tax on their entire consumption.

The tax is planned to start at 95 cents per barrel of residual fuel oil and 87 cents per barrel of distillate. The tax doubles in 1980 and then rises each year to $3.15 and $2.90 for residual and distillate respectively by 1985. In terms of real change, the tax increases fuel prices to industry by 12.9 percent in 1980 and 21.5 percent in 1985 relative to a price without the tax. The price and revenue impacts of the user tax on industry are displayed in Table III-5.

The costs of using petroleum in new plants are already higher on a BTU basis than competing coal prices. Thus it is doubtful whether the user tax provision taken alone would influence many consumers to convert to coal. Perhaps more important than the negative incentive of the user tax is the positive incentive of the proposed rebate provision for new industrial investment for conversion to coal.

Industry is eligible under the President's plan for either an additional 10 percent investment tax credit for expenditures to convert to coal or a rebate of user taxes (on either natural gas or petroleum) for the amount of expenditures incurred during conversion. In order to encourage accelerated investment in conversion, there is a carry-forward provision in the proposed tax amendment which would enable industry (and in later years, utilities) to accumulate credits in advance which could be used later to reduce the tax.

TABLE III-5. THE INDUSTRIAL USER TAX: IN 1977 DOLLARS

	Quantity Consumed a/	Approximate Taxable Use a/	Average Price Before Tax b/	Price After Tax b/	Revenue c/
Revenue in 1980					
Residual Fuel	2.66	2.39	12.15	14.05	1.7
Distillates	1.14	0.68	22.26	24.00	0.4
Total	3.80	3.07	14.40	16.26	2.1
Revenue in 1985					
Residual Fuel	3.22	2.90	12.15	15.30	3.3
Distillates	1.38	0.83	22.26	25.16	0.9
Total	4.60	3.73	14.40	17.50	4.2

SOURCE: Congressional Budget Office.

a/ Millions of barrels per day.

b/ Dollars per barrel.

c/ In billions of dollars.

The Tax on Utilities. The corresponding user tax for utilities would go into effect in 1983 at a flat rate of 25 cents per million BTUs. Based on the assumption that 90 percent of utility oil consumption would be residual fuel and that 1.4 million barrels per day in 1985 would be consumed, the tax revenues are estimated to be approximately $470 million in that year. (Chapter V explains this tax in detail.)

Increases in Production of Oil

The President's proposals attempt to provide incentives to seek new oil production by allowing the price of newly discovered oil to escalate within three years to 1977 world prices, adjusted for domestic inflation. The plan correctly states

that the revenues per barrel collected by the oil industry would be higher than in any other oil producing countries due primarily to the low production taxes or royalties permitted United States producers. Because domestic costs of production are also high relative to other countires, however, producers still argue that additional incentives are necessary.

CBO believes that the amount of oil produced in response to small price increases seems very limited. The increase in oil and gas prices since 1973 has been several times larger than the increase proposed by the plan, yet increases in production have been modest. It is questionable whether price increases above those proposed in the President's plan would stimulate substantial additional investment in exploration and development. Second, incentives such as decontrol of old oil would not necesarily be an efficient means of stimulating new production as this decontrol would not represent a rate of return on the new exploration and development, but mainly a windfall profit. It could, however, be argued that decontrol would improve the cash flow position of the industry. Most economists agree, however, that investment is influenced most heavily by the price of new oil (discovered after April 20, 1977) rather than by the average prices. Unless an industry cannot attract credit, and the oil industry has few such problems, the price of newly discovered oil would generally be the most important determinant of new investment. The National Energy Plan correctly states that the marginal prices proposed in the plan ($14.69 per barrel) would yield among the highest revenues per barrel available to the industry anywhere in the world.

In conclusion, it is possible that some huge new discoveries in virgin areas (the Atlantic, the Gulf of Alaska) could change the entire outlook. However, without those discoveries, the increase in prduction of oil will come from increased development of known but costly fields and advanced recovery from older fields.

This report projects that 200,000 barrels per day additional oil would be produced in 1980 as a result of the President's energy plan. About half of the increase is from advanced recovery, and half is from increased drilling of known but subcommercial pools or extensions. New discoveries as a result of enactment of the President's proposals could not be developed by 1980.

By 1985, production could be increased substantially but it is virtually impossible to make a prediction of how much at this time. There are few additional incentives that are efficient which can be created by using market mechanisms without explicit subsidies. Although the President's proposals have been criticized because they allegedly provide a few incentives for increased production, in fact, the plan does virtually decontrol prices of new oil and thereby rewards exploration and new production. The effects of the incentives will probably be modest but may be the best that can be expected. No amount of additional incentive is likely to substantially change the situation.

CHAPTER IV. THE NATURAL GAS PROPOSAL

The proposals in the Administration's energy plan related to natural gas are designed to accomplish four objectives:

- o to equalize the costs between interstate and intrastate markets
- o to place the burden of new high-priced discoveries of natural gas on industry, and thus encourage them to convert to the use of coal
- o to eliminate the possibility that producers could collect windfall profits because of new higher prices
- o to protect interstate residential consumers from supply curtailments

The specific proposals within the plan are: to merge interstate and intrastate markets by placing federal controls on intrastate production, thereby limiting intrastate price increases; to pass price increases through to large consumers; to place a user tax on industrial and large commercial consumers; and to restrict the construction of facilities that burn natural gas.

CBO analysis indicates that implementation of these proposals would accomplish the above objectives. Shortages or curtailments to industrial and residential customers would be greatly reduced or avoided, large price anomalies would be reduced and industry and electrical utilities would begin conversion toward use of coal and renewable energy resources. However, it is likely that the most significant impacts of implementation of these proposals would be felt after 1985.

But the plan has, however, been criticized by producers for not adequately stimulating new production. CBO analysis of these proposals does not concur with this criticism. Although prices for new gas are controlled under the plan, the proposed level of the controls (a cap of $1.75 per thousand cubic feet, at current prices) appears to be high enough to encourage exploration and new production, and it is unlikely that production would be much higher if prices were not controlled. Moreover,

if the prices were not limited, new gas prices could go as high as $4-$5 per thousand cubic, feet and producers could reap large windfall profits.

PROPOSED POLICY

Currently, natural gas is sold in two distinct markets: The interstate market, where natural gas prices are regulated by the Federal Power Commission (FPC); and the intrastate market, where prices are not controlled. In recent years, the intrastate price has been far above the interstate price allowed by the FPC. Interstate prices regulated at low rates have encouraged gas consumption and discouraged the search for new gas to supply the interstate system. Since 1970, over 90 percent of new reserves have been dedicated to intrastate markets. 1/

A key proposal in the Administration's energy plan is to end the distinction between the two markets by bringing intrastate gas under federal control. The price allowed for new gas in this combined market would be equivalent to the average price of domestic crude oil. This price is expected to be about $1.75 per thousand cubic feet in 1978. 2/ This price is higher than the price now allowed for new gas in the interstate market ($1.46 per thousand cubic feet), but lower than many of the prices now paid for new intrastate gas which vary from $1.50 to $2.00 per thousand cubic feet. 3/ In addition, the plan would authorize the establishment of higher price levels to provide an incentive for specific categories of high-cost gas.

1/ Federal Energy Administration, National Energy Outlook, February 1976, p. 9.

2/ New gas is defined as gas from a well more than 2.5 miles from an existing onshore well or more than 1,000 feet deeper than any well within the 2.5 mile radius. New offshore gas is defined as gas from lands leased after April 20, 1977. The price for new gas will be limited to the BTU equivalent.

3/ Federal Energy Administration, Monthly Energy Review, March 1977, p. 75.

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Under the President's plan, industries and electric utilities will be encouraged to switch from natural gas (and oil) to other fuels. Incentives to convert will be provided by use of incremental pricing and a user tax.

The incremental pricing proposal would require all utilities using or distributing natural gas to pass on all the additional costs of new, usually higher-priced, gas to consumers in industrial, large commercial, and electrical utility sectors. This proposal therefore buffers residential and small commercial users from increased prices, and, instead, places the burden of the higher prices on those consumers (utilities and industry) who are most able to convert to coal. CBO analysis indicates that incremental prices could be as much as three times higher than average prices currently in existence.

Starting in 1979, a user tax would be imposed on all large industrial users of natural gas except fertilizer producers and certain agricultural users. 4/ In 1983 a similar tax would be imposed on utilities that consume natural gas. Furthermore, federal regulations would prohibit the use of natural gas in new industrial boilers. Utilities and existing industrial facilities that can burn coal might also be prohibited from using gas in the future.

The President's proposals would also encourage the development of new gas supplies. For example, it would promote "full development" of the Outer Continental Shelf (consistent with environmental safeguards) and would allow additional imports of liquefied natural gas. A federal task force would be established to identify areas where additional synthetic natural gas plants could be built. Finally, research and development programs would be expanded to explore new sources of gas such as Devonian shale.

4/ Industrial users would be taxed by an amount equal to the difference between their average gas cost and a target price which is determined by the price of distillate oil. The proposal exempts small industrial users and proposes a graduated scale of taxable use for intermediate users.

TABLE IV-1. PROJECTED NATURAL GAS WELLHEAD PRICES AND QUANTITIES a/ SOLD: IN 1977

		1980		1985	
	1977	Present Policy	Carter Proposal	Present Policy	Carter Proposal
Interstate Gas					
Quantity b/	10.1	9.0	9.4	8.1	9.4
Price c/	78	97	104	141	147
Intrastate Gas					
Quantity b/	9.3	9.7	9.3	10.8	9.5
Price c/	92	149	139	205	166
Total National Average					
Quantity b/	19.4	18.7	18.7	18.9	18.9
Price c/	84.5	124	121	178	156

SOURCE: Congressional Budget Office.

a/ Quantity is net marketed production as defined by the U.S. Bureau of Mines.

b/ Per trillion cubic feet.

c/ Per thousand cubic feet.

As with the other components of the Carter plan, the proposals concerning natural gas are designed to conserve energy, to provide proper incentives for development of new gas supplies, to encourage coversion to coal, to allocate scarce resources among regions and consumers, and to avoid unnecessary costs to the consumer. The extent to which the proposals would attain these goals is addressed in the remaining parts of this chapter.

ENERGY IMPACTS

With or without implementation of the National Energy Plan, natural gas prices will be higher in the future and slighty less gas might be available. If enacted, however, the plan would make a difference in how high prices would be, what regions would bear the burden of the price increases, and what regions would receive the limited supplies.

The estimated prices charged at the wellhead and quantities of gas available in the interstate and intrastate markets with and without the Carter plan in 1980 and 1985 are shown in Table IV-1. Enactment of the Administration's proposal would mean that, in both years, customers served with interstate gas would find more gas available, but at somewhat higher prices. However, the gas that intrastate consumers received would be less expensive under the plan. 5/ For the nation as a whole, natural gas prices will be slightly lower with enactment of the plan.

Effects of the Proposals on Consumers

As shown in Tables IV-2 and IV-3, the President's natural gas proposals will affect various groups of consumers in different ways. This section will discuss the effects of these proposals on the availability of gas and the prices that would be paid by various groups of consumers. The subsequent section will discuss the effect of the proposed user tax on prices for industries and utilities.

Residential and Commercial. Residential and commercial users of natural gas would have slightly more gas available with enactment of the proposals. Furthermore, in both 1980 and 1985 implementation of the President's proposals would significantly reduce average fuel bills paid by residential and

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5/ It is often misleading to use average prices for the intrastate market. Many industrial customers are served directly by producers so that their rates will increase abruptly as new contracts are negotiated. In the interstate market, customers are usually served by distributors who co-mingle cheap and expensive gas so that prices charged to consumers often reflect average gas prices.

TABLE IV-3. PROJECTED CONSUMER PRICES OF NATURAL GAS BEFORE USER TAXES: IN CENTS PER THOUSAND CUBIC FEET

	1977	1980 Present Policy	1980 Carter Proposal	1985 Present Policy	1985 Carter Proposal
Residential Commercial					
Intrastate	192	249	202	305	222
Interstate	223	242	221	286	242
Industrial					
Intrastate	112	169	161	225	196
Lease and Plant	97	154	146	210	181
Interstate	118	137	170	180	237
Transportation					
Total	105	130	123	165	220
Utility					
Intrastate	112	169	141	225	196
Interstate	123	142	130	185	242

SOURCE: Congressional Budget Office.

TABLE IV-2. PROJECTED CONSUMPTION OF NATURAL GAS IN TRILLIONS OF CUBIC FEET

	1977	1980 Present Policy	1980 Carter Proposal	1985 Present Policy	1985 Carter Proposal
Residential and Commercial					
Intrastate	2.0	2.1	2.2	2.1	2.3
Interstate	5.5	5.7	5.7	5.5	5.9
Total	7.5	7.8	7.9	7.6	8.2
Industrial					
Intrastate	3.6	4.2	4.2	6.0	4.8
Lease and Plant /	1.6	1.1	1.1	0.9	0.9
Interstate	3.3	2.4	2.7	2.1	3.3
Total	8.5	7.7	8.0	9.0	9.0
Transportation					
Total	0.6	0.5	0.5	0.4	0.5
Utilities					
Intrastate	2.0	2.3	1.9	1.8	1.1
Interstate	0.8	0.4	0.4	0.1	0.1
Total	2.8	2.7	2.3	1.9	1.2
Grand Total	19.4	18.7	18.7	18.9	18.9

SOURCE: Congressional Budget Office.

commercial customers compared to what they would pay under continuation of present policy, particularly those served by intrastate sources. The gas prices paid by these groups would, on average, be 22 percent lower. Furthermore, both residential and commercial groups would be protected against curtailment of supply.

It should not be expected, however, that the availability of natural gas will permit many new homes to be serviced by gas.

Industry. In recent years, because of federal and state gas emergency allocation priorities, interstate industrial customers have borne the brunt of gas service curtailments. Because more gas would be available to consumers now served by the interstate systems than would be available under present policy, interstate industrial customers would have more gas available to them with the President's proposals. The additional supplies, however, will be at much higher prices than at present.

If the incremental pricing proposal were enacted, industries using gas would pay significantly higher prices than they would under present policy because the new higher prices would be passed on to them and to utilities and not to residential and commercial customers. The proposed user tax would further increase the price of gas for industry and utilities.

Industries served by interstate pipelines would receive less gas in 1980 under the Carter proposals than they do now, but as a result of general conservation measures in other sectors, gas supplies to industrial customers could increase after 1980. In the long run, the supply position of industries using interstate gas would be much better with implementation of the plan. Intrastate industry would have more gas available in 1980 and 1985 than it has in 1977, but less in 1980 and 1985 than it would have under present policy.

Electric Utilities. The proposed user tax on utilities burning gas is intended to encourage a significant number of utilities to convert from gas (and oil) to coal. However, if this user tax were implemented, it would not go into effect until 1983. Thus any significant conversions by utilities would not take place until after 1983. At present the prices

paid by utilities using intrastate gas are actually substantially lower than the prices they would have to pay for alternative fuels. By 1985, however, electric utilities would be using about 37 percent less gas with the plan.

The Effect of the User Tax on Natural Gas Prices

If the President's plan were enacted, a user tax for industrial consumers of natural gas would go into effect in 1979. In 1979, the tax would be the difference between the specific price charged the industrial consumer, and a target level which would be set at about $1.05 per thousand cubic feet below that of competing liquid fuels (distillate fuel oil would sell for the equivalent of about $3.05 per thousand cubic feet). The target level would escalate each year until 1985 when it would equal the price of distillate. The expected prices and tax revenues for industrial users (gas use in transportation is not included) are summarized in Table IV-4.

By 1980, the price of distillates is expected to be equivalent to about $3.09 per thousand cubic feet, and the target price would be $2.69 per thousand cubic feet. Industrial prices should range from a low of about $1.46 per thousand cubic feet for field use of intrastate gas to about $1.70 per thousand cubic feet for average interstate gas. The tax (the difference between the specific price and $2.69 per thousand cubic feet would therefore apply to virtually all marketed gas in 1980 except for that proportion exempted for small consumers. Total revenue to the treasury is expected to be about $6.1 billion in 1980 (in 1977 dollars).

In 1985, the price of distillates is expected to be about $3.32 per million BTU, and the target price in that year equals the distillate price. Virtually all industrial gas would be sold at delivered prices below the target and would therefore be subject to the user taxes. Revenue in 1985 would be approximately $8.0 billion.

In summary, natural gas prices paid by industrial users would more than double from 1977 to 1980. Of the increase in prices, about one third would be due to increased prices in the field--much of which would occur even without implementation of the President's plan. The remainder of the increase is due to the user tax. Prices would increase another 23 percent in real terms by 1985. Furthermore, despite differences in wellhead prices for intra and interstate gas, all classes of industrial users would be paying identical gas prices under the President's plan.

TABLE IV-4. PROJECTED INDUSTRIAL PRICES AND TAX REVENUES

	Quantity Subject to Tax a/	Average Price Before Tax b/	Average Price After Tax b/	Average Tax b/	Revenue (In billions of dollars)
For 1980					
Intrastate	2.8 c/	161	269	108	3.0
Lease & Plant	0.6 c/	146	269	123	0.7
Interstate	2.4 c/	170	269	99	2.4
				Total Revenue	$6.1
For 1985					
Intrastate	3.2 c/	196	332	136	4.4
Lease & Plant	.5 c/	181	332	151	0.8
Interstate	3.0 c/	237	332	95	2.8
				Total Revenue	$8.0

a/ In trillion cubic feet.

b/ In cents per thousand cubic feet.

c/ An estimated 25 percent of intrastate gas would be exempt from user taxes (petrochemical and fertilizer feedstocks, agriculture uses, or field use) and about 50 percent of lease and plant uses would be exempt. Furthermore, about 10 percent of intrastate and interstate consumption would not be "taxable use" as defined in Sec. 4992 of the proposed National Energy Act.

As stated earlier a similar user tax is proposed for electrical utilities, beginning in the year 1983. By the year 1985, utilities would pay a tax based on the difference between the price of distillates, less $.50 per thousand cubic feet, and the specific price of gas paid by the utility. On average, interstate utilities should expect prices averaging about $2.42 per thousand cubic feet in 1985, and intrastate utilities should expect prices of about $1.96 per thousand cubic feet. As a result, interstate utilities will be taxed about $.40 per thousand cubic feet on the average. The tax for intrastate utilities would be about $.86 per thousand cubic feet. Because some specific interstate utilities might have contracts in excess of the target, only 90 percent are estimated to pay taxes. Virtually all intrastate utilities would pay taxes. Total tax revenues are estimated to be about $1.0 billion in 1985.

Increases in Production

Prices received by the majority of onshore producers of new gas are presently between $1.50 per thousand cubic feet and $2.05 per thousand cubic feet (the price of new intrastate contracts). 4/ Offshore producers would pay a price of $1.46 per thousand cubic feet because Outer Continental Shelf (OCS) gas can only be sold in interstate markets. The President's plan would combine the markets and limit the price to $1.75 per thousand cubic feet in 1977. This price would escalate in real terms, depending on the price of domestic crude oil. Under present policy, average new intrastate prices, are projected to escalate to about $2.55 per thousand cubic feet by 1985; under the President's plan, the equivalent new gas price would be about $2.08 per thousand cubic feet.

CBO's analysis concludes that exploration and development of new reserves would be stimulated by increased prices, but that the difference in impact between the prices both under present policy and under the President's proposals would be very small--certainly not enough to elicit a measureable difference in production by 1980. By 1985, however, the increase in interstate prices should stimulate slightly more production from the OCS than would occur under present policy. This increase will probably compensate for the projected decrease in new intrastate gas production.

The President's Plan forecasts that under a continuation of present policies, intrastate prices for new gas would plateau or even decline because of an expected increase in gas supplies as a result of recent price increases. This forecast is controversial. Some assert (primarily industry experts) that producible reserves are lower than recent federal estimates and that the amount of new production will be disappointing. They believe, therefore, that intrastate new contract prices will continue to rise toward the price of alternative fuels (about $2.80 per thousand cubic feet).

4/ "Summary of Intrastate Natural Gas Prices," Federal Power Commission, as reported in Monthly Energy Review, Federal Energy Administration, March 1977, p. 75.

If prices were to level off, or recede somewhat, the price cap in the President's plan would pose no constraint to prices and the free-market price would float somewhere below the cap. The purpose of the cap would be to avoid producers charging prices which distributors could "roll-in" with their older supplies. The projections in this analysis, however, indicate that the proposed cap is below the potential market price, but probably not to an extent to affect exploration or production to a significant degree when combined with a projected increase in OCS production.

Finally, it is noted that some pricing provisions of the plan seem inconsistent with the aim of achieving high levels of gas production without providing windfalls to the producers. For example, there seems to be no justification for allowing expiring contracts for interstate gas to be renewed at prices as high as $1.42 per thousand cubic feet. This would appear to be an invitation to windfall profits for some producers.

CHAPTER V. COAL CONVERSION

Several of the proposals in the National Energy Plan involve encouraging or requiring the substitution of coal for oil and natural gas in industrial and public utility use. In fact, more than half of the anticipated savings in imported oil by 1985, projected in the President's plan, would be the result of coal conversion.

Although, CBO is in general agreement with the President's estimates of public utility uses, it is skeptical that the amount of industrial conversion envisioned by the Administration will be forthcoming by 1985. The President's plan anticipates an increase in the industrial consumption of coal from 156 million tons in 1977 to 410 million tons in 1985. Most of the increase would take place in non-metallurgical coal which would have to increase from 70 million tons in 1977 to 305 million tons in 1985. The Administration estimates that the attainment of this goal would require that 10 percent of all existing industrial facilities burning oil or gas and 44 percent of newly constructed industrial facilities would have to convert to coal. This contrasts with the continuation of current policy where only 12 percent of new industrial facilities would burn coal in 1985.

CBO agrees with the Administration's estimate of a 10 percent conversion of existing industrial facilities, but projects only a 33 percent increase in new industrial uses with implementation of the President's proposals. A 33 percent increase would result in total coal consumption by industry of 360 million tons by 1985--50 million tons short of the Administration's projections. In terms of barrels of crude oil equivalents, CBO conversion estimates translate into oil import savings of 1.8 million barrels per day which is 0.6 million barrels below the President's estimate.

The lower estimate of industrial coal conversion provided by CBO is based on the difficulties of altering existing planned construction, the problems that may arise with transporting coal to the factory, environmental restrictions and the desire of industry to take full advantage of the rebate system by stretching out new construction.

It is possible, however, that the additional 50 million tons of coal production estimated by the Administration could be achieved if more stringent regulations regarding future burning of oil and gas were imposed by the Administration, or if the above problems prove easier to solve.

PROPOSED POLICIES

The immediate goal of the President's proposed coal program is to increase the production of coal, presently at about 680 million tons per year, by 400 million tons per year by 1985. This increase is to be encouraged primarily through the use of price incentives and regulation, implemented without adverse effects in the environment.

A second goal is to provide efficient, economically feasible technologies for the longer term that will support the substitution of coal for oil and gas.

Two types of taxes have been proposed to further the incentive to conversion to coal. The first, designed to increase the price of domestic oil, has been discussed in detail in Chapter III of this paper. The second, a users tax plus rebates is designed specifically to encourage the use of coal in new and existing facilities.

If this users tax is implemented, industrial users of oil would be taxed beginning in 1979 at about $0.90 per barrel. This tax would increase to about $3.00 per barrel by 1985. Industrial users of natural gas would also be taxed. This tax would be imposed in 1979 and would be the difference between the average price of natural gas and a target price that would be set in 1979 at about $1.05 per thousand cubic feet below the price of other liquid fuels--such as distillate oil. The target price would increase incrementally each year until 1985. At that time, the price of natural gas would equal that of distillate.

Public utilities would also be taxed under the President's plan but the tax on utilities would not be implemented until 1983. At that time, an additional tax of about $1.50 per barrel would be applied to all oil burned by utilities.

Utilities burning natural gas would pay a tax based on the difference between their cost of gas and the equivalent BTU price of distillate. This tax would also begin in 1983 and would be imposed in the same fashion as the tax on industrial users of gas except that the target price would be set at about $0.50 per thousand cubic feet below the price of distillate oil.

Since it is less feasible for economic reasons for small industrial users to convert to coal, users consuming less than 500 billion BTUs per year--about 90,000 barrels of oil per year--would not be required to pay tax.

A major component of the proposed user tax is the existence of tax rebates to industries that convert to coal. An industrial user would have the option of either using an additional 10 percent investment tax credit or taking a rebate of up to that year's oil or gas tax and investing the rebate in coal conversion. Utilities would have the option of receiving a rebate on the user tax paid to be used for new construction which would help accelerate the retirement of facilities burning gas or oil.

President Carter's coal conversion program also includes restrictions on the burning of natural gas:

- With only limited exception, no new boilers would be constructed that burned either oil or natural gas.
- Other industrial facilities could be prohibited from burning natural gas.
- Existing boilers capable of burning coal could be prohibited from burning oil or natural gas.
- Utility boilers would be prohibited from burning gas after 1990, with certain limited exceptions.
- Any industrial facilities burning coal would need permits to shift to oil or gas, and utilities would need permits to shift from gas to oil.

An integral part of any coal conversion program is a policy regarding the effects of conversion on the environment. The President's plan would require that the best available technology be applied to clean up all coal burning plants. At present, this requirement would make scrubbers (flue gas disulfurization)

mandatory in all large coal-fired facilities whether or not low sulfur coal is used, thus reducing the pressure to use low sulfur western coal.

Although not a part of the present energy plan before the Congress, proposals to fund expanded research and development (R and D) in the area of coal technology will eventually become part of an overall energy policy. New R and D initiatives would probably include accelerated research on ways to clean coal before it is burned and to clean the smoke from coal burning; plus demonstrations of new ways to process and burn coal (e.g., fluidized bed combustion and low BTU coal gasification). These efforts would not include subsidies for existing BTU gasification technologies.

ENERGY IMPACTS

Unless converted to liquid or gaseous form, coal is inconvenient to use except as fuel for relatively large, stationary boilers. Consequently, the market for coal is likely to be greatest for the electric utilities and large industrial consumers that have such boilers. Demand for coal is sensitive to its price and availability and to that of alternative fuels. Air pollution regulations, and the cost of coal-fired facilities and related coal handling equipment also affect its use.

In 1976, U.S. coal production was 681 million tons, which included 459 million tons for electric utilities, 6 million tons for household and commercial consumers, 156 million tons for industrial users, and 60 million tons for export. Total domestic coal consumption was 621 million tons.

Different assumptions about factors affecting coal demand can give rise to very different projections of coal consumption in 1985. Various estimates project that under present policy, domestic coal consumption in 1985 could be as low as 730 million tons, or as high as 1,305 million tons.

The projections of present policy assume that oil price controls will be continued, interstate natural gas will be regulated at $1.42 per thousand cubic feet by the Federal Power Commission, air pollution standards will require either scrubbers or low sulphur coal, coal conversions required under present law are carried out, world oil prices are constant in real dollars, and real coal prices rise at about 2 percent per year.

The projections for the President's coal conversion proposals assume that the wellhead taxes on crude oil and industrial and utility user taxes will be implemented, the rebates will be available, and regulatory restrictions on burning oil and gas will be implemented. The major variables affecting coal demand that are not components of any of the above assumptions are: the relative capital cost of coal and the use of nuclear power by utilities. Consequently, considerable uncertainty about coal demand remains.

Utility Coal Consumption

For the present policy projections, coal demand by electric utilities has been estimated to increase to about 768 million tons by 1985, resulting in an annual rate of increase of 5.9 percent.

Under the President's proposals utility demand for coal has been estimated to increase to about 777 million tons by 1985 which is in general agreement with present policy projections.

Electric utilities will find coal superior to oil and gas as fuel for new base-load facilities given almost any set of energy prices. 1/ The level of coal demand for new baseload facilities will depend on total electricty demand and on the coal-nuclear mix. Under present policy, construction of new coal-fired power plants to substitute for existing oil-fueled base-load facilities will probably also be economically attractive to utilities.

However, substitution of coal for oil in intermediate-load facilities is less likely to be attractive until oil price controls are removed and domestic oil prices rise. The price of utility fuel would have to go substantially above current world coal prices before it would become attractive to construct new coal-fired facilities to substitute for existing oil-fired plants in intermediate load service. 2/

There are various reasons why implementation of the President's coal conversion program would result in only a small

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1/ Council on Wage and Price Stability Staff Report, A Study of Coal Prices, March 1976, pp. 52-53.

2/ Federal Energy Administration, 1976 National Energy Outlook, p. 182.

increase in the use of coal in utilities by 1985. In brief, these reasons relate to proposed requirements for protecting the environment, and long lead times associated with building new facilities.

- o Environmental Restrictions. The proposed environmental standards for coal use would require the best available pollution control technology for all new facilities (including those burning low sulfur coal), thus increasing the capital cost of coal-fired plants. Consequently, because of these restrictions, a slightly larger number of utilities would turn to nuclear power than is anticipated under present policy. However, this factor will not be of any great significance until after 1985.

- o Long Lead Times. Over the past few years, construction of a significant number of coal-fired power plants has already begun, many of which are scheduled to begin operation in 1978-1981. 3/ However, it is not likely that these plants will be affected by the President's proposals. Any concentrated effort to construct new coal-fired plants, resulting from the coal conversion program, will mean that these plants will not become operational until well after 1985, because of the long lead time needed to construct the facilties. However, conversion of existing facilities, when technically feasible, may occur more quickly.

Industrial Coal Consumption

The key to the President's coal conversion program is the conversion of industrial facilities from oil and gas to coal. The success of industrial conversion will account for nearly all of the difference between present policy projections of coal consumption and projections of the President's proposals. Indus-

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3/ R. L. Gordon, The Future of Western Coal, Chapter 5; and Marketing Prospects for Western Coal, a report to the National Science Foundation, Grant Number OEP-75-20827, December 1976, Chapter 5, pp. 31-34.

trial consumption of metallurgical coal will increase somewhat, but will be the same in 1985 whether the coal conversion program is enacted or not.

Fossil fuels are presently used in industrial settings in four ways:

- o to generate steam
- o to generate electric power
- o as a source of direct heat
- o as feedstocks

The major growth in demand for coal will be for those uses, exclusive of feedstocks, which in 1968 resulted in 89 percent of all industrial fossil fuel consumption. 4/

The economics of coal transportation and combustion technology make the costs of burning coal much higher for smaller installations than for larger ones. Therefore, it is not feasible to anticipate that all industrial facilities could convert to coal to generate steam and electric power in the foreseeable future. Furthermore, small installations may find meeting air quality standards more difficult if they convert to coal. 5/ There will be further difficulties in converting to coal as a source of direct heat because of elements in the coal--such as sulfur--that may contaminate the product being heated.

Projections of present policy indicate that industrial demand for non-metallurgical coal will increase by 4 percent a year reaching about 100 million tons by 1985. Combining all industrial uses for coal will create a demand for about 206 million tons in 1985, under present policy.

4/ R. L. Gordon, Historical Trends in Coal Utilization and Supply, August 1976, prepared for U.S. Bureau of Mines, Chapter 7, pp. 3-5.

5/ If new technology, such as the fluidized bed combustion passes the demonstration stage soon, industry may be able to use more coal in small installations.

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President Carter's energy proposals for coal conversion combine economic incentives with user taxes and regulatory restrictions to convince various energy sectors to convert both new and existing facilities to the use of coal. However, projections of energy use in industry indicate that even if gas were taxed at a rate higher than that proposed by the President, most industrial facilities would still substitute gas for coal if the gas were available. Consequently, oil and gas taxes and conversion incentives by themselves may be ineffective in discouraging the use of gas as a primary energy source in industry.

On the other hand, direct regulatory restrictions on gas use, also proposed by the President, would transfer the demand for gas to oil or coal.

The Administration estimates that the President's proposals would result in the conversion of about 10 percent of existing industrial facilities from oil and gas to coal plus the substitution of coal for oil and gas in about 44 percent of new facilities by 1985.

This conversion and substitution is estimated by the Administration to result in industrial non-metallurgical coal consumption of nearly 305 million tons by 1985, a growth rate of 16 percent per year. This is an increase of 200 million tons over estimated demand under present policy. About 50 million tons of the increase is due to conversion of existing facilities and about 150 million tons would result from the substitution of coal for oil and gas in new facilities.

CBO analysis concurs with Administration estimates of a conversion to coal by 10 percent of existing facilities by 1985. However, CBO estimates conclude that 33 percent of new facilities would substitute coal for oil and gas by 1985 instead of the 44 percent estimated by the Administration, if the President's proposals were implemented. Various problems exist which CBO believes may affect the Administration estimates. These include the exemption of user taxes on small facilities, facilities already planned or under construction which may not be able to convert to coal, difficulty in meeting environmental standards, difficulties in transporting coal to newly constructed facilities, and the stretching out of construction of new facilities beyond 1985 to gain optimal benefits from tax incentives. However, it is possible that a strong regulatory program which simply prohibited most non-coal facilities and strong government efforts to solve the aforementioned problems could increase coal production closer to the Administration estimates.

CBO estimates that if the President's coal conversion proposals were implemented, non-metallurgical industrial coal consumption in 1985 would be about 150 million tons more than consumption estimated under present policy, resulting in a growth rate of about 14 percent. Although CBO estimates indicate 50 million tons less in industrial coal consumption by 1985 than the Administration estimates, it is likely that if these estimates were projected to 1990, CBO and the Administration estimates would differ only slightly.

The export of coal would, on the whole, not be affected by the President's proposals. Thus, estimates of exports under present policy and with implementation of the President's proposals do not differ. The projections suggest an increase in the amount of coal exported from about 60 million tons in 1976 to 90 million tons by 1985. Estimated coal consumption for various sectors, both under present policy and under CBO estimates of the President's proposal, is shown in Table V-1.

TABLE V-1. COAL CONSUMPTION (MILLION OF TONS)

Coal Consumers	Current Policy 1976	Current Policy 1985	Carter Policy 1985
1) Electric Utilities	459	768	777
2) Household/Commercial	6	2	2
3) Industrial	156	206	360
4) Exports	60	90	90
Total	681	1,066	1,229

SOURCE: National Energy Plan and Congressional Budget Office.

SUPPLY OF COAL

The success of conversion from gas and oil to coal is more likely to be constrained by inadequate demand than by inadequate supply.

U.S. coal reserves are concentrated in the Appalachians, the Midwest, and the Northern Great Plains. Most Appalachian and midwestern coal has higher heating value and higher sulfur content than does Great Plains coal. Appalachian and midwestern coal is also more expensive to mine, because it is found in thinner, deeper seams than the Great Plains coal which can be easily strip-mined. However, Great Plains coal is located further from major electricity markets, and thus, carries higher transportation charges. Great Plains coal reserves are also sufficiently large and of such even quality that production can be expanded without increasing unit costs. Costs of producing coal in other regions are likely to rise as it becomes necessary to utilize less accessible and lower-quality reserves. The amount of western coal that finds its way to eastern markets will depend on relative production costs in the different regions, transportation costs, and on the premium users are willing to pay for low-sulfur coal.

Financing for coal mine expansion has been cited by some authorities as a potential constraint to increasing coal production. However, financing is readily available to any mining concern with long-standing contracts with its customers. These contracts can be used as collateral to provide financing for new operations. If the demand for coal continues to increase, the desire for contracts by coal users will also increase, 6/ as will the collateral.

If conversion to the use of coal is undertaken to the extent estimated in the President's proposals, coal production could fall short in the short term. And the mismatch of short-term demand and supply could cause sharp coal price increases which could, in turn, create decreases in future coal demand. The phasing in of user taxes as proposed may greatly mitigate such effects.

6/ Mitre Corporation, Report on Potential Constraints to Coal Supply, January 1975.

In all of these projections of the increase in coal supply one very large uncertainty remains. The effect of an increase in coal production in the West from about 100 million tons now to near 400 million tons in 1985 will require a great effort to mitigate adverse effects on the environment, transportation systems, and the life of western communities. To the extent that these issues cannot be easily solved, coal prices may rise and production may be reduced. Since utility consumption has to be contracted in advance, it is likely that any net reduction of western production that may occur will reduce the conversion of industries which are more dependent on shorter-term commitments. Of course if this results in simply a shift to eastern coal, industry may still have adequate coal, at somewhat higher prices.

OTHER IMPACTS

Consequence of Environmental Restrictions

The most significant problems associated with future coal use relate to the adverse effects on the environment of coal production and use.

Strip-mining of coal is a very visible example of the deleterious effects to the environment of coal production. Strip-mining necessitates excavating very large land areas. This land must be completely restored and revegetated in order to be used for other purposes. There is some question about the feasibility of restoring strip-mined land in the Great Plains coal fields; eastern strip mines can be restored, but at a cost that could be as high as $4.85 per ton of coal mined. 7/ Mining can also adversely affect water supply and quality. More sulfur oxides and particulates are emitted into the atmosphere by typical coal-burning installations than would be emitted by similar facilities burning oil or gas. Measures that would mitigate these effects are available, at a cost.

The stringent application of environmental regulations, coupled with the desire to increase dramatically the use of coal in all energy sectors, creates a paradox. Furthermore, should environmental goals become even more ambitious, it is possible that expanded use of coal will become relatively less desirable.

7/ Council on Environemntal Quality estimates cited in Council on Wage and Price Stability, Study of Coal Prices, p. 79.

This could be true particularly for use of coal by small industrial facilities, or in facilities that do not have a long history of pollution control.

However, for the time being it is likely that coal use and production will respond to government incentives whether stringent or lenient environmental regulations are chosen. But stringent standards and rapid development may be consistent only if substantial expenditures to compensate for higher coal costs or penalties on the use of other fuels are imposed.

BUDGET IMPACTS

If the President's coal conversion proposals were implemented, user taxes on industrial and utility oil and gas consumption would be phased in over a five-year period. Industrial users of oil and gas converting to coal would be eligible for a rebate of these taxes paid in any given year, not to exceed investment expenditures on "alternative energy property"--i.e., property that qualifies for the rebate plan--in the same year. Qualified expenditures in excess of the firm's user tax each year could be carried forward and claimed as a rebate of a future year's user taxes. Industrial firms would have the option of electing--on a once and for all basis--an additional 10 percent investment tax credit instead of the rebate plan.

The user tax itself increases the incentive to use coal by raising the cost of oil and gas relative to coal. The rebate reduces the capital cost of acquiring coal-burning equipment; together the two give a strong incentive to use coal rather than oil or gas.

The user tax is a business expense deductible from sales revenues in computing taxable income. CBO estimates assume that the businesses will pass the user tax through to their customers in higher sales prices, thus increasing sales revenues by the amount of the tax. Under this assumption the user tax will not change businesses' income tax liability. 8/ Every $1.00 of

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8/ On the other hand, to the extent that a dollar of user tax is not "passed through," then, as corporation income is taxed at the 48 percent corporate rate, every dollar of user tax paid will reduce corporate income tax liability by $0.48. The net tax bill to the corporation will be $0.52 and thus total federal tax revenues will increase by only $0.52.

eligible investment can earn a rebate of $1.00 of user tax. But in electing the rebate the firm loses its income tax deduction for that amount of user tax. The net result then is to provide the firm with a taxable cash grant of $1.00 or $0.52 after tax at the 48 percent corporate tax rate. Therefore, as compared to the option of an additional 10 percent investment tax credit, firms often will be better off paying the user tax and obtaining a rebate. As a result, there will be an incentive to delay conversion of part of a firm's oil- and gas-burning facilities, so that the firm can obtain the largest possible rebate.

User taxes would also be collected from electric utilities. The rebate mechanism is available for utilities but the additional investment tax credit option is not. The definition of qualifying investment is broader for utilities than for other enterprises.

CBO estimates that user tax liability for industries that have not converted to coal would be about $8.2 billion in 1980 rising to $12.2 billion in 1985. The total tax liability for these industries during the period 1979-1985 would amount to $64 billion in 1977 dollars.

The rebate would substantially reduce this tax liability. The cost of constructing a new asset is large compared to the amount of tax a firm will pay for using oil and gas. Therefore, investments that account for even a small proportion of existing capacity can absorb a large proportion of the excise tax. For example, CBO estimates that the cost of converting to or using new coal facilities would be in the neighborhood of $7.5 billion for each quad of energy. The tax on a quad of gas used in 1985 would be about $1.2 billion and the tax on a quad of oil would be about $0.5 billion. CBO estimates that the President's proposals would result in conversion of 10 percent of existing oil and gas uses and the substitution of 33 percent of all new fossil fuel uses for coal, thus rebating between 1970 and 1985 $38 billion and reducing tax revenues to $26 million over the period.

Utility tax liability would be considerably smaller. It would only begin in 1983 amounting to about $1.5 billion each year. Because of the requirement to retire all gas-fueled generators by 1990, it is quite likely that all of this tax will be rebated to defray costs of retirement.

CHAPTER VI. AUTOMOBILE-RELATED PROPOSALS

The automobile-related provisions of the President's energy proposals are aimed at reducing gasoline consumption 10 percent below current levels by 1985. The plan is to:

- o encourage the manufacture and purchase of cars that are more fuel-efficient through a system of taxes and rebates that would make more efficient cars cheaper and less efficient cars more expensive for the buyer;

- o encourage people to drive fewer miles by imposing taxes that would raise the price of gasoline.

CBO analysis indicates that the President's proposals--combined with fuel-efficiency regulations already on the books--would indeed cut automotive gasoline consumption but probably by no more than 5 percent below current levels by 1985.

The goal of 10 percent reduction in gasoline consumption by 1985 is ambitious, considering that motor gasoline consumption increased an average of 4.5 percent per year between 1965 and 1975. Legislation already on the books, however, as well as the delayed effects of post-embargo gasoline price increases, will slow future increases in gasoline consumption even if no further steps are taken. This slowing will take place as auto manufacturers adjust to higher fuel prices and to existing energy legislation by producing cars with improved fuel economy. It will become evident in national gasoline consumption when, during the next decade, these new fuel-efficient vehicles are phased in and the nation's auto fleet as a whole reflects substantially upgraded fuel economy.

CBO projections presented later in this chapter indicate that, because of improvements in auto fuel economy anticipated under present policy, the gasoline cost per mile of driving a new car in 1985 will be 18 percent lower than it is now. Because of reduced fuel costs per mile and increased affluence, the number of vehicle miles of travel per household in 1985 is projected to be over 20 percent higher than it is now.

There has been considerable public concern about the adjustments in travel which the American people will be forced to make in response to the President's plan. By and large, these adjustments are really slowdowns in the rate of the rise of the standards of living between now and 1985. But even with the rate slowed, the standard in 1985 would still be higher than it is now. For example, the average American family now drives slightly less than 15,000 miles per year. Under the plan, they would likely drive 17,000 miles in 1985, which is more than they drive now even though it is less than the 18,000 miles they would drive without the plan. Similarly, the cost per mile of fueling cars will be lower in 1985 under the President's plan than it is presently, although it would still be lower in 1985 under a continuation of present policy.

Three programs in the President's proposals are likely to reduce future automotive gasoline consumption. The "gas-guzzler" excise taxes and rebates for new cars appear to offer the greatest fuel savings. CBO estimates fuel savings for the gas-guzzler program to be 215,000 barrels a day in 1985 and 450,000 barrels a day in 1990, savings slightly above those projected by the Administration for this program. The crude oil equalization tax would have only minor effects on gasoline consumption, reducing it by about 40,000 barrels a day in 1980, 25,000 barrels a day in 1985, and even less thereafter. The standby gasoline tax could eventually lead to significant fuel savings, but CBO expects only moderate effects by 1985. The stringent gasoline consumption goals contained in the President's plan are projected to trigger the standby gasoline tax from 1982 on, producing additional fuel savings of 65,000 barrels per day in 1985, and 200,000 barrels per day in 1990. Taken together, CBO estimates these three program elements lead to total gasoline savings, relative to present policy, of 305,000 barrels per day in 1985, and 650,000 barrels per day in 1990.

The greater the fuel savings from other measures, the later the standby gasoline tax will be triggered, and consequently, the smaller the savings attributable to the standby tax by 1985. Both the extent of diesel usage within the auto and truck fleets and the stringency of fuel-economy standards to be set for light trucks under the EPCA will play major roles in determining when the standby tax is initially triggered. More diesel usage and more stringent light-duty truck standards could delay triggering

of the standby gasoline tax from 1982 (as projected by CBO) until 1984. On the other hand slower developments in these highly uncertain areas could lead to 1985 motor gasoline consumption that exceeds the Administration target by anywhere from 400,000 to 740,000 barrels per day. The Administration projects 1985 gasoline consumption of 350,000 barrels a day above target without consideration of the standby gasoline tax. Given the magnitude of the differences between the likely outcome and the target projected by both the Administration and CBO, 1985 gasoline consumption is not likely to be held beneath the target that will trigger that standby gasoline tax.

In short, President Carter's program produces sizable gasoline savings--equivalent to about 20 days of auto gasoline use in 1985 and 45 days in 1990. The provisions contained in these proposals do not appear to be sufficient, however, to meet his goal for 1985 gasoline consumption. CBO expects 1985 automobile gasoline consumption under the President's program to be only about 5 percent beneath that experienced in 1976, compared with the 10 percent reduction called for by the President.

Trucks hold the key to narrowing the gap between actual and target gasoline consumption in 1985. There is now one truck for every four cars registered in this country, and the number of light-duty trucks continues to soar as vans, pick-ups, and recreational vehicles increase in popularity. Because of the great variety of trucking equipment and operations, federal programs for trucks can be cumbersome, particularly for heavy trucks, and current truck fuel-economy programs lag behind those for automobiles. As yet to be specified fuel-economy standards for light-duty trucks, authorized by the Congress under the Energy Policy and Conservation Act, will play a key role in shaping an effective and even-handed policy for transportation fuel conservation.

PROPOSED POLICIES

Three of President Carter's energy proposals could have particularly strong impacts on automobile sales, ownership, use, and fuel consumption:

- Crude oil provisions (price controls and equalization taxes) that would effectively bring domestic crude oil prices up to the world price by 1980 and that would increase them at the rate of inflation thereafter.

- Graduated gas-guzzler excise taxes and rebates imposed on new cars on the basis of their fuel economy. Similar taxes and rebates would be imposed on light trucks.

- A standby gasoline tax of up to 50 cents per gallon, imposed in five-cent increments starting in 1979, if actual gasoline consumption exceeds a predetermined target level for each year.

This chapter explores the likely automobile-related consequences of these proposals. 1/ Before examining the effects of the Administration program, each of these auto-related proposals will be summarized and major areas of uncertainty specified.

Crude Oil Equalization Taxes

As noted above, the President's proposal includes measures that would levy a tax on domestic crude oil to bring its net price up to the prevailing world price by 1980. This would in turn increase the price of gasoline at the pump in future years.

Gas-Guzzler Excise Taxes and Rebates

The so-called gas-guzzler provisions of the President's program are excise taxes and rebates for auto manufacturers 2/

1/ The term "automobile" in this report refers to conventional passenger cars and does not include light-duty trucks as does the same term in the Administration's proposed energy bill.

2/ The proposed act would require manufacturers to validate that the rebates and taxes had been passed along to vehicle purchasers. Inclusion of the tax or rebate as a separate item in computing the sticker price would apparently constitute such validation. The act would not prohibit manufacturers from raising the price of vehicles nor from passing along the costs of technological changes made in order to improve fuel economy.

based upon the fuel-economy ratings of new cars that they sell. The objective of this proposal is to provide an additional incentive to automobile manufacturers to improve the fuel economy of their cars and to encourage consumers to purchase vehicles that are fuel-efficient.

The Energy Policy and Conservation Act of 1975 (EPCA, P.L. 94-163) established a set of gradually more stringent new car fuel-economy standards to be implemented between 1978 and 1985. An auto manufacturer who does not meet these standards is liable for civil penalties based upon the degree to which the average fuel economy on its cars falls short of the standards. On the basis of CBO's analysis, it does not appear that the standards and noncompliance penalties built into current law are sufficiently strong to induce full compliance in all future years. Indeed, the analysis presented later in this chapter indicates that, in the absence of further policy changes relative to auto fuel economy and gasoline prices, EPCA standards will yield an average new car fuel economy of only 23.3 miles per gallon (mpg) in model year 1985, well short of the statutory standard of 27.5 mpg.

The gas-guzzler element of the Administration's program is designed to reinforce the existing standards. As stated earlier, the President's proposal calls for imposition of a set of graduated excise taxes and rebates based upon the relative fuel consumption of new vehicles. As proposed, taxes (in current dollars) would range from $449 for a 12-mpg car to a rebate of up to $473 for a 38-mpg car in model year 1978. In 1985, the corresponding figures would be a tax of $2,488 for a 12-mpg car and a rebate of up to $493 for a 39-mpg car.

In each future year, the proposed tax/rebate schedule uses the current EPCA miles per gallon standards as the dividing line between those cars subject to taxes and those eligible for rebates (for example, 18 mpg for 1978 and 27.5 mpg for 1985).

The magnitude of taxes and rebates increases throughout the 1978-1985 period; but in any single year the differences between tax and rebate entries are roughly proportional to the fuel savings implicit in each extra mile per gallon. For example, if cars are assumed to travel 10,000 miles per year, then improving a car's fuel economy from 12 to 13 miles per gallon saves 64

gallons of fuel per year. Similarly, a simple computation shows that improving a car's fuel economy from 35 mpg to 36 mpg yields fuel savings of 8 gallons per year. Thus, the extra fuel savings associated with one mpg improvement to the 12 mpg car are about eight times those of a one mpg improvement to the 35 mpg car. The Administration tax/rebate schedule reflects these fuel savings by including large steps in the schedule for fuel-economy improvement at the low-mpg end of the table, and small rebate differences for improvements toward the high-mpg end.

Under this proposal, the rebate side of the table would not be specified for future years, however, but would be adjusted from year to year so that rebate payments just balance tax collections. That is, the net tax collections under the gas-guzzler proposal would be zero.

One major area of uncertainty in this proposal is the treatment of imported cars. Since imports are generally smaller and more fuel efficient than domestic cars, the rebates for them would be substantially larger than for the average domestic car if they are treated on the same basis as domestic cars. Thus, equal treatment of foreign and domestic cars could be viewed as a substantial subsidy for foreign automobile production, while omission of foreign cars from the rebate system could be viewed as a trade barrier with effects similar to a tariff.

The actual rebates for imported cars will be determined through negotiations with individual countries to "develop equitable rebate agreements." 3/ The Administration's proposed legislation is no more specific, declaring that the agreements with foreign countries "...shall be designed to assure that manufacturers of domestically manufactured automobiles are not disadvantaged...." 4/ At this writing, the exact mechanism of achieving this goal is yet to be specified.

Another major uncertainty involves the treatment of light trucks. Under the Energy Policy and Conservation Act, the Secretary of Transportation is authorized to promulgate efficiency

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3/ Executive Office of the President, Office of Energy Policy and Planning, The National Energy Plan, 1977, p. 38.

4/ The National Energy Act, H.R. 6831, Title II, Part B, Section 1202a.

standards for trucks with gross vehicle weight ratings of up to 10,000 pounds. Standards for vehicles under 6,000 pounds (gross vehicle weight) are currently being promulgated, and the President has directed that the Secretary of Transportation begin to set standards on vehicles in the 6,000 pound to 10,000 pound (gross vehicle weight) range. These standards, when set, would encourage improved fuel economy of light trucks in two ways. First, by establishing a set of fuel-economy standards and noncompliance penalties for light trucks, a clear economic and legal signal is given to manufacturers of light trucks to comply with the standard. Second, the standard to be set under the Energy Policy and Conservation Act would also serve as the dividing line between light truck taxes and rebates for light trucks under the President's energy plan, thus giving light truck manufacturers a reinforcing set of economic incentives to meet (and exceed) whatever fuel-economy standard is set for them. Together, these incentives have the potential to be very effective in conserving fuel in light trucks. It is impossible to provide estimates of their effect at this stage, however, since the standards themselves have not yet been set by the Secretary of Transportation.

Standby Gasoline Tax

Probably the most controversial proposal in the President's energy package is the standby gasoline tax. Under this program, at the end of each year starting with 1978, actual nationwide gasoline consumption would be compared to the predetermined consumption target. If actual consumption is found to exceed the target consumption, a gasoline tax of five cents per gallon would be imposed for each full percentage point by which the actual consumption exceeds the target. However, year-to-year changes are limited so that the tax never changes by more than five cents from the previous year. If the standby tax were to grow at the maximum possible rate under this constraint, the tax could start at five cents per gallon in 1979 and reach a level of 50 cents per gallon by 1980, in current dollars.

The proposed target levels of consumption increase from 7.35 million barrels per day in 1978 to 7.45 million in 1980 and then decline rapidly to 6.6 million barrels per day in 1985 and 6.5 million barrels in 1987 (see Table VI-1). For comparison, actual 1976 gasoline consumption is estimated to be 7.0 million barrels.

TABLE VI-1. PROPOSED TARGET LEVELS FOR NATIONAL GASOLINE CONSUMPTION, AVERAGE DAILY CONSUMPTION IN MILLION OF BARRELS

Year a/	Target
1978	7.35
1979	7.40
1980	7.45
1981	7.40
1982	7.20
1983	7.00
1984	6.80
1985	6.60
1986	6.55
1987 and thereafter	6.50

SOURCE: H.R. 6831, Section 1221c, Title II, Part B.

a/ For 12-month period ending September 30.

The standby gasoline tax would probably not have any effect until the early 1980s. Fuel-economy improvements already in evidence in model year 1977 vehicles as well as anticipated fuel-economy improvements between now and 1980 lead to a forecast of auto gasoline consumption that increases from 1976 to 1978, levels out through 1980, and then declines slightly between 1980 and 1986. Thus, the target proposed in the Administration plan appears to reflect the general shape of the trajectory expected for future automobile gasoline consumption. Since the standby gasoline tax would be triggered by overall gasoline consumption, however, (not just automobile gasoline consumption) the gasoline used for other purposes must be taken into account when analyzing the likelihood that the standby gasoline tax would be triggered in any given year.

Trucks are the principal nonautomobile users of gasoline. In 1972 trucks used about 20 percent of the nation's gasoline. Of this, more than half was used by light-duty trucks such as

pick-ups, vans, and recreational vehicles. Light-duty trucks have been growing in number by more than 5 percent a year during the last decade. A continuation of this growth trend would lead to increases in fuel consumption that more than offset automobile fuel savings in 1985, as discussed below under the analysis of energy impacts.

ENERGY IMPACTS

Options Examined in this Report

Using an econometric model, 5/ forecasts are developed for each of five different policy options. These five options represent present policy and four combinations of proposals from President Carter's proposals.

Option 1 (Present Policy):

Present policy reflects the imposition of the EPCA (although not necessarily assuming attainment of the standards contained therein) and assumes that, except for a gradual relaxation of price controls, gasoline prices increase at the rate that inflation increases.

Option 2 (Crude Oil Equalization Tax):

Implementation of the crude oil equalization tax.

Option 3 (Gas Guzzler):

Implementation of both the crude oil equalization tax and the new car excise taxes/rebates of the President's package.

Option 4 (Full Package):

Implementation of all provisions within the President's energy package (i.e., crude oil equalization tax,

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5/ For details, please refer to Marketing and Mobility, report of a panel of the Interagency Task Force on Motor Vehicle Goals Beyond 1980, March 1976; and Damian Kulash, "Forecasting Long-Run Automobile Demand," in Transportation Research Board Special Report 169, 1975, pp. 14-19.

gas-guzzler excise taxes and rebates, and the standby gasoline tax.) This option assumes that the standby gasoline tax is triggered in each year from 1982 to 1981.

Option 5 (Fully Triggered Tax):

Implementation of all provisions of the President's energy package, assuming that the standby gasoline tax is triggered from 1979 to 1988. This option represents the most restrictive outcome possible under the standby gasoline tax and is not judged to be a likely outcome.

Present Policy Forecast for the Auto Sector

The impacts of President Carter's energy program should be gauged in terms of shifts from what would be expected in the absence of his program. In view of changing technology, rising population, and increasing affluence, automobile usage and the associated fuel consumption will differ from previous usage and consumption. The increase in gasoline prices of recent years and the existence of the standards required by EPCA will also play significant roles in shaping that future.

Under present policy, vehicle miles of travel are expected to increase more rapidly than new car sales, fleet size, or use of gasoline by automobiles. Travel growth is projected to average nearly 3.2 percent per year between 1977 and 1985. The stock of cars is forecast to grow somewhat more slowly, around 1.9 percent per year less than the very rapid growth experienced in the late 1960s and early 1970s. Its tapering off is attributable to several factors:

- a decline in the rate of increase of driver-age population;
- increases in automobile operating costs;
- increases in automobile purchase prices; and
- the existence of near-saturation levels of auto ownership among upper-income groups.

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This slow growth in the number of cars translates into an almost level pattern of auto sales from now until 1985. Under present policy, new car sales are not projected to vary by more than 3.5 percent from their current level throughout the next decade.

In spite of the 32 percent growth in vehicle miles of travel forecast between 1977 and 1985, total auto fuel consumption is expected to change only slightly. As vehicles with improved fuel efficiency are phased in, the historic pattern of annually increasing automotive fuel use is expected to reverse itself. Auto fuel consumption is expected to peak in 1978 at about 5.4 percent above the 1976 level, then fall to about 0.7 percent above the 1976 level in 1985, and to begin to increase again in the late 1980s. The slight growth and eventual decline of auto gasoline usage between now and 1985 is primarily attributable to fuel economy improvements made in response to the fuel-economy provisions of the EPCA and to today's gasoline prices (which are considerably higher than those which prevailed when most existing cars were manufactured). The average fuel economy of new cars is projected to rise from 18.3 mpg in 1978, to 20.5 in 1980, and to 23.3 in 1985. These gains in new car fuel economy imply that the fuel cost per mile of model year 1985 cars will be 30 percent lower than that of model year 1976 cars. Along with increasing affluence, this decrease in projected fuel cost per mile is expected to increase auto travel per household from 15,000 miles per year in 1976 to 18,000 miles per year in 1985.

Future truck gasoline consumption under a continuation of present policy is difficult to predict for two reasons. First, as noted earlier in this chapter, it is not yet clear how stringent the EPCA truck fuel-economy standards will be. Thus, their impact on truck fuel consumption is still unclear. Second, increases in the diesel-powered share of trucks will reduce truck demand for gasoline, but the extent to which the diesel share will increase in future years is subject to considerable uncertainty because of technological, environmental, and regulatory questions.

It has been assumed here that truck gasoline consumption increases 1.6 million barrels per day in 1976 to 1.9 million barrels per day in 1980, to 2.2 million in 1985, and to 2.6 million in 1990. This assumption, based upon a forecast made

for the Federal Energy Administration, 6/ reflects expected increase in trucking activity, modest increases in the share of diesel trucks (for example, the diesel share of heavy trucks increases from 61 percent in 1973 to 84 percent in 1985,) and no increases in truck fuel economy. In view of the light truck provisions of the Energy Policy and Conservation Act and other conservation actions being taken by truckers, the future truck fuel consumption assumed here is probably conservative, that is, higher than what would be expected if these initiatives are successful. Nevertheless, it is adoped here in order to gauge the maximum possible impact of the standby gasoline tax. That is, to the extent that this forecast may overstat future truck gasoline consumption, the future total gasoline consumption which it implies will be high, with the result that the standby gasoline tax is projected to be triggered earlier than it probably would. Correspondingly, the effect of this assumption about truck fuel consumption is to examine the standby gasoline tax proposal in the strongest form it could take.

Although the automobile fuel consumption projected above implies a downturn in the nation's gasoline consumption during the early 1980s, taken together with the truck fuel consumption projections of the preceding paragraph, the result is gasoline consumption substantially above the targets for the mid-1980s put forth in President Carter's energy proposals.

Estimated Fuel Savings

Under present policy, (which includes the EPCA new car fuel-economy standards) automotive gasoline consumption will probably increase by 1.2 percent per year until 1980, decrease by about 0.8 percent per year from then to 1985, and then begin increasing again by 0.3 percent per year from 1985 to 1990. Table VI-2 shows expected gasoline savings resulting from adding various components of the energy package to present policy. These findings indicate:

- Option 2: The crude oil equalization tax by itself would likely save only minimal amounts of gasoline

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6/ Jack Faucett Associates, Trucking Activity and Fuel Consumption: 1973, 1980, 1985, and 1990, report submitted to the Federal Energy Administration, June 1976.

TABLE VI-2. PROJECTED GASOLINE CONSUMPTION UNDER PRESENT POLICY AND ALTERNATIVE OPTIONS: PRESENT CONSUMPTION AND CHANGES (MINUS) IN THOUSANDS OF BARRELS PER DAY

Option	1978	1980	1985	1990
1. Present Policy EPCA Standards a/	7,390	7,530	7,650	8,160
2. Crude Oil Equalization Tax	-10	-40	- 25	0
3. Crude Oil Equalization Tax, Excise Taxes and Rebates	-20	-55	-240	-450
4. Crude Oil Equalization Tax Excise Taxes and Rebates, and Partial Gas Tax (level of tax)	-20	-55	-305 (20 cents)	-650 (45 cents)
5. Crude Oil Equalization Tax, Excise Taxes and Rebates, and Full Gas Tax (level of tax)	-20	-120 (10 cents)	-390 (35 cents)	-710 (50 cents)

SOURCE: Congressional Budget Office.

a/ Figures shown for present policy refer to projected consumption levels; figures for the other cases refer to differences relative to present policy.

by 1978, but by 1980 would save about 40,000 barrels per day and about 25,000 per day in 1985.

- Option 3: By adding auto excise taxes and rebates onto the crude oil equalization tax, the gasoline savings would become quite substantial, beginning with 55,000 barrels per day in 1980 and rising to 240,000 in 1985 and 450,000 by 1990. (This option would increase savings by about 15,000, 215,000, and 450,000 barrels per day over Option 2 for 1980, 1985, and 1990 respectively.)

- Option 4: The standby gasoline tax, which most likely would not begin before 1982, would, combined with the crude oil equalization tax and the excise tax/rebates, save about 305,000 barrels per day in 1985 and about 650,000 by 1990. (This option would increase savings by about 65,000 and 200,000 barrels per day over Option 3 in 1985 and 1990.)

- Option 5: In conjunction with the crude oil and excise tax/rebate provisions, a gasoline tax triggered in 1979 by much stricter consumption standards could produce substantial gasoline savings much earlier: 120,000 barrels per day could be saved by 1980, 390,000 by 1985, and 710,000 by 1990, if the full five cent per gallon increase in the gasoline tax were imposed every year. (This option would increase savings by about 65,000, 85,000, and 60,000 barrels per day over Option 4 for 1980, 1985, and 1990 respectively.)

Options 4 and 5 reflect two possible outcomes under the standby gasoline tax, namely, that it would be triggered from 1982 on and from 1979 on, respectively. CBO projections indicate that, in 1990, the standby gasoline tax would add 200,000 barrels per day to the gasoline savings of the other proposals in the President's package, assuming that it is triggered from 1982 on and reaches a value (in current dollars) of 45 cents per gallon in 1990. The corresponding projection assuming triggering from 1979 on is 260,000 barrels per day in 1990. These projections suggest that the standby tax could have substantially different effects on fuel conservation depending upon when it would take effect. Furthermore, the determination of when it would take effect is strongly influenced by what happens to future gasoline consumption by trucks.

Option 4, which assumes that the standby gasoline tax would be triggered from 1982 on, is consistent with a very conservative view of future energy conservation by trucks. As was discussed earlier under the description of the present policy case, it is assumed here that the diesel share of heavy truck sales increases from 61 percent in 1973 to 84 percent in 1985, and that there are no gains in the fuel economy of light trucks. Both of these assumptions understate the extent of gasoline conservation likely to be achieved by the trucking industry. CBO estimates that, under the light truck standards of the Energy Policy and Conservation Act and the reinforcing taxes and rebates for light trucks proposed in the President's energy plan, it would be possible to obtain reductions in truck use of gasoline sufficient to delay triggering of the standby gasoline tax until 1984 and possibly even until 1985. It is difficult to attribute savings in gasoline consumption by trucks to the Administration plan versus present policy since both are based on the same, yet to be determined, fuel-economy standards for light trucks. It is clear, however, that these policies regarding trucks would exert a strong influence on the triggering mechanisms of the standby gasoline tax.

It should be noted that the standby gasoline tax would not apply to diesel-powered vehicles, apparently as an incentive to encourage greater diesel use. While diesel engines are generally more fuel-efficient than gasoline ones, their efficiency advantage does not appear to be very substantial for light vehicles in local use. 1/ Exclusion of diesel-powered vehicles from the standby gasoline tax would thus encourage some shifts to engines that save gasoline but would have little effect on overall petroleum product conservation.

The reduction in gasoline consumption projected under the standby gasoline tax would come largely through reductions in vehicle miles of travel. In the most restrictive case (including a gas tax starting in 1979 as in Option 5), travel reductions relative to present policy would be small until about 1980, but increase to about 4 percent in 1985 and 5 percent in 1990. These travel reductions are thought to be indicative of only minor traveler inconveniences since they represent declines in travel growth per household relative to what would be expected under present policy, not absolute reductions from current levels.

1/ See Jack Faucett Associates, op. cit.

OTHER IMPACTS

Impact on Motor Vehicle Manufacturers

President Carter's proposals would influence the auto manufacturers in two major ways: (1) by encouraging the manufacturers themselves to make changes in autos that result in greater fuel efficiency; and (2) by encouraging consumers to alter the number and type of cars they purchase.

Table VI-3 shows that both increases in gasoline prices and the new car excise tax/rebate scheme would reduce the number of

TABLE VI-3. PROJECTED AUTO SALES UNDER PRESENT POLICY AND ALTERNATIVE OPTIONS: PRESENT SALES AND CHANGES (MINUS) IN THOUSANDS OF AUTOS

Option	1978	1980	1985	1990
1. Present Policy, EPCA Standards a/	11,660	12,090	11,620	12,180
2. Crude Oil Equalization Tax	-120	-370	- 80	0
3. Crude Oil Equalization Tax, Excise Taxes and Rebates	-140	-360	-360	-160
4. Crude Oil Equalization Tax, Excise Taxes and Rebates, and Partial Gas Tax	-140	-360	-990	-1,240
5. Crude Oil Equalization Tax, Excise Taxes and Rebates, and Full Gas Tax	-140	-1,000	-1,210	-1,220

SOURCE: Congressional Budget Office.

a/ Figures shown for present policy are projected auto sales; figures for other years refer to differences relative to present policy.

autos sold in future years beneath the levels anticipated under present federal policy. This reduction is caused in part by expensive technological improvements that would be made by manufacturers under the Administration's plan (and whose cost would be passed along to consumers) in order to increase the amount of the rebate for which each new car is eligible. The decline in new unit sales would also be partly attributable to the increase in the cost per mile of fueling vehicles that would emerge under the President's proposals. By 1985, the President's package would increase the fuel efficiency of new cars by 12 percent above present policy, while the price of gasoline (including the standby gasoline tax triggered in 1982) would increase by 22 percent. Taken together, these factors would increase the cost per mile of fuel for new cars relative to present policy about 10 percent. As a result of the increased purchase cost and fueling cost of automobiles under the Administration program, the projected reductions in new cars sold relative to present policy would range from as little as 80,000 autos or 0.7 percent of anticipated new car sales in 1985 if only the crude oil taxes are imposed (Option 2) to as much as 1.2 million autos or 10.4 percent of new car sales if the crude tax is combined with the excise tax/rebate system and the imposition of maximum increases in the standby gasoline tax (Option 5). However, imposition of the excise tax/rebate proposal alone would probably increase unit sales slightly in the first few years.

Even though the number of new cars sold would decrease under the President's proposals, relative to present policy, the sales revenue of the auto industry adjusted for penalties under the Energy Policy and Conservation Act would probably remain about the same. The principal reason why auto industry revenues would not fall under the program is because of technological improvements made in response to the gas-guzzler excise taxes and rebates. CBO expects that these improvements would add between $400 and $600 to the price of new cars in 1985, thereby producing additional new car sales revenues almost equivalent to those lost through the decline in the number of new cars sold. Furthermore, penalty liabilities for noncompliance with the Energy Policy and Conservation Act are projected to be about $1.3 billion lower in 1985 under the President's plan. If auto industry revenues were adjusted to reflect penalty liabilities, the President's plan would produce adjusted 1985 auto industry revenues that would be almost identical to those projected under present policy.

The effect that the President's proposals would have on the profits of the auto manufacturers is not clear. Under most options, auto unit sales would decrease, perhaps reducing the profit margin on each vehicle sold. Under most options the intermediate and large car proportion of new auto sales would increase even faster than under present policy, however (see following section). Since profit margins are thought to be greater on large autos, and since U.S. firms produce the vast majority of these vehicles, the profitability of U.S. auto manufacturers might not be impaired by the proposed auto energy controls.

The influence of the proposed energy package on auto imports cannot be estimated until the policy on rebates for fuel-efficient imports is clarified.

Mechanism of Influence of Auto Sales

The increase in gasoline prices and the system of excise taxes/rebates proposed by President Carter appear to affect the auto industry in different ways. As gasoline prices would be increased (either through the crude oil provisions or through triggering of the standby gasoline taxes), total auto sales would be decreased relative to sales anticipated under present policy as well as relative to alternative energy proposals that include the excise tax/rebate system.

In addition, increased gasoline prices would tend to encourage a shift in market share away from small cars and toward larger cars that are relatively fuel-efficient. (Of course, these new larger cars would be substantially more fuel-efficient than current ones.) This somewhat counter-intuitive result would occur because it is easier (and relatively less expensive) to make large percentage improvements in the fuel efficiency of large cars as compared to the already efficient small cars. Therefore, the combined cost of buying and fueling large cars would be increased relatively less than the corresponding cost for small cars. The smaller relative cost increase for large cars would thus encourage a greater proportion of consumers to buy large cars than would have been the case with no cost increase at all. This effect is magnified by the fact that small car buyers are more price-sensitive than are large car buyers.

In general, the proposed system of excise taxes and rebates in projected to encourage the purchases of small cars relative to the number estimated to be purchased under present policy and relative to the number purchased under proposals which increase gas prices. The market share of large cars projected under the gas-guzzler provisions would be reduced relative to options which include significant gas price increases. A combination of excise taxes with even a small increase in gas prices (for example, with the crude tax only as in Option 3) tends to increase the market share for large cars relative to present policy.

The proposed excise tax/rebate system would probably influence the auto manufacturer more than it would the auto purchaser. For example, most of the rebates would not be fully passed on to consumers in the form of lower prices for existing models; but some of the rebates would, in effect, be absorbed by manufacturers in making tecnological improvements that result in even more fuel-efficient models, that is, vehicles that can qualify for larger rebates.

Used Car Market

Changing the prices of new cars in turn changes the prices of used cars as well as the dynamics of the used car market. An excise tax on larger, less fuel-efficient autos would increase somewhat the value of existing cars of this type and discourage people from junking them. Under the existing EPCA standards, these gas guzzlers will become increasingly rare, however, so that the additional effect on fuel consumption associated with delayed scrappage is likely to be minor.

Similarly, rebates for new small- and medium-size autos that are fuel-efficient should decrease somewhat the value of existing cars of this type. This effect would be reduced since much of the rebates would likely be used by the manufacturers to make changes that improve auto fuel efficiency.

Increased gas prices would probably have the opposite effect on the used car market--encouraging a more rapid turnover of inefficient autos and a longer retention of fuel-efficient autos. Taken together, changes in vehicle scrappage patterns are not expected to have significant implications for the nation's fuel consumption. In 1985 even the most extreme of the energy options (Option 5) is projected to decrease the number of autos scrapped by less than 1.2 percent.

Penalty Liabilities on Industry

Individual auto companies must make penalty payments if their car sales do not meet the fuel-efficiency standards set by the Congress under the EPCA. 8/ It appears that the system of auto excise taxes and rebates proposed by President Carter would have a major effect in reducing the auto industry's overall penalty liability and in moving the industry as a whole toward meeting the EPCA standards. Under present policy the auto industry is projected to be liable for penalty payments of $2.5 billion in 1985 (in 1977 dollars). Options 3, 4, and 5 (which include the excise tax/rebate system) would reduce the penalty liabilities by more than one-half, to between $1.05 billion and $1.21 billion in 1985.

Consumer Impacts

The shifts in crude oil price controls, the increase in crude oil taxes, and the standby gasoline tax would all translate into higher gasoline prices for consumers relative to those anticipated under present policy. Most motorists would simply pay these higher gasoline prices and continue driving much as before; some would curtail their driving; and a few would find that the increased gasoline prices made it no longer worthwhile to buy a second car or replace cars as often. CBO projections indicate that vehicle miles of travel would fall by 4.2 percent in 1985 as a result of the full Administration package, including a fully triggered standby gasoline tax. The gas-guzzler provisions are not expected to have any noticeable impact on the total vehicle miles of travel. The crude oil equalization taxes by themselves would lead to a reduction in 1985 auto travel of under 0.5 percent.

The number of cars in use would decrease slightly under the gas-guzzler taxes and rebates, although the drop appears to be only about 1.3 percent in 1985. The standby gasoline tax (if it is fully triggered) is the only element in the Carter package which promises to have a significant impact on automobile ownership patterns. The full gas tax combined with the other parts of

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8/ These penalties equal $50 per car for each mile per gallon by which a manufacturer's average new car mpg falls short of the standard. These civil penalties are not tax deductible.

the proposal could lead to a drop of 6.1 million cars in use by 1985, about 5.4 percent under the level expected under present policy.

It is difficult to project who will bear the brunt of the reduced travel and auto ownership that result from the Administration proposals, specifically from the standby gasoline tax. High-income groups would face the largest total travel price increases because they tend to own more cars per household, to use each car more, and to buy large cars that are relatively fuel inefficient. While these figures clearly indicate that relatively high-income households would encounter the greatest net price increases, they are also, however, clearly the households that are least inconvenienced by these extra charges. Low-income households whose fuel use is much lower could nonetheless curtail their travel the most. The evidence available on the effects of gasoline price increases on different income groups is discussed in detail in Chapter X.

DISTRIBUTIONAL IMPACT

There are several factors that would be likely to reduce the potentially regressive nature of increased gasoline prices. Most significantly, the revenues from the gas tax and crude oil provisions would be rebated on a per capita basis, regardless of automobile ownership. Families with no auto would receive the full rebate, and since these families are concentrated at lower incomes, the system of rebates would represent a transfer of income to them. In 1973, only 36 percent of families with incomes under $3,000 owned a car, compared to over 90 percent car ownership by families with incomes over $10,000. 9/ Also, because the sum to be rebated to individuals would include a part of the taxes paid by business, all income groups should receive larger rebates than their increased gas payments. A major offset to this rebate would be the likely increased prices for consumer goods as trucking firms and others pass on their increased fuel costs. These increased prices are addressed more fully in Chapter X.

Under present policy, significant improvements are expected in the fuel efficiency of new cars so that by the late 1980s,

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9/ Bureau of Labor Statistics, Consumer Expenditure Survey Series: Interview Survey, 1972 and 1973, Table 16b.

when the nation's vehicle fleet as a whole should be about 30 percent more fuel efficient than now, families at virtually all income levels should be able to drive the same vehicle miles as today, for a lower expenditure on gasoline. (Of the options examined here, the only exception is if the standby gas tax is fully triggered, resulting in a 5 percent increase in gas cost per vehicle mile in 1985 over 1976.) Since higher-income families purchase a larger proportion of new cars than lower-income groups, they would be the first to receive these gains in fuel efficiency, however. In time, as new cars pass through the used car market, all income groups would enjoy these fuel-efficiency gains.

The President's proposals would improve average fuel efficiency of new cars over the gains likely to occur under present policy by about 12 percent in 1985, leading to an improvement in the average fuel efficiency of all cars of 1.6 percent relative to present policy. For the average consumer, these efficiency gains would be more than offset by increased gas prices, however, increasing the fuel cost per mile relative to that expected under present policy. But because of the significant improvements in average miles per gallon expected under the existing EPCA standards, the Administration proposals would still result in an improvement relative to today's conditions in gasoline costs per vehicle mile.

The increased gasoline prices would have different effects depending on where people live. Since people living in central cities are less apt to own cars (32 percent of central city inhabitants own no car versus 15 percent for other urban areas and 18 percent for rural families), more central city dwellers would receive rebates and yet bear relatively minor cost increases. Also, since public transportation is better in urban areas, it should be easier to shift some work-related trips from auto to public transit. In general, rural families with autos already spend a larger portion of their income on gasoline than do similar urban families.

BUDGETARY IMPACTS

Federal Budget

The direct impact on the federal budget of the gas price and new car excise tax/rebate proposals is planned to be neutral. Rebates would be adjusted annually so that total auto rebates

offset total auto excise taxes. Any temporary imbalances would be absorbed by the Treasury, but would likely to be small (perhaps $50 million at most) and of little significance to the federal budget. Similarly, revenues from the standby gas tax (if and when it is imposed), would be returned to consumers through the income tax system and other mechanisms.

The revenues generated by the standby gas tax could be quite substantial. Using the proposed gasoline consumption targets, a five cent per gallon tax would likely be imposed in 1982, increasing to 20 cents in 1985 and 45 cents in 1990. A tax at these levels would produce about $3.3 billion in 1982, $11.2 billion in 1985, and $19.9 billion in 1990 (in 1977 dollars), net of revenue losses due to business claiming the gas tax as an itemized deduction on their income taxes.

The energy provisions would have an important impact, however, on the ability of the auto manufacturers to meet the existing EPCA auto-efficiency standards, and thus on the penalty payments they are required to make. With no changes in existing law, penalty payments could equal $2.5 billion in 1985. The influence of the crude oil provisions on the price of gas should lower this by only about $15 million. Adding the excise tax/rebate system would, however, significantly improve the extent to which the auto industry is likely to meet the EPCA standards, reducing the expected 1985 penalty liabilities to between $1.05 and $1.21 billion. The federal budget might also be increased by as much as $0.7 billion in 1985 and $1.3 billion in 1990 if additional aid were provided to replace state revenue losses caused by decreased state and local gas tax receipts and other highway-related receipts. This problem is discussed in the next section.

State Budgets

Reductions in automotive gasoline consumption under the President's plan would be accompanied by adverse effects on state (and possibly local) budgets. Fuel tax revenues, auto license fees, and titling fees and taxes would all be reduced. Highway tolls would also be affected. There might also be a slight change in sales tax receipts, but this is indeterminate since consumers would simply spend roughly the same proportion of their incomes on a different market basket of goods and services, most of which would also be subject to sales taxes. Table VI-4 shows estimated state revenue losses in each option examined. There is no easy way to determine the share of losses on a state-by-state

basis, although some would be more severely affected than others. The most restrictive combination of President Carter's proposals (Option 5) could reduce state receipts by 0.4 percent, 2.5

TABLE VI-4. IMPACTS OF ENERGY PROPOSALS ON STATE BUDGETS: IN MILLIONS OF DOLLARS

Option	Direct Auto-Related Revenue Changes Compared to Present Policy a/			
	1978	1980	1985	1990
1. Present Policy b/	10,500	10,600	10,460	10,670
2. Crude Oil Provisions	-25	-90	-55	0
3. Crude Oil Provisions, Excise Tax/Rebates	-40	-120	-380	-640
4. Crude Oil Provisions, Excise Tax/Rebates, Partial Gas Tax	-40	-120	-540	-1,130
5. Crude Oil Provisions, Excise Tax/Rebates, Full Gas Tax	-40	-270	-740	-1,270

SOURCE: Congressional Budget Office.

a/ Includes decreased fuel tax revenues, auto license and registration fees, and title fees and special titling taxes.

b/ Figures shown for present policy are projected auto-related state revenues; figures for other years refer to differences relative to present policy.

percent, 7.1 percent, and 11.9 percent in 1978, 1980, 1985, and 1990 respectively relative to present policy. 10/

The federal government might wish to consider state aid packages to make up these losses. Since many of the state losses would fall in revenue areas that are earmarked by law for highway use, one option would be to provide a system of block grants to the states, some of which would be tied to highway spending but not be tied to new highway construction. This could reduce the impact of the energy proposals on the state money available for maintenance of highways. Grants could be apportioned by a formula that attempts to simulate revenue losses by state.

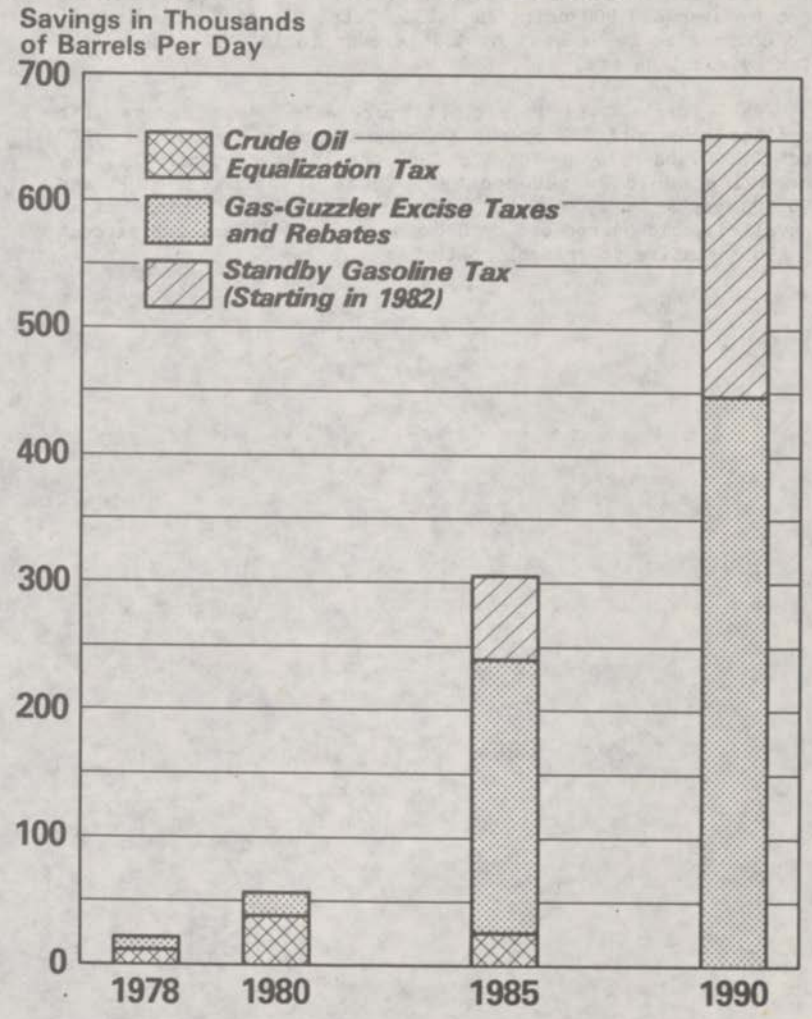
SUMMARY OF PRINCIPAL IMPACTS OF THE PREDIDENT'S PROPOSALS

Of the three proposals in the President's energy program shown in the following figure, the gas-guzzler excise taxes would have the largest effect on fuel consumption, reducing automotive gasoline consumption in 1985 by 215,00 barrels a day. This saving could reach 450,000 barrels of gasoline a day in 1990. Because the gas-guzzler provision influences the type of new car produced by manufacturers and purchased by consumers, it would take a number of years for it to have an appreciable impact on gasoline consumption. At the same time, its effect on total car sales should be relatively minor, reaching a maximum reduction of about 280,000 new cars sold in 1985.

The standby gasoline tax appears unlikely to be triggered before 1982, and, in constant 1977 dollars, could reach as much as 23 cents per gallon in 1990. Under optimistic assumptions about diesel penetration and standards for light-duty trucks, the tax might not be triggered until 1984 or 1985. If the standby gasoline tax is triggered in 1982, it could reduce auto gasoline consumption by an additional 65,000 barrels a day in 1985 and 200,000 barrels a day in 1990.

10/ State governments are expected to spend about $13.7 billion in highway-related tax receipts on highways in calendar year 1977. This sum includes truck-related taxes and parking charges and tolls that are not included in the estimates in Table VI-4. Local governments are expected to spend an additional $600 million in highway-related receipts. (Federal Highway Administration News Release, December 31, 1976, Table HF-11.)

Projected Gasoline Savings of the President's Energy Proposals (Savings refer to gains relative to present policy.)



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In contrast to the gas-guzzler provisions, which would reduce new car sales by about 280,000 units in 1985, the standby gasoline tax could have a large impact on new car sales, reducing them by over 600,000 units in 1985. Total vehicle miles travelled could also be reduced by 1.7 percent in 1985 because of the standby gasoline tax.

As a whole, the President's proposals would reduce auto gasoline consumption compared to present policy by about 55,000 and 305,000 barrels per day in 1980 and 1985, respectively. New car sales would be reduced by a total of about 360,000 and 990,000 units in 1980 and 1985, respectively. Vehicle miles travelled would be reduced by 0.8 percent in 1980 and 2.3 percent in 1985 relative to present policy.

CHAPTER VII. HOME INSULATION AND SOLAR HEATING TAX CREDITS

President Carter's proposed tax credits for insulation and solar equipment would help reduce private consumption of energy for heating the nation's homes. However, they would do so at sharply different costs. For each barrel of oil not burned because of responses to the insulation credit, the federal government would pay $2.42 to taxpayers who insulate. For the solar credit, the figure is $11.28 per barrel of oil not burned. These costs are high because a large portion of the credits are paid to people who would have made energy-saving improvements anyway.

Between 1978 and 1985, the proposed insulation tax credit would reduce federal revenues by $2.1 billion. This tax expenditure would induce people to spend $2.9 billion on insulation, in addition to the $6.3 billion that would be spent without the tax credit. 1/ Of the 23.8 million households making insulation improvements, 7.8 million are expected to do so in response to the proposed credit. The 7.8 million who insulate only in response to credit would save themselves $9.2 billion in heating costs by the year 2004. 2/ Without the proposed credit, consumers would (on average) save $3 in

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1/ The National Energy Plan (NEP) states that homeowners would be entitled to the insulation credit. The bill (H.R. 6831) submitted to the Congress does not exclude renters from claiming credits. This chapter proceeds on the basis that H.R. 6831 reflects the Administration's intent on this point. Even if the credit is available to renters, few of them are expected to make these improvements. Rental leases typically are shorter than the payback period for these investments.

2/ The $9.2 billion is the present value of a saving of 890 million barrels of oil (or equivalent) in 7.8 million homes over a 27-year period.

heating costs by investing $1 in insulation. The credit would raise the return to $4 for $1 invested in insulation.

During the same period, the solar tax credit would add $460 million to the $700 million that would be spent for solar equipment without the credit. By 1985, 773,000 households (compared to the Administration goal of 2.5 million) would own solar equipment. Without the credit, the number would be only 464,000. Tax credits from 1978-1985 (amounting to $262 million) would lead to $460 million of increased private investment, and would save the 309,000 affected homeowners 3/ $240 million over a 27-year period. From a private perspective, investment in solar equipment barely repays its costs for most buyers, even with the proposed tax credit.

The costs and benefits of energy-saving investments for residences can be compared as cash amounts--the cost of improvements vs. the amount of fuel savings. Public costs can also be stated in dollars--the estimated tax credit. The public benefits, however, come in a less tangible form--one that cannot easily be reduced to a dollar value. The public benefit from reducing private energy purchases comes in the form of reduced national energy consumption (i.e., reduced consumption of oil and gas) and an implied decrease in imports, which reduces vulnerability associated with dependence on foreign energy. Measured by its impact on private energy consumption, the insulation tax credit is 4 1/2 times as efficient as the solar credit. Yet, neither tax credit may provide a sufficient public benefit to justify the public cost.

PROPOSED POLICY

Residential heating (space and hot water) accounts for 10 percent of total energy use in the United States. A reduction in the use of conventional fuels for these purposes would be desirable for many of the same reasons that reductions are sought in other sectors. Improved levels of insulation

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3/ The solar credit is not specifically limited to owners, but few tenants are expected to invest in costly equipment for premises that they do not own.

and weatherproofing are highly efficient means for bringing about reductions (perhaps 30-40 percent) in the consumption of heating fuels. In addition, the increased use of solar heating equipment offers the potential to shift some heating demands away from conventional fuels.

Increased use of insulation and solar equipment may be encouraged in a number of ways, including:

- o raising fuel prices
- o educating the public
- o setting mandatory standards
- o subsidizing manufacturers
- o granting tax credits
- o offering direct grants.

The Administration plan focuses primarily on the tax credit strategy (although there are some educational efforts, direct grants, and minor price increases as well).

The proposed incentive for adding insulation and related equipment consists of a tax credit equal to 25 percent of the first $800 spent, and 15 percent of the next $1,400 spent to improve primary residences. The maximum allowable credit per household is therefore $410. Major items eligible for the credit include insulation, storm windows, and clock thermostats. Some weather stripping, caulking, and miscellaneous improvements to heating equipment are also included.

The proposed incentive for solar equipment consists of a tax credit for solar space heating and solar water heating installations. The tax credit would initially be set at 40 percent of the first $1,000 of expenditures and 25 percent of the next $6,400 spent for eligible equipment. It would decline over time and expire at the end of 1984. The maximum credit

would be $2,000 through 1979, $1,580 through 1981, and $1,210 through 1984. 4/

The home insulation and solar heating tax credits have at least one short-run goal--to speed the purchase and installation of certain materials and equipment--and at least one long-run goal--to reduce the use of scarce and costly conventional fuels for home heating. There is widespread acceptance of the fact that additional insulation and related weatherproofing can reduce heating fuel needs by 30 to 40 percent. In the case of solar heating, recent research and engineering experiments suggest that solar heating, despite high initial costs, is beginning to be competitive with conventional heating systems. 5/ In both instances, reduced fuel use will lessen the need for imported petroleum products.

ENERGY-SAVING IMPACT OF INSULATION CREDITS

The purchase of insulation and related materials after the effective date of the proposed tax credit will undoubtedly produce significant reductions in energy consumption. However, not all future reductions in energy usage should be attributed to the proposed tax credit. The proportion of future residential energy savings properly attributed to the tax credit depends on how many households will still respond to past increases in heating costs.

Motivation to Insulate

Generally, people are motivated to buy and install added insulation as a result of fuel cost increases--including

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4/ These reductions are based on the assumption that equipment and related costs will decline as the relevant technology improves, reducing the need for large subsidies to purchasers.

5/ Cost comparisons between solar heating and conventional systems are best made by comparing payments necessary to repay a loan for the initial solar cost (amortized) with the initial cost plus the expected operating cost (largely fuel) of the conventional system.

those expected in the future (a tax credit merely adds to the impetus). 6/ Nevertheless, long delays often occur between recognition of fuel price increases and the purchase of added insulation. Many people are just now responding to fuel cost increases occurring years ago, and expectations about future energy costs will contribute to insulation sales for many years to come, even without a tax credit. 7/

Given the normally long response lags between fuel price increases and insulation purchases, a large share of any tax credit would be a windfall payment to people who have already decided to add insulation. It is estimated that two-thirds of the households receiving the credit would have bought insulation anyway.

The Demand for Insulation

Some 34 million dwelling units in the United States (all suitable candidates for improved insulation) are the target of the proposed credit. 8/ This figure is calculated as follows. First, of 45 million owner-occupied dwellings, an estimated 38 million are suitable for additional insulation (i.e.,

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6/ Insulation sales began a sharp rise in 1974, with the rapid increase in heating fuel costs. In the intervening three years, insulation sales have shown no sign of tapering off. There is no reason to assume that sales would show a marked drop without the proposed tax credit.

7/ The literature on diffusion of technology and adoption of innovations suggests long lags and incomplete implementation, even though the savings from adding insulation are substantial. See Rogers and Shoemaker, Communication of Innovations, New York, 1971, especially pp. 129 and 350-352.

8/ The NEP includes a number of insulation measures in addition to tax credits, including utility-sponsored programs, grants to low-income households, and the prospect of mandatory standards. This analysis seeks to identify the cost and effectiveness of the proposed credit apart from the other related, but separable, initiatives aimed at the same objective.

have accessible attics). Approximately 8 million of these dwellings have already been upgraded since 1974. Thus, 30 million owner-occupied homes remain to be insulated. Second, of nearly 25 million rental housing units, an estimated 11.5 million are suitable for additional insulation. Among these 11.5 million, approximately 4.0 million are occupied by people who stand to benefit from the tax credit. 9/ Thus, a total of 34.0 million dwelling units are the possible focus of the insulation tax credit.

The fact that 8 million homeowners purchased insulation between 1974 and 1976 in response to increased heating costs indicates that insulation will be purchased even without the tax credit. These recent purchases are estimated to represent only a fraction (about one-third) of the eventual response to the 90 percent increase in fuel prices experienced since 1974. Therefore, an additional 16 million homes are expected to be insulated by 1985, even without a tax credit. The proposed credit (which would reduce the cost of insulation by 25 percent) would encourage still other homeowners and renters to make energy-saving improvements. Under assumptions used here, it would lead to insulation purchases by 7 million more homeowners and 0.8 million renters. Another 10.2 million dwellings would not receive improved insulation, because they are not physically suited to individual insulation, are occupied by short-term renters, are heated by landlords, or for some other reason.

Savings Due to Added Insulation

The prospects for reducing private consumption of energy for home heating are very bright. Together, normal insulating plans and the stimulus of the proposed tax credit could result in re-insulation by 1985 for 70 percent of all owner-occupied homes built before 1975. The tax credits for renters and landlords and other programs to insulate rental housing are expected

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9/ In order for a renter to benefit from the tax credit, he must (1) pay for his own heat, (2) expect to remain in his home as long as the payback period for his investment, and (3) have sufficient tax liability to claim the credit as a tax offset.

to be less successful. The energy savings attainable by re-insulating a home and making related improvements are estimated to be 35 percent of the 100 million British thermal units (BTUs) per year currently used to heat the typical home. 10/ An energy saving of 35 million BTUs per home annually is equivalent to about 6 barrels of oil (worth $84 at $14 per barrel). This saving is achieved each year after re-insulation occurs for the useful life of the dwelling. Based on the expected level of insulating activity during the life of the credit, a rising pattern of energy savings could be expected as more homes receive additional insulation.

The full energy saving resulting from additional insulation installed after the effective date of the proposed credit is equivalent to 2.9 billion barrels of oil over 27 years. The present value of this energy saving to consumers, in the form of reduced expenditures for fuel, is $29 billion. 11/

The energy saving enjoyed by individuals would exceed the cost of the improvements needed to achieve those savings, both with and without the tax credit. The benefit-cost ratio for private investments in insulation and related items is about 3:1 without the proposed credit, and about 4:1 with the credit (i.e., after costs to homeowners are reduced). In other words,

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10/ It has been estimated that the heating requirement for a home insulated to previous standards is about 17 BTUs per square foot of living space for each degree-day of heating demand. Insulating to up-to-date standards reduces the heating requirement to 10 BTUs per degree-day. (See The Economics of Solar Home Heating, Joint Economic Committee Print, March 13, 1977, p. 31.)

11/ The present value calculation is the customary way to measure benefits which accrue over time. In calculating the present value of future savings, oil prices are assumed to rise at the same rate as prices generally; therefore, future returns are discounted at the real rate of return. A 2 percent real discount rate is roughly equivalent to an 8 percent discount rate with 6 percent inflation.

TABLE VII-1. ESTIMATED IMPACT OF INSULATION TAX CREDITS: 1977-1985

Calendar Year	Homes Insulated in Response to Tax Credit a/ (in millions)	Annual Energy Saving Stimulated by Tax Credit (in millions of barrels of oil)	Credits Allowed in Following Fiscal Year b/ (in millions)	
			1977 Dollars	Budget Dollars c/
	(I)	(II)	(III)	(IV)
1977	0.8	--	$ 224	$ 224
1978	1.4	4.2	358	379
1979	1.3	12.0	348	391
1980	1.1	19.2	345	411
1981	1.0	25.8	313	395
1982	0.9	31.8	272	364
1983	0.6	36.6	230	326
1984	0.7	40.2	209	314
1985	--	44.4	--	--
Total 1977-1984	7.8	--	$2,299	$2,804

Present Value of Private Energy Saving: (assumed 20-year life for improvement) $9.2 billion

Present Value of Tax Expenditure (1978-1985): $2.1 billion

SOURCE: Congressional Budget Office.

a/ The figures in Column I represent homes that would not have been improved without the credit; they do not show the total number of homes re-insulated from 1977-1984.

b/ The figures in Columns III and IV reflect the credits paid for improvements spurred by the tax credits, as well as those improvements which would have occurred anyway during the credit period.

c/ Budget dollars reflect the actual cost of the credits when paid, allowing for 6 percent inflation annually.

the fuel savings are three times the cost of insulation without the credit, and four times the cost with the credit. Thus, the credit further enhances an already profitable investment.

The proposed credit will motivate $2.9 billion worth of home insulation that would not otherwise take place. As a consequence, private oil consumption will be reduced by 44 million barrels annually by 1985, and by 890 million barrels in total by the year 2004. Table VII-1 summarizes estimated responses to the credit and the energy saving that results.

ENERGY-SAVING IMPACT OF SOLAR EQUIPMENT TAX CREDITS

Expected Use of Solar Equipment

The potential for energy saving with the widespread use of solar equipment for residential space and water heating is immense, but so is the potential cost. Currently, equipment costs are high. Solar equipment is not expected to come into widespread use, unless fuel prices rise substantially more than is already projected, or solar equipment costs decline. Solar equipment is most attractive in new structures where savings on conventional equipment partially offset solar costs, and in areas where water is presently heated by high-cost electricity. The Administration goal of solar energy equipment in 2.5 million homes by 1985 suggests the potential for an annual saving by 1985 of 9 million barrels of oil (or equivalent) if those homes use solar power only for heating water. If some of the 2.5 million homes also use solar power for space heating, the saving would be even greater.

Administration Goal. The Administration goal of 2.5 million solar-equipped homes by 1985 seems unattainably high. Achieving that goal would require sales growth in excess of 75 percent annually or a technical breakthrough that permits even more rapid growth for the last few years of the credit. It is unlikely that a 75 percent growth rate will occur, and a technical breakthrough cannot be counted upon. Therefore, estimates reflecting a more modest (25 percent) annual growth from sales of 50,000 units in 1978 will be used for illustrative purposes.

Illustrated Response to Solar Tax Credit. In the following illustration, a number of assumptions apply. Each solar unit is assumed to save 75 percent of the energy required for domestic water heating, but none of the energy required for

TABLE VII-2. ESTIMATED IMPACT OF SOLAR TAX CREDIT: 1977-1988

Calendar Year	Solar Units Installed in Response to Tax Credits (in thousands)	Annual Energy Saving Stimulated by Tax Credit (in millions of barrels of oil)	Credits Allowed in Following Fiscal Year b/ (in millions)	
			1977 Dollars	Budget Dollars c/
	(I)	(II)	(III)	(IV)
1977	8	--	$ 10.5	$ 10.5
1978	20	.03	26.2	28.1
1979	25	.10	32.8	36.9
1980	31	.20	31.2	37.2
1981	39	.32	39.1	49.4
1982	49	.46	39.7	53.1
1983	61	.64	49.6	70.4
1984	76	.87	62.0	93.2
1985	a/	1.16	--	--
Total 1977-1984	309	--	$291.1	$378.8

Present Value of Private Energy Saving: (assumed 20-year life for improvement) $240 billion

Present Value of Tax Expenditure (1978-1985): $262 billion

SOURCE: Congressional Budget Office.

a/ Proposed credit expires at the end of 1984. Figures in Column I represent solar units that would not be installed without the tax credit.

b/ The figures in Columns III and IV reflect estimates (based on the CBO illustration) of credits paid for improvements spurred by the tax credits, as well as those improvements which would have occurred anyway during the credit period.

c/ Budget dollars reflect the actual cost of the credits when paid, allowing for 6 percent inflation annually.

space heating. Sales grow at a 25 percent annual rate from 50,000 units in 1978. Solar equipment has a 20-year life. Oil is worth $14 per barrel. The average annual savings per solar installation is 3.75 barrels of oil (or its equivalent in other energy forms).

CBO's estimates for sales of solar installations due to the proposed credit, energy savings due to the credit, and credit costs are presented in Table VII-2. Not all the expected savings can be attributed to the tax credit, however. A significant number of future purchases of solar heating equipment would have occurred in some regions (based on fuel savings) even without the credit. Although the annual energy savings are small initially (30,000 barrels of oil in 1978), they rise to 1.16 million barrels of oil in 1984 as more solar equipment is installed. The energy saving to consumers from responses to the credit would amount to a present value of $240 million. Thus, the federal government would make a present-value tax expenditure of $262 million to 773,000 citizens. The 773,000 credit recipients would include an estimated 309,000 who would save $240 million in fuel costs from solar equipment they would not otherwise have purchased.

Efficiency of the Tax Credits

The proposed credits for insulation and solar equipment can be evaluated from many different perspectives: (1) How much of the total credit allowance actually stimulates the desired activity and how much goes to individuals who would have made energy-saving improvements anyway? (2) How much additional investment (hence energy savings) results from the credits? (3) Are the public benefits commensurate with the costs? The focus here will be on how much additional investment is spurred by the credits and how much additional energy saving results.

It is important to specify additional investment and savings because substantial purchases of insulation and solar equipment would occur even without the credit. Rising heating costs, for instance, represent a continuing incentive for such improvements.

Insulation Credit. In the absence of the proposed tax credit, an estimated 16 million homes would receive added insulation by 1985. The primary motivation for this activity is

the high return on private expenditures for insulation. 12/ It is estimated that publicity created by the tax credit and the increased return ($4 instead of $3 for $1 invested) will motivate 7.8 million additional homeowners and renters to purchase additional insulation and related items. The tax expenditure of $2.1 billion will stimulate improvements that would not otherwise occur, and that will reduce private energy consumption by the equivalent of 890 million barrels of oil. (See Table VII-3.) The cost to the public for each barrel by which private oil consumption is reduced comes out to $2.42. This represents a payment from taxpayers in general to those who buy insulation.

Solar Credit. In terms of spurring additional investment and additional energy savings, the solar credit is less efficient than the insulation credit. The proposed tax credit, according to a CBO estimate, will motivate 309,000 homeowners to purchase solar units. In return for a $262 million tax expenditure, oil import requirements will be reduced by 23.2 million barrels. The cost to the public would be approximately $11.28 per barrel of oil not consumed. 13/

For most households, solar equipment represents only a borderline investment. Consequently, the figures on the private return and the public benefit are not as impressive as for an investment in insulation.

With both credits, the saving from reduced consumption of fuel accrues to individuals, not taxpayers generally. Neither credit therefore provides a direct reduction in government costs.

INCOME DISTRIBUTION EFFECTS

The proposed tax credits will have varying effects upon families at different income levels. Three major conditions

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12/ Over a 20-year life, insulation yields a return (on average) of more than $3 for every $1 invested.

13/ The public cost of reducing private oil consumption appears high because a large investment in solar equipment is required for each barrel of oil saved.

TABLE VII-3. COSTS AND BENEFITS OF PROPOSED RESIDENTIAL ENERGY CONSERVATION TAX CREDITS, PRESENT VALUE COMPARISONS

Item	Insulation Credit	Solar Equipment Credit
Costs		
Private (improvements)	$ 8.60 billion	$ 1.2 billion
Public (tax credit)	2.15	0.3
Net Private Cost	6.45	0.9
Benefits		
Private (reduced fuel expenditures)	$ 29.1 billion	$ 0.6 billion
Public (reduction in energy usage compared to present policy)	890 million barrels a/	23.2 million barrels a/
Tax Expenditure Costs of Reducing Private Demand b/	$ 2.42 per barrel	$11.28 per barrel

SOURCE: Congressional Budget Office.

a/ Public benefits occur as reduced private energy consumption, measurable in barrels of oil or equivalent, rather than as direct reductions in government cost.

b/ These costs are shown as the tax credit divided by the induced reduction in private demand for energy (e.g., $2.15 billion/890 million barrels).

are responsible. First, the credits are available only to taxpayers whose tax liabilities are sufficient to cover the credit claim. To claim a $50 credit for insulation expenditures of $200, a family will generally need an income of at least $7,000. 14/ The maximum solar credit ($2,000) is generally available to families with incomes in excess of $18,000, although it is available to single taxpayers with incomes as low as $12,000. A refundable credit, which would avoid this selectivity, was incorporated in prior proposals for insulation credits (e.g., H.R. 6860, 94th Congress).

Second, because the credits are more available to middle- and upper-income households, they tend to favor homeowners more than renters, and homeowners with significant tax liabilities more than those with little or no tax liability. (Homeowners generally have higher income levels than renters--$13,600 vs. $7,900 in 1975.) 15/ The direct grant proposals incorporated in the National Energy Plan may help some low-income families, but the grant funds requested by the Administration would cover only about 2.5 million homes. 16/ The proposed 10 percent insulation credit for landlords may help some tenants, but the likely landlord response is uncertain. 17/ With regard to the solar credit, it is unlikely that any significant number of low-income families or renters will receive any benefit.

SUPPLY CONSIDERATIONS FOR INSULATION

Production and Prices

A sudden increase in the demand for insulation and related items could raise the prices of these products. If purchases

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14/ This figure, like the following one, is based on a family of four using the standard deduction.

15/ See Department of Housing and Urban Development, Annual Housing Survey, 1976.

16/ The National Energy Plan proposes expenditures of $530 million over three years. (See National Energy Plan, p. 41.)

17/ National Energy Plan, p. 42.

are delayed because of price increases or outright shortages, achievement of the Administration's energy-saving goals could be delayed. CBO regards widespread shortages of insulation materials as unlikely--partly because not everyone will buy the various insulating materials in the early years of the credit, and partly because production capacity is already being expanded.

Both glass fiber and cellulose are widely used for home insulation. Glass fiber insulation is manufactured by three dominant firms, all of which have expanded or are expanding their plants. Manufacturing capacity is expected to double by 1980. Cellulose insulation, which is coming into increasing use, is manufactured by a large number of small companies. Cellulose insulation is made from old newspapers, which are in plentiful supply. Growing use of this product may minimize the impact of possible supply limitations for glass fiber insulation.

Storm windows and materials for caulking and weather stripping are not expected to present any particular supply-constraint problems. Storm windows are fabricated by a large number of firms serving local markets. Although little is known about the total capacity for production, supply contraints are unlikely to bind, because storm windows are generally given a lower priority than insulation. The saving per dollar spent for added insulation generally exceeds that attainable from adding storm windows.

Prices for insulation products have gone up recently--even before the credit was proposed. The wholesale price index for insulating materials rose by about 55 percent between 1973 and 1976, compared to a 36 percent increase for all items. As the demand for insulation expands, insulation prices may increase still further. Some experts suggest that the windfall portion of the credits to buyers who planned to insulate anyway will only compensate those buyers for the cost increase resulting from announcement of the credit.

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Producer Strategies

Insulation manufacturers face an interesting problem in deciding how rapidly to try to meet the burgeoning demand for insulation. Once a customer has purchased more insulation, his demand is satisfied, and he is not likely to need more unless he expands his house or there is another increase in oil prices. Under such circumstances, manufacturers will not want to build to meet a sudden demand and then have their factories idle after the demand is met. A more efficient strategy (from the producers' point of view) is to build capacity sufficient to satisfy the new demand over a period that corresponds to the useful life of the plants they build. For this reason, insulation manufacturers may prefer to meet the insulation demand over a longer time period than would be suggested by energy-conservation goals alone.

CHAPTER VIII. IMPLICATIONS FOR THE FEDERAL BUDGET

The aggregate impact of the President's energy program on the federal budget would be relatively small. On the basis of preliminary analysis, it appears that direct expenditures in the short run would be greater than net revenues from taxes. In 1978, increased outlays and reductions in revenues would cost the federal government $2.13 billion, and in 1980, by $2.68 billion. In the longer term, however, the situation should reverse. By 1985, a budgetary surplus of $1.46 billion would appear, attributable for the most part to the industrial conversion from oil and gas to coal, induced by the proposed tax rebate formula. The surplus would be somewhat diminished, however, by the reduction of sales from the Naval Petroleum Reserves. But overall, CBO anticipates the effects on the budget to be neither extensive nor sudden.

The components of this gradual shift (in billions of dollars) are as follows:

	1978	1980	1985
Direct Outlays	1.14	5.02	5.97
Revenue Changes	-0.99	2.34	7.43
Tax Revenues less Tax Expenditures	-0.59	3.04	7.43
Naval Petroleum Reserves	-0.40	-0.70	--

TAX-RELATED EFFECTS

The impacts on the federal budget of the President's proposals fall into two general categories: tax and nontax effects. The former category includes revenues from the tax proposals designed to alter the cost of energy to businesses and consumers so that consumption (of oil and natural gas in particular) is reduced. Tax effects also include credits and payments designed

either to return revenues to the economy or to induce energy conservation or industrial conversion to coal. The net effect of the tax programs is an increase in revenues for each year between 1979 and 1985. Nontax effects include direct federal expenditures and receipts from energy-related sales, leases, and royalties.

Tax effects result from four types of provisions. The first--represented by the gas-guzzler tax, the crude oil equalization tax, and the standby gasoline tax--is designed to rebate all taxes collected, which would yield no net effect on the budget. These provisions are designed primarily to alter the structure of costs associated with inefficient uses of energy or to force the conversion to coal. A second type of tax provision is designed to induce energy conservation; these include tax expenditures for commercial and residential improvements or such tax reductions as the repeal of excise taxes on inter-city buses. In general, these provisions reduce revenues to the U.S. Treasury. A third type of tax provision is planned to increase the price of energy without a rebate; among these proposals are the motorboat and airplane fuel taxes. Finally, there are taxes related to inducing coal use, which generate net revenues only if firms do not convert. The estimates for these various tax provisions are presented in Table VIII-1. (The estimates are derived mostly from the analysis in previous chapters; other estimates were provided by the Office of Management and Budget.)

Effects on Expenditures

Six features in the National Energy Plan would contribute to direct federal expenditures:

- Expanded and accelerated Strategic Petroleum Reserve Program,
- New programs to improve the energy efficiency of federal buildings, residences of low-income families, schools, and hospitals,
- Changes in federal energy research and development programs,
- Reduced sales of petroleum products from the Naval Petroleum Reserves,

TABLE VIII-1. PROJECTED TAX GAINS AND LOSSES: IN MILLIONS OF CURRENT DOLLARS, BY FISCAL YEARS

	1978	1980	1985
Tax Expenditures			
Thermal efficiency credit--residential a/ (Insulation Tax Credits)	-224	-391	-314
Thermal efficiency credit--industrial b/ and commercial	-306	-349	--
Cogeneration credit b/	-52	-106	--
Solar equipment credit--residential a/	-11	-37	-93
Expense geothermal intangible drilling b/ costs	-5	-17	-54
Restricting minimum tax on intangible b/ drilling cost	-19	-37	-74
SUBTOTAL	-617	-937	-535
Other Revenue Losing Provisions			
Repeal of excise tax on intercity buses b/	-13	-9	-9
SUBTOTAL (TAX EXPENDITURES & OTHER LOSSES)	-630	-946	-544
Revenue-Gaining Provisions			
Motorboat and airplane fuels tax b/	45	54	80
Coal conversion incentives industrial c/ taxes: Revenues -	--	9,758	19,398
Rebates	--	-5,831	-11,607
Coal conversion incentives utility c/ taxes net of rebate	--	--	101
Crude Oil Equalization Tax: d/			
Revenue	--	18,800	17,967
Rebates	--	-18,800	-17,967
SUBTOTAL (REVENUE GAINS)	45	3,981	7,972
TOTAL TAX EFFECTS	-585	3,035	7,428

a/ See Chapter VII.
b/ These provisions are detailed in the National Energy Act, Title II. The data were provided by the Office of Management and Budget.
c/ See Chapter V.
d/ See Chapter III.

- Direct rebates, and

- Inflation, which would raise employee pay as well as those benefit payments that are indexed to the rate of inflation, (e.g., social security, federal civilian and military retirement, food stamps, and school lunch programs).

Some of these impacts are explicitly contained in the proposed National Energy Act (NEA) or would result indirectly from provisions of the act; others would result from administrative or legislative changes that would be made in the future. Table VIII-2 summarizes the outlays.

The largest increase in federal expenditures results from the proposal to expand the Strategic Petroleum Reserve of crude oil from 500 million barrels now projected to one billion barrels. As the reserve was originally conceived by the Ford Administration, 500 million barrels of crude oil costing $7.3 billion were to be stockpiled by 1982. The Carter Administration's proposal to increase capacity from 500 million to 1 billion barrels of oil would cost roughly $19 billion; of course, this figure could change depending on the fill rate and changes in oil prices. An estimated $1.7 billion is the aggregate cost for storage facilities, administrative salaries and expenses, and other support efforts. The price of oil, which accounts for more than 90 percent of the project's total expense, therefore represents the critical factor in determining total cost of the reserve.

The second category of programs affecting federal expenditures includes those conceived to improve the energy efficiency of buildings. Under the National Energy Act, the program created by the Energy Policy and Conservation Act to conserve energy in low-income dwellings would be augmented by $75 million in budget authority for fiscal year 1978; the recommended authorizations would be 200 million for fiscal years 1979 and 1980. A new grant program to finance energy conservation projects in private and non-profit schools and hospitals is proposed to commence in 1978. This proposal would authorize $300 million annually for 1978 through 1980.

TABLE VIII-2. PROJECTED DIRECT FEDERAL OUTLAYS UNDER THE NATIONAL ENERGY PLAN: IN MILLIONS OF CURRENT DOLLARS, BY FISCAL YEARS

Program Component	1978	1980	1985
Strategic Petroleum Reserve Expansion a/	216	482	--
Building Conservation Programs a/, b/	330	1,000	--
Increased Federal Fuel Costs	110	360	1,100
Energy Research and Development a/	-116	-400	-250
Other Programs			
National Energy Act a/, c/	48	28	--
National Energy Plan a/, d/	100	90	95
Indexed Programs			
Indexed by Law	181	1,679	2,398 e/
Implicitly Indexed	268	1,780	2,627 e/
TOTAL	1,137	5,019	5,970

a/ Based on data from the Office of Management and Budget.

b/ Includes the following programs: insulation of low-income residential units, insulation of schools and hospitals, improvement of federal buildings, and solar demonstration facilities in federal buildings.

c/ Programs include: development of building and appliance efficiency standards, development of home conservation plans by public utilities, and federal vanpooling.

d/ Programs include: creation of new reporting systems, expansion of HEW emergency assistance, augmentation NRC staff, and expansion of coal research.

e/ The 1981 estimate is shown here; the appropriate figure for 1985 will be at least this large.

The National Energy Plan calls for existing federal facilities to reduce their energy consumption by 20 percent from 1975 levels, and for 45 percent greater energy efficiency in new federal buildings. Because new construction proceeds at a rate of only 20 million square feet per year (adding 1.25 percent to existing federal space), the budgetary impact of the 45 percent reduction would be insignificant in the early years of the program. An approximation of the necessary funding level needed to achieve a 20 percent reduction of energy use in existing facilities can be derived by using the Department of Defense (DoD) energy conservation program as a base. Using DoD's six-year "retrofitting" program as a model, it is estimated that the average annual costs would be approximately $250 million for all federal buildings.

The National Energy Act proposes a corollary program to install solar demonstration facilities in federal buildings, which would add $37 million in budget authority for the Federal Energy Administration in fiscal year 1978, $32 million in fiscal year 1979, and $31 million in fiscal year 1980 for a cumulative funding level of $100 million. 1/

The projected decrease in federal consumption of fuel would somewhat offset the higher costs anticipated as a result of fuel tax provisions in the act. The federal government spent approximately $4 billion in fuel for facilities and transportation in fiscal year 1976. Without the plan, it is assumed that federal consumption would remain constant through 1985 while fuel prices would rise by about 5.5 percent a year. The cumulative fuel bill between fiscal years 1978 and 1985 would therefore be $44 billion. If the fuel tax provisions are instituted, fuel prices will increase at higher rates (assuming an average annual increase of 10 percent in all fuel categories), but the cost to the government would be offset by a 2 percent reduction in federal consumption each year. Under the plan, therefore, the federal fuel bill through fiscal year 1985 would be $48 billion, or $4 billion higher than without the plan.

1/ These projections are based on present policy. If the proposal now before the Congress to merge federal energy-related agencies is adopted, the projections concerning the FEA, ERDA etc. would change.

The effect of the proposals on the research program conducted by the Energy Research and Development Administration (ERDA) would be a net reduction of $455.1 million in budget authority and $116 million in outlays for fiscal year 1978. This reduction would result from cancelling construction of the gaseous diffusion uranium enrichment plant in Portsmouth, Ohio, and the construction-related components of the Clinch River Liquified Metal Fast Breeder Reactor. These two decisions would result in reduced budget authority requests of $512 million and $173 million, respectively. An additional $61.4 million would be saved through the elimination of research and development programs on fuel cycle technologies for light water reactors and uranium process development associated with gaseous diffusion technology. These reductions would be offset by an additional $111.3 million in budget authority in fiscal year 1978 to expand research in the areas of fossil, geothermal and solar energy, and nuclear nonproliferation.

The energy plan also calls for increased emphasis on the construction of a gaseous centrifuge plant for uranium enrichment, which will increase the budget authority for ERDA for fiscal year 1978 by $180 million. The cumulative project cost is not considered an additional cost element of the plan, however, because the centrifuge plant has already been included in ERDA budget projections. The primary effect of shifting the research and development effort away from nuclear energy to other energy sources, would be a substantial reduction in budget authority and outlays in the years discussed.

The Administration's proposed legislation would authorize development of energy efficiency standards for buildings and appliances, as well as for the development of home conservation plans by public utilities, and the establishment of a federal "vanpooling" program. (Vanpooling is a form of carpooling designed to reduce the number of vehicles the federal government uses.) The legislation would authorize $10 million in fiscal years 1978 and 1979 for the building standards program. But it does not specify authorization levels for the appliance standards, utility plans, or vanpooling programs; however, estimates of these program costs in fiscal year 1978 are $12.5 million, $12.7 million, and $12.5 million, respectively. The vanpooling program, which would ultimately be reimbursed through passenger fares, would nevertheless incur net outlays until the program is fully underway. The cumulative costs of these proposed programs through fiscal year 1985 (excluding the vanpooling program) are $129 million.

The National Energy Plan proposals also include: creation of three new reporting systems to facilitate the management of energy data; expansion of the emergency assistance and energy development impact assistance programs addministered by the Department of Health, Education, and Welfare; augmenting the Nuclear Regulatory Commission inspection staff; and enlarging coal research and development programs administered by the EPA and the Department of Interior. These proposals could increase the fiscal year 1978 budget authority by $135 million, and would produce a cumulative increase of $857 million through fiscal year 1985.

In addition, as a result of the slight inflationary effect of the proposed act (see Chapter IX), federal payment programs indexed to the cost of living would reflect corresponding increases in outlays. Federal programs tied by statute to the Consumer Price Index 2/ would show a cumulative increase in outlays of $5.2 billion between fiscal year 1978 and fiscal year 1981. In addition, an increase of $5.7 billion in outlays over the same period would be anticipated for other federal programs that, while not indexed by law, are implicitly indexed because payments are based on items whose prices increase with general price levels. 3/

In addition to the direct expenditure effects of the energy plan, nontax revenues will be affected as receipts from the sale of products from the Naval Petroleum Reserves decline pursuant to limiting production from Elk Hills. This reduction in receipts, however, would be offset in part by increased royalties and lease payments associated with acceleration of Outer Continental Shelf (OCS) development. Since information about the extent of anticipated OCS acceleration is not available, it is not possible to estimate the revenue impact. The effect of a limiting Elk Hills oil production to 30,000 barrels per day would be to reduce revenues by $400 million in fiscal year 1978 and $700 million in fiscal year 1980. After 1980 it is assumed that production will return to normal levels.

2/ Includes social security, federal civilian and military retirement, food stamps, child nutrition, supplemental security insurance, and railroad retirement programs.

3/ Includes unemployment insurance, aid to families with dependent children, medicaid, medicare, and federal and military pay programs.

CHAPTER IX. SHORT-RUN IMPACT ON THE ECONOMY

INTRODUCTION

Through 1980, the energy proposals of the Carter Administration would have a major impact on energy markets, a noticeable but small impact on the overall rate of inflation, and only a minor impact on total output and employment. (Economic effects after 1980 have not been investigated for this chapter.) The inflation effect is estimated to add about 1.6 percent to the level of consumer prices by 1980 or about half a percentage point per year to the rate of inflation from 1977 to 1980. The output effect is estimated to reduce constant-dollar GNP by no more than 0.7 percent by the end of 1980. The employment effect is estimated to add 0.2 percentage points to the unemployment rate by 1980.

To understand these conclusions, it is helpful to consider what is likely to happen to the nation's fuel bill with and without the energy proposals. In 1976, as Table IX-1 shows, total U.S. expenditures on fossil fuels (including imports, but before domestic transportation, refining, or other processing) amounted to about $90 billion or just over 5 percent of total GNP. A 10 percent increase in fuel prices passed through dollar for dollar to final product prices would, therefore, cause roughly a 0.5 percent increase (5 percent of 10 percent) in the overall price level.

This direct passthrough is not the end of the story, of course. On the one hand, reduced demands for fuel in response to higher prices could diminish the effect on the overall price level; but over a period of only a few years the demand response to fuel prices appears to be small enough so that this factor can safely be neglected in rough calculations. On the other hand, higher wage settlements in response to the higher prices, and additional price increases based on these wage settlements, could amplify the initial passthrough; and past experience suggests that this amplification would be of some importance.

Under the President's proposals, it is estimated that fuel prices would rise by approximately 74 percent from 1976 to 1980, which should result in an additional 3.7 percent increase in the

TABLE IX-1. PROJECTED FOSSIL FUEL PRICES a/

Fuel	Total Fuel Bill, 1976 (billions of dollars)	Price Indexes, 1976 = 1.0			
		1977	1978	1979	1980
Domestic Crude Oil					
Baseline	31.3	1.033	1.189	1.320	1.461
Carter		1.042	1.391	1.703	1.970
Imported Crude Oil					
Baseline	35.9	1.090	1.150	1.213	1.280
Carter		1.090	1.155	1.241	1.325
Natural Gas					
Baseline	12.5	1.341	1.758	1.943	2.311
Carter		1.341	1.725	2.107	2.652
Coal					
Baseline	9.8	1.078	1.163	1.254	1.352
Carter		1.078	1.174	1.272	1.377
Total					
Baseline	89.5	1.104	1.250	1.357	1.495
Carter		1.107	1.319	1.527	1.742

SOURCE: Congressional Budget Office.

a/ Prices are measured before transportation, refining, or other processing, but include excise and user taxes.

overall price level (before any amplification due to wage-price interaction). But this projected fuel price rise would by no means be all due to the Administration's proposals. Some would be due to general inflation and some to fuel market developments that would take place without the program. Without the Administration's proposals, it is estimated that fuel prices would rise by about 49.5 percent from 1976 to 1980, which translates to 2.5 percent in the overall price level before wage-price amplifications.

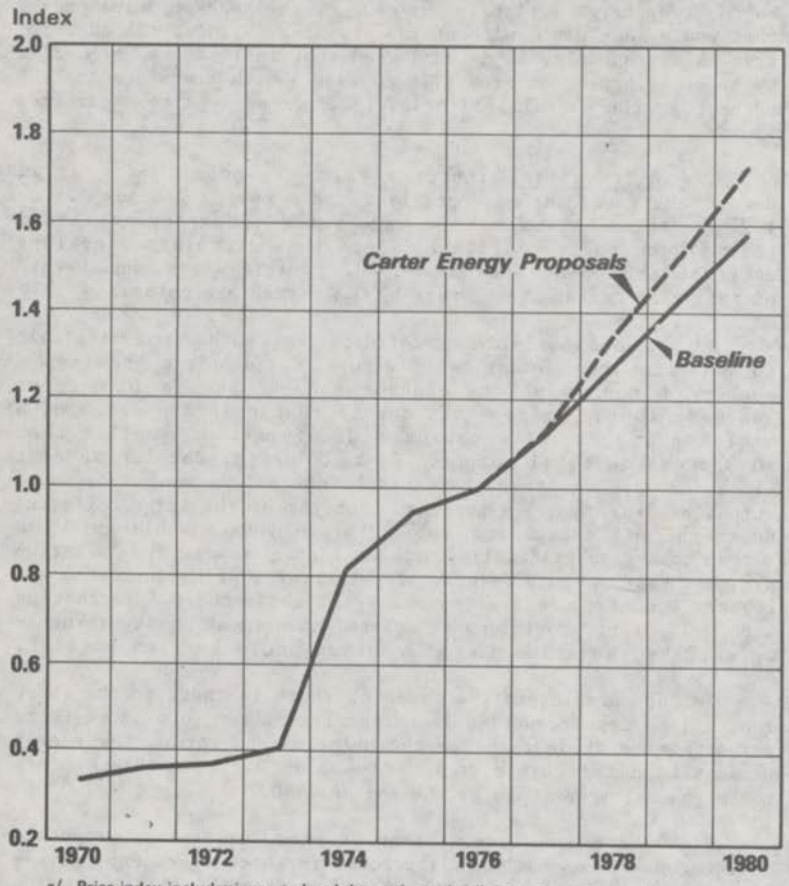
The differential increase in the general price level due to the President's proposals is thus only 3.7 minus 2.5 or 1.2 percent. Allowing for wage-price interactions raises this figure to 1.6 percent. Since this difference develops over the three-year span 1977-1980, it raises the annual rate of inflation during those years by 0.5 percentage points.

Output and unemployment effects are much more difficult to estimate than inflation effects. Calculations based on a number of models of the economy suggest that a 10 percent increase in the price level due to change in the price of a basic input commodity causes a drop somewhat smaller than 10 percent in total output. On this basis, the 1.6 percent price increase due to higher fossil fuel prices would decrease output by less than 1.6 percent. Rebates of the taxes collected under the oil excise and some other proposals would cut this output impact substantially, without adding much to the inflation projections during 1977-1980. Together, the price increases and rebates would reduce real output by an estimated 0.7 percent by 1980. If other provisions stimulated investment in new technologies, the reduction in real output could be even smaller.

As for unemployment, a rule of thumb is that, in the short run, a 1 percent reduction in output translates into a one-third percentage point increase in the unemployment rate. The energy proposals on this basis could add about 0.2 percentage points to the unemployment rate by the end of 1980.

From the macroeconomic point of view, the energy proposals invite comparisons with a major economic shock of recent years--namely, the OPEC quadrupling of oil prices in 1973-1974. The following figure, showing an index of fossil fuel prices (1976 = 1.0) from 1970 to 1980, is helpful in making the comparison. The Administration's energy proposals would add 0.25 points (the

Index of Fossil Fuel Prices[a/] 1970-1980
(1976 = 1.0)



a/ Price index includes imported and domestic crude oil, natural gas, and coal. Prices are inclusive of the proposed excise and user taxes but exclusive of transportation, refining, or other processing costs.

Source: Congressional Budget Office.

difference between the solid and dashed lines in 1980) to the price index of commodities worth $90 billion in 1976. They thus add roughly 0.25 times $90 billion, or $22 billion to our national fuel bill (in 1976 prices), and do so gradually over a period of three years. The OPEC increase added 0.40 points to the price index, or a bill of $36 billion (in 1976 prices), and did so all at once rather than over several years. Clearly, the OPEC increase was a much larger shock than the energy proposals. Immediate decontrol of "old" oil, had it taken place during 1975, would also have been a much larger shock than the energy proposals.

The remainder of this chapter deals with the short-run macroeconomic impacts of the President's proposals in greater detail. The price effect of the proposals will be discussed first, with the output and employment effects following.

PRICES

The central energy proposals which would directly raise prices are:

- o The excise tax on domestic crude oil to be introduced in stages beginning late in 1977;
- o The high price permitted on newly discovered oil;
- o Removal of the present ceiling on gasoline prices; and
- o The tax on industrial use of gas and oil beginning in 1979.

Two provisions that could raise prices under some circumstances, but that are not expected to do so during 1977-1980, are:

- o The increase of the ceiling price on interstate natural gas, which is offset by the reduction in intrastate natural gas prices;
- o The standby tax on gasoline to be imposed if gasoline consumption exceeds a target path, which is estimated not to be triggered before 1981.

In addition, other parts of the program could affect prices. Requirements for use of coal by utilities and industry could lead to more expensive technologies that, in turn, could be passed along in the form of higher prices. Subsidies for insulation, solar heating, and other energy-conserving measures could increase the demand for some kinds of output and raise their prices. The assumption underlying this analysis is that these more conjectural price effects are small enough to be neglected in an overall analysis. The price effects of the proposed gas-guzzler tax, which raises the price to consumers of some cars and lowers the price of others, are also neglected in this macroeconomic analysis. Finally, the analysis assumes that the standby tax on gasoline will not be triggered until after 1980. (For discussion of these last two points, see Chapter VI.)

The effects of the program on final demand also have price consequences. As discussed below, there are reasons for believing that price-raising features of the program would tend to depress final demands, while the proposed rebates would add to final demands. It is estimated that these offsetting influences on final demands net out to a fairly small impact and one which would have a scarcely measurable effect on inflation rates through 1980.

It is helpful to think of the price effects of the energy program in three stages, although in fact the three stages may overlap. In the first stage, the proposed taxes and other measures directly affect fuel prices, with consumers feeling the impact only to the extent that they purchase fuels--for example, gasoline--directly. In the second stage, increased fuel costs for producing many thousands of goods and services are reflected in higher final product prices. In the third, and most conjectural stage, higher consumer prices affect wage negotiations and price expectations generally and become magnified through a price-wage spiral.

To analyze this complex process, it is necessary to use econometric models of the economy. The results of such models are subject to wide margins of uncertainty, but they are the most complete way of taking account of a whole set of complex economic forces and their interactions. To minimize the uncertainty involved, the analysis below is based on several different models.

As Table IX-2 shows, the most immediate and largest price impact of the program is estimated to be at the wholesale level. Wholesale fuel prices could increase by an estimated 5.5 percent in 1978, an additional 7 percent in 1979, and by 4 percent more in 1980, so that by the end of the period they would be 16.5 percent higher than they would otherwise be. The overall Wholesale Price Index, mainly reflecting this fuel increase, goes up by 3.1 percent from 1977 to 1980 as a result of the energy package.

TABLE IX-2. IMPACT OF THE ENERGY PROPOSALS ON PRICES AND WAGES (Percent Difference from Baseline Price Projections)

Prices and Wages	1977	1978	1979	1980
Wholesale Prices				
Fuels	0.3	5.5	12.5	16.5
Total	0.1	1.3	2.8	3.1
Consumer Prices	0.0	0.5	1.1	1.6
Average Hourly Wages	0.0	0.2	0.4	0.7

SOURCE: Congressional Budget Office.

At the consumer level, effects build more gradually. From 1977 to 1978, the calculated increase would be only 0.5 percent. In 1979 and 1980, the increase would be somewhat larger so that the three-year increase is 1.6 percent, or an average of just over 0.5 percent per year. The consumer increase reflects partly the transmission of higher wholesale costs to the retail level, but it also reflects the effect of the program on wage negotiations and, subsequently, second-round price adjustments. According to the models, by 1980 average hourly wages would be 0.7 percent higher with the energy proposals than without them.

What the models suggest, in short, is that the energy proposals would add 1.6 percent to the 1980 consumer price

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level, or about 0.5 percentage points per year to the rate of inflation during 1977-1980. If the underlying rate of inflation without the program were 5 percent enactment of the program would raise the rate to 5.5 percent. To put this number in perspective, it may be useful to compare it to some recent rates of inflation. In 1974, the Consumer Price Index was 11 percent higher than a year earlier. Rates of increase in the two subsequent years were 9.1 and 5.7 percent. Thus, the 0.5 percent per year that the energy proposals are estimated to add to the rate of inflation, while measurable and significant, is not large in relation to the underlying rate or its changes in recent years.

OUTPUT AND EMPLOYMENT

There are three reasons for thinking that the price-raising portions of the energy package might depress constant-dollar spending on goods and services and hence exert a negative influence on output and employment. The first is that higher prices reduce the real value, or purchasing power, of many forms of wealth, such as money, savings accounts, insurance policies, and pension rights. This decrease in purchasing power, in turn, could reduce real expenditures on consumer goods. The second channel of influence is the effect of higher prices on interest rates. Fuel price increases tend to raise inflation rates and current-dollar incomes (even though they depress real incomes). If these changes are not offset by a more expansionary monetary policy, they tend to raise interest rates, which in turn depress investment and possibly other final demands. The third channel of effect is the redistribution of income away from households and toward government and businesses. To the extent that these transfers occur, they could cause a temporary rise--in all likelihood not a permanent one--in the national saving rate.

To offset this third channel of influence, the energy proposals include full rebates to households of the proceeds of the oil excise tax and the standby gasoline tax (if it comes into play) and a partial rebate to business of the oil and gas user tax. These rebates, by adding to purchasing power in the hands of consumers and businesses, would tend to offset the drop in private purchasing power caused by the price-increasing features of the energy program.

Other portions of the program could also affect final demand. Subsidies to certain kinds of conservation expenditures could well increase demands for those goods and could possibly increase overall demands. Creation of a national petroleum reserve, while it is being built up, would have a direct impact on demand for petroleum. Requirements for conversion from oil and gas use to coal use would affect the composition of investment and could affect its overall level.

Once again it is necessary to use econometric models to analyze the net effect of all of these provisions on output and employment. The results in Table IX-3 are based on the calculated effects of the price-raising measures and the rebates, assuming that the rebates are paid out at the same time that the revenues are collected. The calculated effects assume a zero net impact of the other provisions on investment. For this reason, the numbers in Table IX-3 might be considered to be upper-limit estimates of the reduction in output and the increase in unemployment that the energy proposals could cause.

TABLE IX-3. IMPACT OF THE ENERGY PROPOSALS ON OUTPUT AND EMPLOYMENT (Percent Difference from Baseline Projections)

Economic Variables	1977	1978	1979	1980
Real GNP and Components (Constant Dollars)	0.0	-0.2	-0.5	-0.7
Consumption Expenditures (Constant Dollars)	0.0	-0.1	-0.3	-0.4
Fixed Investment Expenditures (Constant Dollars)	0.0	-0.4	-1.2	-1.8
Unemployment Rate a/	0.0	0.0	+0.1	+0.2

SOURCE: Congressional Budget Office.

a/ Differences from baseline in percentage points.

Output and employment effects, even those in Table IX-3, are estimated to be fairly small. At the end of three years, the program is estimated to reduce output by approximately $10 billion in 1972 dollars, or 0.7 percent of real GNP. This amounts to about $14 billion in 1977 dollars. The unemployment rate, as calculated, would be about 0.2 percentage points higher under the energy program by the end of 1980 than it would otherwise be. Since these effects build up over three years, they must be considered to be fairly small compared to other influences on the course of macroeconomic activity. The unemployment effect, for example, is equivalent to an acceleration in the rate of growth of the labor force of approximately seventy thousand persons per year, which is only a small increase above its projected year-to-year growth of approximately two million persons.

Macroeconomic effects could be smaller than the amounts indicated in Table IX-3 if some of the investment incentives and conversion requirements proposed have a sizable stimulative effect on investment or government purchases. A spending impact, growing to approximately $7 billion by 1980, would serve to offset completely the output and unemployment effects indicated in Table IX-3.

In summary, the impact on output and employment of the proposed energy program appears likely to be negative but of small size. If the energy program is enacted, the economic outlook for the next two or three years may be a shade worse than it would have been in the absence of the program, and these energy effects will be one among many factors that policymakers will wish to take into account in setting overall monetary and fiscal policies for the years ahead.

CHAPTER X. THE DISTRIBUTIONAL IMPACT OF THE ENERGY PROPOSALS

Several parts of the Administration's energy program are designed to change the energy-using habits of Americans by raising the relative cost of those goods and services that use scarce energy resources lavishly. At the same time, the program seeks to maintain the overall purchasing power of consumers by providing benefits that help to replace the losses stemming from higher prices. A system of taxes, efficiency standards, tax credits, and cash rebates has been proposed to induce both the desired changes in prices and in energy consumption and to provide compensatory benefits for the costs that will be imposed.

Although the income taken away by the higher prices of energy-intensive products is to be refunded, partly in the form of cash rebates, it is not expected that these refunds will simply be used to pay the higher energy prices. Because a dollar of income will buy relatively more of the energy-saving goods and less of the energy-intensive goods than before, it is anticipated that consumers will have a strong incentive to buy less energy-intensive goods with their cash rebates. In addition, some of the rebates can be obtained only by purchasing low energy-using products, as in the case of the rebate for purchasing gasoline-efficient autos.

Although the Administration's program is designed to replace the aggregate income lost through higher prices, the income losses and rebates implicit in the program can have very different impacts on individual consumers. The cost of auto travel, of new energy-inefficient cars, and of other goods and services that rely on oil or gasoline as inputs will rise relatively sharply. These price increases are likely to impose different burdens on different people. The proposed per capita rebates of oil and gasoline taxes, the rebates associated with new energy-efficient cars, and the tax credits for insulation and other energy-conserving expenditures for the home will provide benefits that may not be related to the individual burdens imposed. Whether, on balance, the distribution of those costs and benefits is perceived as being fair, however, is likely to be an important determinant of the political viability of the proposals.

This chapter contains a discussion of the conceptual and practical problems encountered in defining and implementing a

fair energy policy as well as a description of the likely effects that the Administration's proposals will have on families differing by income class and by place of residence.

THE CONCEPTUAL PROBLEM

While we may all believe in the principle of fairness, it is a difficult concept to define precisely or to put into practice with respect to energy policy. Generally, a policy is thought to be fair if the burdens imposed by that policy are related to the ability of individuals to bear those burdens.

The Administration's energy proposals will deliberately raise the price of commodities essential to modern American life-styles--gasoline and other products dependent on oil. Those who consume relatively few of the goods and services that are to rise in price will have minimal costs imposed on them. Those who consume relatively more of these products will be faced with the possibility of large losses in the purchasing power of their incomes. For example, if owners of fuel-inefficient cars were to persist in driving the same cars the same number of miles as before, they would have to give up substantial amounts of other goods and services to do so. Most people will, however, adjust their behavior somewhat by reducing their consumption of the goods and services that rise in price and substituting the use of cheaper products.

Not everyone has the same opportunities, or willingness, to make these substitutions. Some have ready access to car pools or mass transportation; others would make nontransportation substitutions, for example, playing tennis instead of taking a Sunday drive.

An ideal system of offsets would involve a separate evaluation of each family's preprogram energy use and the opportunities available to it to conserve. The offset from the federal government would then be tailored to equalize the excess burden or income loss imposed by higher energy prices after the family had made "reasonable" substitutions. Of course, in practice, only much cruder methods for moderating inequities are available.

The burden of an increase in prices for energy-intensive products will vary from group to group. Some of these variations may be traced to a few general characteristics, such as family

size, climate, and location. Consumption of energy-intensive products is likely to rise with family size. People living in warmer climates will be less affected by a rise in the price of home heating fuel. People living in cities with good public transit systems are likely to find it easier to reduce work trips by car. People using their cars mostly for commuting to work may find it more difficult to cut back on gasoline consumption.

The Administration's energy proposals offer various mechanisms for offsetting the burden imposed by increased energy prices. These include per capita credits and payments that will refund much of the money collected through the crude oil equalization and the standby gasoline taxes, rebates that will distribute the proceeds of the gas-guzzler tax to purchasers of energy-efficient cars, and refunds to suppliers of home heating oil that will keep the price to consumers from reflecting the crude oil equalization tax. These instruments implicitly make some rough adjustments to mitigate the burdens imposed by the price increases. Since the proposed rebates will be applied on a per capita basis, there is an implicit adjustment for the effect family size may have on energy consumption. Because of subsidies to keep down the price of home heating oil, there is an adjustment for regional impact (cold versus warm places) that the crude oil equalization tax would have had on those who heat with oil. Nevertheless, it is clear that, because of individual differences, the Administration's energy policy will compensate some families in excess of the added cost and will compensate others less than the added cost of the program.

The remainder of this chapter looks at the likely impact of the costs of the program on families differing by income and other characteristics. The extent to which the rebates mitigate the differential cost effect is also examined.

THE DISTRIBUTIONAL IMPACT OF RISING ENERGY PRICES

The Administration's energy proposals will cause prices of different types of energy and energy-using products to rise at different rates. The reliance of different income classes and regions on the various types of energy and products varies considerably. This section summarizes what is known about the possible distributional impacts of the major elements of the Administration's energy proposals affecting prices, particularly those elements that would increase gasoline prices.

Increased Gasoline Prices

The imposition of the crude oil equalization tax and the standby gasoline tax will cause a substantial rise in gasoline prices. CBO estimates that by 1980 the equalization tax will increase the price of gasoline by 3.5 cents per gallon (in 1977 prices). The standby gasoline tax is not expected to be triggered until at least 1982. By 1985, it is estimated to add an additional 12 cents per gallon (in 1977 prices) to the price of gasoline.

The initial burden imposed by these price increases will vary according to gasoline usage. On average, gasoline consumption increases with family income (see Table X-1). This reflects the fact that higher-income persons tend to have more cars per family, that they drive each car more miles, and (according to some evidence) that their cars tend to be less energy efficient --that is, they get fewer miles per gallon than cars owned by lower-income families (see Table X-2). 1/

TABLE X-1. ANNUAL EXPENDITURES PER FAMILY ON GASOLINE, BY FIFTHS OF FAMILIES RANKED BY MONEY INCOME, 1973-1974

Families Ranked by Money Income a/	Average Annual Gasoline Expenditures		Average Annual Gasoline Expenditures, Families With Vehicles Only		Percent of Families Owning One or More Vehicles
	Dollars	Percent of Income	Dollars	Percent of Income	
Lowest Fifth	139	6.6	311	14.8	44.7
Second Fifth	290	5.2	383	6.9	75.8
Third Fifth	419	4.5	473	5.1	88.6
Fourth Fifth	497	3.6	522	3.8	95.2
Highest Fifth	605	2.5	624	2.6	97.0

SOURCE: Calculated by CBO based on data from the Consumer Expenditure Survey Series: Diary Survey, July 1973-June 1974, U.S. Department of Labor, Bureau of Labor Statistics, Report 448-3.

a/ In 1973-1974, the income ranges for each fifth were: lowest fifth-under $3,800; second fifth-$3,800 to $7,456; third fifth-$7,457 to $11,198; fourth fifth-$11,199 to $17,010; highest fifth-$17,011 and over.

1/ Evidence on the relative fuel efficiency of cars owned by high- and low-income families is contradictory. In any case, the improvements in auto efficiency expected over the next ten years benefit high-income families first.

TABLE X-2. FACTORS RELATED TO GASOLINE USE, FAMILIES CLASSIFIED BY INCOME, 1972-1973, IN PERCENTS a/

Factor	Income Class of Family or Car Owner b/			
	Poor	Lower-Middle	Upper-Middle	Well-off
Cars				
No cars	47	16	4	1
1	37	52	35	21
2	14	25	51	58
3 or more	2	7	10	21
All cars	100	100	100	100
Miles driven in past years c/				
Less than 10,000	64	39	15	12
10,000 to 14,999	17	27	18	15
15,000 or more	20	35	67	72
All cars	100	100	100	100
MPG (Locally)				
0-14 mpg	31	50	54	62
15-19	47	32	30	24
20 and over	22	17	16	14
All cars	100	100	100	100
MPG (Long distance)				
0-14 mpg	22	23	32	34
15-19	46	49	46	44
20 and over	32	29	22	22
All cars	100	100	100	100

SOURCE: Dorothy K. Newman and Dawn Day, The American Energy Consumer, a report to the Energy Policy Project of the Ford Foundation, 1975.

a/ Percents may not add to 100 due to rounding.

b/ Income in 1972. The average income of the poor as defined by the study was $2,500; for the lower-middle, $8,000; for the upper-middle, $14,000; for the well-off, $24,500. The classification of poor takes family size into account.

c/ Cars owned 12 months or more for which mileage was reported.

Car use varies by income in part because of differences in the age, work participation, and other characteristics of people at different income levels. According to one survey, commuting to work accounts for more than 40 percent of all car miles traveled. 2/ About three-quarters of all workers go to work by car. Families at the lowest-income levels, however, are much less likely to be composed of workers since they tend to be headed by older or retired people or by women with young children. 3/ By contrast, families in higher-income categories often have at least two earners. If one considers only heads of families who are working, however, there is not much difference in the means of transportation to work by income group. In the poorest-income fifth, 84 percent go to work by car and among the richest fifth, 91 percent do so. The difference is made up by a larger proportion of walkers and bicycle riders among the poorest fifth. Only 8 percent of the employed household heads (whether poor or rich) use public transportation to go to work 4/.

While gasoline consumption does tend to increase with income, it does so less than proportionately. Thus, families in the lowest fifth of the income distribution in 1973-1974 spent an average of $139 on gasoline during the year and families in the highest fifth spent $605. This expenditure represented 6.6 percent of the income of the lowest fifth but only 2.5 percent of the income of the highest fifth (see Table X-1). If low-income families find it no easier than high-income families to reduce their consumption of gasoline, then the

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2/ U.S. Department of Transportation, Federal Highway Administration, Household Travel in the United States, Report #7, December 1972.

3/ In 1973, among families in the lowest fifth, close to 50 percent were headed by a person who was out of the labor force and 39 percent had no family members in the labor force at all. Among families in the highest fifth, 97 percent were headed by a person in the labor force, 45 percent had two earners, and 31 percent had three earners or more. (U.S. Bureau of the Census, 1973 Current Population Report, Series P-60, #97.)

4/ Dorothy K. Newman and Dawn Day, The American Energy Consumer, a report to the Energy Policy Project of the Ford Foundation, 1975.

burden of an increase in gasoline prices will be regressive; that is, the increase will have a relatively larger impact on those with lower incomes than on those with higher incomes.

While there is clear evidence that average gasoline consumption varies by income group, there is also evidence that there is a great deal of variation within each group. While virtually all upper-income families own cars, a substantial portion of lower-income people do not. In 1973-1974, about 55 percent of families in the lowest-income fifth did not own a car and therefore were hardly affected by increased gasoline prices. Thus, the absolute and relative burden placed on those lower-income families who do own cars would be substantially greater than the average. As indicated in Table X-1, those families in the lowest-income fifth who did own cars spent close to 15 percent of their incomes on gasoline, compared to the average of 7 percent for all families at that income.

Greater detail about the distribution of the relative burden of gasoline expenditures is given in the estimates of Table X-3. It appears that there is considerable dispersion in the relative burden of gasoline expenditures within an income class, but that

TABLE X-3. PROPORTION OF INCOME SPENT ON GASOLINE, BY TENTHS OF FAMILIES RANKED BY MONEY INCOME, 1974

Family Income by Tenths	Fuel Cost as Percent of Family Money Income						
	No Car Zero Percent	0-5 Percent	5-10 Percent	10-15 Percent	15-20 Percent	20 Percent	NA	Total
	(Distribution of Families)							
Lowest	57.8	14.7	6.2	5.4	2.8	6.0	7.0	100.0
Second	38.2	31.6	11.6	5.8	2.5	5.9	4.2	100.0
Third	23.2	34.3	21.3	8.7	2.8	3.7	6.0	100.0
Fourth	13.0	44.8	27.1	7.2	2.2	2.5	3.1	100.0
Fifth	10.3	48.2	29.8	6.2	1.8	1.6	2.1	100.0
Sixth	4.6	60.2	24.4	7.1	1.0	0.8	2.1	100.0
Seventh	3.4	64.4	23.8	5.6	0.6	0.3	1.9	100.0
Eighth	3.2	68.5	22.5	2.9	0.0	0.0	2.9	100.0
Ninth	0.6	80.1	13.0	2.0	0.2	0.4	3.7	100.0
Highest	0.7	88.3	8.0	0.4	0.0	0.0	2.6	100.0

SOURCE: John Holmes and James Morgan, The Impact of Rising Gasoline Prices: Some National Survey Data, Survey Research Center, University of Michigan, February 1975.

the dispersion narrows as income rises. Thus, among families in the lowest-income tenth, 58 percent spent nothing on gasoline in 1974, while 6 percent spent more than 20 percent of their income on gasoline. As income rises and car ownership becomes almost universal, the percentage of income spent on gasoline tends to concentrate in the 0-5 percent range. Among those in the highest tenth, 88 percent are in that range; in that group, however, about 8 percent spend more than 5 percent (a very large absolute expenditure) of their income on gasoline.

The impact of higher gasoline prices will differ significantly by region as well as income class. As indicated in Table X-4, families in the lowest-income fifth living in the South spent 57 percent more on gasoline than those living in the Northeast in 1973-1974. In general, within an income class, more is spent on gasoline in the South and West and less in the Northeast, but the regional differences are smaller at the highest-income levels.

TABLE X-4. REGIONAL DIFFERENCES IN ANNUAL EXPENDITURES ON GASOLINE FOR FAMILIES RANKED BY MONEY INCOME, 1973-1974

Family Ranked by Money Income a/	Annual Expenditures Per Family On Gasoline					
	Northeast	North Central	South	West	Rural	Inside SMSAs b/
Lowest Fifth	102	132	160	146	208	124
Second Fifth	226	301	306	318	387	259
Third Fifth	346	415	475	421	529	407
Fourth Fifth	440	483	548	523	587	487
Highest Fifth	580	615	609	625	663	601

SOURCE: Calculated from the Consumer Expenditure Survey Series: Diary Survey, July 1973-June 1974, U.S. Department of Labor, Bureau of Labor Statistics, Report 448-3.

a/ See Table X-1 for income boundaries of each fifth.

b/ Standard Metropolitan Statistical Areas.

Regional differences partly reflect differences in the percentage of families who live in rural areas. As also shown in Table X-4, families who live in rural areas spend considerably more on gasoline than those living within metropolitan areas--even at the same income level. Other data suggest that there are differences in automobile use within metropolitan areas. As one would expect, those living in the suburban ring of a metropolitan area own more cars than those with the same income living in central cities. Car ownership has been found to be greater in the newer large cities (such as Los Angeles) than in the older large cities (such as Philadelphia). 5/ The new cities have grown up after the advent of the automobile and reflect that development in terms of lower density and lack of public transportation. Since old cities are clustered in the Northeast, this may help explain the relatively low usage of gasoline there. Of course, income, region, city size, and age of city are not independent characteristics. They overlap, and a detailed analysis would be needed to determine the net effect of each factor.

Data are not readily available to determine how different families would or could adjust to higher gasoline prices. One possible indicator is the extent to which driving is related to commuting to work. Presumably, in the short run, it is more difficult to change this type of automobile use. As indicated in Table X-5, the proportion of total miles spent driving to work is very small (less than 10 percent) for most low-income families, although a small percentage do use their cars heavily for commuting. Among families above the median income, about 20 percent generate more than 50 percent of their total mileage commuting to work.

Some auto commuters do have access to public transportation. One study estimated that, among employed household heads living in central cities of metropolitan areas, 24 percent could switch from private to public modes to get to work without incurring any additional commuter time. 6/ It would be possible for another 54 percent of the central city dwellers to switch to public transit,

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5/ See J.B. Lansing and G. Hendricks, Automobile Ownership and Residential Density, Institution for Social Research, June 1967.

6/ Dorothy K. Newman and Dawn Day, The American Energy Consumer, a report to the Energy Policy Project of the Ford Foundation, 1975.

TABLE X-5. VARIATION BY INCOME TENTHS IN THE RATIO OF COMMUTING MILES TO TOTAL MILES DRIVEN a/, FAMILIES WITH CARS, 1974

Family Income by Tenths	Commuting Miles as a Percent of Total Miles					
	0-10	10-20	20-30	30-50	More Than 50	Total
	(Distribution of Families)					
Lowest	87.0	3.6	2.1	1.4	5.7	100.0
Second	74.8	7.9	3.1	4.8	9.5	100.0
Third	59.6	6.3	8.5	8.9	16.5	100.0
Fourth	51.8	11.3	7.4	11.5	17.9	100.0
Fifth	51.6	11.7	10.3	9.9	16.6	100.0
Sixth	38.5	13.6	11.5	15.7	20.6	100.0
Seventh	33.6	14.9	14.2	15.3	21.9	100.0
Eighth	30.0	15.1	14.9	15.0	25.2	100.0
Ninth	31.6	15.4	12.0	15.1	26.0	100.0
Highest	37.4	14.2	16.2	15.7	16.7	100.0

SOURCE: Calculated from The Impact of Rising Gasoline Prices: Some National Survey Data, John Holmes and James Morgan, Survey Research Center, University of Michigan, February 1975.

a/ Refers to commuting miles of head of household and, where applicable, of wife who drives to work.

but it would greatly increase their commuting time. Altogether, about 90 percent have some access to public transit, including the 13 percent who now use it. For those working heads of households who live in the ring of a metropolitan area, the prospects for public transit are lower--only 56 percent have any access to public transit, including the 8 percent who already use it. Public transit is virtually unavailable to workers in rural areas and small urban areas. In the largest cities, many downtown-oriented public transit systems operate at or close to capacity during commuting hours and thus are not capable of absorbing a great influx of commuters without further incentives to expand capacity. Systems oriented toward suburban employment tend to be less capa city-bound, but service of this sort is costly to provide and often inadequate in route coverage and schedule frequency.

Further, many areas have no public transit systems, or have inadequate ones, so the above-mentioned conclusions may not hold everywhere. Thus, while many workers have some access to public transportation, it is not clear that there is a substantial number of nonusers for whom sufficiently convenient public transport alternatives are available. 7/

7/ From an energy conservation perspective, the concern about public transport is often overstated. While well-utilized bus services have been found to be less energy-intensive per passenger mile than cars, the evidence on fixed rail systems is less encouraging. For example, Charles Lave has estimated that, because of the extra energy needed to build San Francisco's BART rail system relative to its equivalent in highways, it would take over 160 years for the savings in operating energy to break even, even if ridership doubled and the proportion of riders diverted from the auto tripled. ("Negative Energy Impact of Modern Rail Transit Systems," Science, Feb. 11, 1977, pp. 595-596.) Similarly, an analysis of Philadelphia's Lindenwold Line found that, because many of the rail system's patrons were former bus passengers and because they made circuitous routing (often by automobile) in order to use the system, an average trip after the system was built used more energy than it had before the system was operating. (David E. Boyce, et. al., "Impact of a Suburban Rapid Transit Line on Fuel Consumption and Cost for the Journey to Work," report submitted to the Federal Energy Administration, December 1975.)

Since low-income people are concentrated in both central cities of larger metropolitan areas and in rural places, there is likely to be a larger variation in the extent to which they can adjust to rising gasoline prices (just as there is a larger dispersion in their gasoline consumption patterns). Upper-income people are most heavily concentrated in suburban areas of large metropolitan areas, where switching to public transit is possible for many, but time consuming. In the long run, adjustments can be made through job and residence changes. These changes are costly, however, and are not likely to be initiated solely in response to energy prices. Rather, higher energy prices would be one factor to be balanced against many other factors that affect the pattern of urban development.

Based on available information, it is not possible to determine the extent to which families will adjust to higher prices by cutting back their gasoline consumption. Perhaps because their driving consists largely of commuting to work, families above the median could cut back proportionately less, at least in the short run.

Impacts on Other Goods and Services

The equalization tax on crude oil would increase the prices of other goods and services (as well as gasoline) to consumers. The gasoline price increase would raise the cost of trucking 8/ and that expense for the most part would be passed on to consumers. Products that use oil as an input would also experience cost increases. In addition, taxes would be imposed on all industrial users of natural gas and oil. There are some offsets that would keep the price of some energy-using products from rising. In particular, controls and rebates are intended to prevent price increases affecting gas and oil for residential heating.

It is difficult to identify precisely which goods and services would rise in price and by how much. Furthermore, it is unlikely that all cost increases would be passed on as higher prices, dollar-for-dollar, particularly after the economy has had time to adjust.

8/ More than half of for-hire trucks (intercity and local) are gasoline powered; about 45 percent are diesel powered.

The chain of producer and consumer adjustments to increased energy prices would be very complex. There would be changes on the production side induced by the changes in relative input prices. Producers would seek to shift to technologies that use less of the oil- and gas-intensive inputs. Shifts in production would also be induced by changes in consumer demand. As the prices of oil- and gas-using products rise, consumers would be likely to substitute and to buy fewer of the goods increasing in price and more of the goods becoming relatively cheaper. As a result of these shifts in demand and changes in input prices, profits would fall in some industries and rise in others. There would be contractions in some industries resulting in reduced employment and expansions in other industries bringing increased employment. Such adjustments would undoubtedly have regional differences.

The final distributional effects of the induced increases in gas and oil prices would be extremely difficult to tabulate. To do so would require information on many aspects of the economy, including the substitutions consumers would be likely to make among products in response to price increases, the technological possibilities open to producers, and the supply of inputs that would be substituted for gas and oil products. The final effects would influence the earnings and employment of many individuals as well as the relative price consumers pay. In general, however, one would expect that a broad increase in prices would hit families in proportion to their total consumption expenditure. Since consumption generally rises less than proportionately to income, such price increases would be regressive.

TAXES AND TAX CREDITS

Automobiles

Incentives to encourage the purchase of gasoline-efficient cars and to discourage the purchase of gasoline-inefficient cars are contained in a system of rebates for the former and taxes on the latter. As noted above, those in the lowest-income fifth are less likely to own a car or to use cars as much if one is owned. Moreover, when a low-income family does buy a car, it is likely to be a used one. Therefore the tax rebate scheme for new cars is unlikely to involve directly many at the lowest-income levels. Among the rest of the income distribution, one can only guess who would gain and who would lose. The purchase of a new car is related to income, so those with higher incomes are more likely to be involved

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in the scheme. Since the taxes and rebates are designed to cancel each other out, however, much of the outcome would be a transfer from high-income purchasers of gas-guzzlers to high-income purchasers of fuel-efficient cars. Since higher-income families tend to purchase a greater proportion of larger cars than do lower-income families, there would also be a transfer of income from high-income (over $20,000) new car buyers to lower-income (under $12,500) new car buyers.

Homes

Tax credits are also being offered to induce investments in home insulation and other fuel-saving equipment in the home and for solar heating systems. The home insulation proposal would entitle homeowners to a tax credit of 25 percent of the first $800 spent and 15 percent of the next $1,400 to install certain items, such as insulation, storm windows, and improvements in heating equipment. The Administration's proposal also calls for the Federal Home Loan Mortgage Corporation and the Federal National Mortgage Association to help ensure that capital is available to homeowners, at reasonable interest rates through private lending institutions, for energy conservation measures. Another provision of the proposal would increase funds to aid people with low incomes to weatherize their homes.

The home insulation tax credit would be nonrefundable so that families without a federal income tax liability would not be able to take advantage of it. For this reason, and also because home ownership is more limited at lower-income levels, families in the lowest-income fifth would be less likely to participate in the program.

Homeownership increases with income. Only about 43 percent of families in the lowest-income fifth are homeowners, with the percentage rising to 82 percent at the highest fifth. Correspondingly, it is likely that the proportion benefiting from the insulation tax credit would rise with income. It is possible that, among homeowners as a whole, response to insulation incentives could be greater among those at lower-income levels. Such a response is not likely to offset the effect of more homeowners in upper-income brackets, however.

Since 1974, many homeowners have added insulation in response to the increase in fuel prices. According to a 1976 survey for the National Insulation Tracking Study, about 20 percent of owner-occupied homes were reinsulated between 1973 and 1976. The proportion of homeowners who insulated was slightly higher for those with annual

incomes below $10,000 (about 23 percent) than those with higher incomes (about 19 percent). But the differences would appear too small to offset the larger differences in the percentages owning homes as opposed to renting.

One aspect of the proposal is aimed specifically at the lowest-income households: expansion of the weatherization program for low-income homeowners. The program is currently operated by the Community Services Administration and serves families with incomes up to 125 percent of the official low-income category. In certain circumstances, renters are also eligible for this assistance. The Administration's proposal provides for an increasing level of funding for each year between fiscal year 1978 and fiscal year 1980 for this program.

REBATES AND THE DISTRIBUTIONAL BENEFITS AND COSTS

The Administration's energy package contains two direct cash rebates to consumers--rebate of the crude oil equalization tax and rebate of the standby gasoline tax. The entire tax in each case would not be refunded directly. Some of the equalization tax proceeds would be used as indirect rebates to prevent home heating fuel from increasing in price. (The precise method for the home heating oil exemption has not yet been announced.) Some of the gasoline standby tax would be used to pay for business tax deductions for costs incurred because of the gasoline price rise.

According to CBO estimates, $15.0 billion (in 1977 prices) would be available for direct cash rebates in 1980; and, in 1985, when the standby gasoline tax is expected to have been triggered, about $21.9 billion would be rebated directly. These rebates would be distributed as an equal amount per person. Taxpayers and their families would receive their rebates through the tax system. Those who do not pay taxes would be contacted through social security, other transfer programs such as Aid to Families with Dependent Children (AFDC), and through special state outreach programs. Assuming all recipients were found, each family would receive a rebate that varies only with family size. In 1980, the per capita cash rebate is estimated to be about $197, and in 1985, about $272 (both in 1977 prices).

Table X-6 shows how the direct cash rebate would vary for families at different income levels in 1980 and 1985. Because average family size generally increases with income, the average rebate would increase with income--though not proportionately. Thus,

TABLE X-6. FIRST-ROUND INCREASES IN EXPENDITURES PER FAMILY RESULTING FROM ENERGY PROPOSALS a/ AND REBATES PER FAMILY, ESTIMATES FOR 1980 AND 1985, IN 1977 DOLLARS

Fifths of Families Ranked by Money Income b/	Induced Cost Increases Relative to Present Policy				Net Gain or Loss c/	
	Gasoline	Other Goods & Services	Total	Rebate	1977 Dollars	As a Percent of Real Income
			1980			
Lowest Fifth	11	47	58	139	+ 81	+2.8
Second Fifth	23	107	130	165	+ 35	+0.6
Third Fifth	33	162	195	197	+ 2	+0.0
Fourth Fifth	40	217	257	231	- 26	-0.2
Highest Fifth	48	320	368	248	-120	-0.4
Average	31	170	201	197	- 4	-0.0
			1985			
Lowest Fifth	49	52	101	195	+ 94	+3.0
Second Fifth	103	113	216	229	+ 13	+0.2
Third Fifth	149	170	319	274	- 45	-0.3
Fourth Fifth	177	231	408	321	- 87	-0.4
Highest Fifth	215	338	553	343	-210	-0.6
Average	139	183	322	272	- 50	-0.3

a/ Gas guzzler taxes and rebates on new cars and home insulation provisions are not included.

b/ The boundaries of each fifth are extrapolated from the 1973-1974 Consumer Expenditure Survey (see Table X-1). Money income was assumed to grow at 6 percent a year until 1977, real income at 2 percent a year to 1980 and 1985.

c/ See note below for discussion of net loss.

NOTE: Gasoline cost increases assumed to be distributed proportionately for gasoline consumption in 1973-1974 (see Table X-1). The increased cost of other goods and services is distributed proportionately to an average of the distribution of gasoline consumption and family income. Total increases in cost of gasoline and of other goods and services assume some reductions in consumption of gasoline and some offsetting consumer substitution. However, given more time for adjustment, cost increases would not exceed rebates and average net cost for all families would be zero. Totals for cost increases and rebates were derived as follows:

	1980	1985
	(in billions of 1977 dollars)	
Increase in Prices Due to:		
1) Crude Equalization	13.5	12.6
(less home heating)	- 0.8	- 0.6
2) User Tax - Industry	8.2	12.2
User Tax - Utilities	--	1.7
3) Controls	- 0.6	- 4.0
4) Gasoline Standby	--	14.9
(less business deductions)	--	- 3.7
5) Coal Conversion Rebates	- 4.9	- 7.3
Total	$ 15.4	$ 25.8
Share for Auto Gas	2.4	11.2
Share for Other Goods and Services	13.0	14.6
Rebates:		
1) Crude Equalization	15.8	11.3
(less home heating)	- 0.8	- 0.6
2) Gasoline Standby	--	14.9
(less business deduction)	--	- 3.7
Total	$ 15.0	$ 21.9
Number of Families	77.0 million	80.7 million
Average Persons per Family	2.9	2.9

the rebate would be progressive, equalling about 3 percent of income in the lowest fifth in 1980 and declining as a percent of income to less than 0.5 percent for the highest.

The direct cash rebates are the most easily determined part of the proposals. It is much more difficult to determine the indirect effects on the incomes of consumers. As discussed above, families would be affected differently depending on the extent to which goods and services rising in price make up their budgets. In addition, second-order employment and wage effects would have an impact on incomes.

Table X-6 makes a rough attempt to measure how cost increases may affect families at different income levels. Gasoline will be one item experiencing a major price hike. Based on the gasoline consumption patterns shown in surveys and discussed above, the effect of increases in gasoline prices on family gasoline expenditures can be calculated. The estimates shown in Table X-6 assume that all families would cut back somewhat in their fuel consumption and at approximately the same rate (see Chapter 6).

Increases in expenditures per family on goods and services other than gasoline were calculated based on an estimate of the aggregate increase in prices induced by the energy program. It was assumed that these other goods and services would rise with income but less proportionately.

It should be noted that the total amount of price increases exceeds the amount of direct cash rebates in 1980, primarily because the tax on industrial users would not be included in the direct cash rebate. However, if tax deductions of a comparable amount were granted so that there were no net tax increase, the amount would be indirectly refunded in the form of some price reductions or changes in income. Therefore, the average net loss to families in 1985 could eventually be reduced to zero (instead of $50). However, the general pattern of net gains for low-income families and net losses for high-income families would not necessarily change. In 1985, rebates would be slightly larger than price increase because of decreased natural gas prices relative to present policy. Because of the very intricate changes in the economy that would be likely to occur, the final incidence of price changes might be quite different from those shown; this should be remembered when interpreting Table X-6.

As shown in Table X-6, the increased cost per family attributable to the energy program would be regressive; that is, increased

cost as a percent of income falls as income rises. the rebates contained in the program would be highly progressive, however, and the net effect (increased costs and rebates together) would be progressive as a result. The average family in the lowest-income level should gain the most since the net cost rises proportionately faster than income. Of course, within income classes there would likely be considerable variation in the net gains or losses. Low-income families with automobiles would experience much steeper cost increases than the average low-income family. The rebate might not cover the cost increases for low-income families that must drive long distances to work.

In general, because the cash rebate would vary only by family size and would not take into account other factors affecting consumption, it would tend to redistribute income to low-income families who do not use automobiles. Represented in this group would be families consisting of retired persons and families living in central cities, particularly in the Northeast.

The proposed rebates are not designed to reflect any other form of compensation for energy-related price increases that might have been received by families. Thus, individuals whose incomes are automatically adjusted for changes in the Consumer Price Index (CPI)--such as social security recipients and workers whose wages are tied to cost of living escalations--would receive compensation twice for the energy-induced price rises.

Is the tax and rebate system fair? Very roughly, going up the income ladder, the plan would be progressive and would impose relatively greater costs as income increases. However, within income classes, the gains and losses would likely be extremely variable and therefore many might not consider them fair. Because of the greater variations in automobile use within lower-income levels, particularly related to commuting to work, this might be the area of greatest concern.

It is, of course, enormously difficult to design a rebate that takes into account individual circumstances and is administratively feasible. One possible alternative would be to give rebates of a somewhat larger amount to workers. This would provide some adjustment for increases in the cost of commuting, which would be one important source of dispersion in the cost of the gasoline tax.

Dr. RIVLIN. Thank you, Mr. Chairman.
Mr. DINGELL. The next panel is a panel on long-term issues.

STATEMENTS OF JAY W. FORRESTER, PROFESSOR, SLOAN SCHOOL OF MANAGEMENT, MASSACHUSETTS INSTITUTE OF TECHNOLOGY; JOHN H. GIBBONS, DIRECTOR, ENVIRONMENT CENTER, UNIVERSITY OF TENNESSEE; AND ROGER F. NAILL, PROFESSOR, THAYER SCHOOL OF ENGINEERING, DARTMOUTH COLLEGE

Mr. DINGELL. Gentlemen, we are honored that you are with us. If you will come forward, take your place at the witness table and identify yourself for purposes of the record and then we will be most pleased to proceed with your statements.

Dr. Forrester, if you will identify yourself and then your associates going across to your right, we will recognize you first.

Mr. FORRESTER. I am Jay W. Forrester, Massachusetts Institute of Technology.

Mr. GIBBONS. John H. Gibbons, University of Tennessee.

Mr. NAILL. Roger F. Naill, Dartmouth College.

Mr. DINGELL. It is a pleasure to welcome you all back. We look forward to your assistance.

Dr. Forrester, you may lead off.

Mr. FORRESTER. Thank you, Mr. Chairman. I have a prepared paper which I will read and another paper I would, if possible, like to include as an appendix.

Mr. DINGELL. It will be most useful and without objection your full statement will appear in the record and your appendix will appear in the appropriate place.

Mr. FORRESTER. This subcommittee, in considering the President's energy proposal, faces one of the most important public policy issues of recent decades. But before devoting great effort to details, the subcommittee should be clear on the cause and nature of the energy problem. Furthermore, the subcommittee should debate which of several broad classes of policies should be followed before developing a class of policies that may do more harm than good. In particular, the Congress should first make a carefully considered choice between policies that deeply involve government in the myriad of everyday decisions in the country, versus policies that induce private decisions to solve the energy problem in the normal course of working and living.

THE ENERGY SITUATION

Urgency. The President has compared the energy situation to the challenge of war. The comparison is appropriate. We do face major changes in economic activity and style of living.

Nature of Crisis. The "energy crisis" means only that we will not be using as much energy as would have been used if petroleum had remained plentiful at a very low price. Higher prices, rationing, and shortages will always keep consumption in balance with supply. The energy situation does not even imply a serious threat to future quality of life, if we act wisely. If we do not act wisely, unfortunate energy policies can have a number of serious consequences:

Make national security even more dependent on OPEC;

Continue to worsen inflation;

Lead to progressively more unfavorable balance of trade and exchange rates;

Create still greater threats to stability of domestic and international banking; and

Result in additional American farm land and corporations being sold to OPEC investors in exchange for oil that we could have avoided buying.

Past Excess of Oil. The oil problem arises not so much from a shortage in the future as from an excess in the past. In real dollar terms adjusted for inflation, and even after recent price increases, gasoline today costs about the same as in 1955. Today the price of gasoline in the United States is a third the price in many other countries. The low cost of energy has seduced the United States into extravagant use of energy and substitution of energy for labor. Energy prices have been held artificially low. By contrast, use of labor is heavily taxed through income tax, Social Security tax, and payroll tax. Employers have operated with tax incentives to substitute capital equipment and energy for people. Partly as a result of government-created incentives to use energy instead of labor, we have an energy shortage and high unemployment.

Imbalances from Cheap Energy. Energy is deeply imbedded in all processes of modern society. Energy is involved in almost every human decision. The important energy decisions occur in turning off lights, heating an unused room, living in an unnecessarily large house, joining a car pool, choosing an automobile, moving to the suburbs, deciding how far from work to live, choosing manufacturing processes, designing products, and centralizing industry in a way that uses more transportation. The imbalances that have arisen from unusually cheap energy now permeate homes, businesses, social structure, and political processes.

Conserving Oil. The energy problem arises primarily from depletion of oil and gas. No one use of petroleum is more a cause of concern than any other. Gasoline use in automobiles should be discouraged but so should all other uses of oil and gas. Oil use for home heating and electric generation is just as important as energy for transportation.

ENERGY POLICIES NOW BEFORE CONGRESS

Congress is now debating energy policies that have been proposed by the administration. The proposals include a tax on large automobiles, a possible small increase each year in gasoline tax, tax credits for residential conservation measures, and adjustment of domestically produced oil and gas prices toward the world prices set by OPEC.

Inadequacy of Proposed Policies. The proposed energy policies that are now before Congress appear inadequate for resolving the energy problem. The policies are not consistent with the gravity of the situation. The modest taxes and incentives in the proposed legislation will be overwhelmed by the force of past practices and traditions. The proposed policies are being perceived by many as annoying, bothersome, and ineffective. They do not harness the great capability of the United States to respond to challenge.

Inappropriateness of Proposed Policies. The proposed policies are of an inappropriate kind. They attempt to legislate detailed control over private decisions and economic choices. The proposed policies set up contradictory signals by still encouraging energy use through

continued adherence to prices that are too low, while at the same time trying to force conservation. Energy is deeply interwoven in the fabric of society. Congress cannot reach enough of the dispersed decision points that determine the energy picture, and cannot cope with the multitude of ways that energy interacts within a modern society. The proposed policies do not transfer enough pressure into the private sector to induce appropriate automatic responses for solving the energy problem.

ON THE NATURE OF NATIONAL POLICY

Criteria for Policy. Energy policy should meet several operating criteria:

It should be simple;

It should operate through leverage points that will radiate pressures into the many private decisions that relate energy to the economy; and

It should not require a large bureaucracy.

Objectives of Policies. A desirable energy policy should give the United States control over its own future. Energy policy should:

Reduce dependence on foreign energy toward zero as rapidly as possible;

Conserve domestic petroleum and gas for emergencies and for premium uses like petrochemicals;

Encourage diversity in energy supply so that different ideas will be tried and the most effective demonstrated;

Create an umbrella of energy pricing that will encourage private initiative to develop the more expensive alternative energy sources;

Set in motion internal socio-economic forces that will produce a more suitable balance between energy capital investment, and labor; and

Stress long-term considerations to counteract short-term pressures in the private sector.

Form of Policy. Before debating details of a national energy policy, the country should debate the form of that policy. Is it to be an activist policy in which the government does the research and development, installs home insulation, decides how to heat water, enforces conservation, designs automobiles, and provides energy? Or, is a more effective role of government to establish ground rules that induce individual and corporate creativity toward long-term solutions, with the government acting as referee while others in the economic system provide the action?

Limits to Government. A national government cannot successfully juggle a variety of tightly interrelated actions through the country. Government management of all production and use of energy means sweeping intervention in personal affairs. But if government manages only a few aspects of energy, further imbalances will probably be created between controlled and uncontrolled actions.

Multiple Interventions Unsuitable. Government controls are not a suitable mechanism for making each of the multiplicity of detailed decisions that establish the balance between energy and all other social and economic actions. Yet a change in government policy is needed to encourage private decisions that will reduce the dependence on oil and gas.

Merely Removing Controls. Some people, especially those in the energy business, suggest the energy problem can be solved by

removing all controls on price. A free market in energy is probably better for the country than present confusion and internal contradictions. But a free market in energy is opposed politically by many and a free market does not place adequate emphasis on the long-term future. The windfall profits from deregulation would cause public outrage, even though it is not clear why we willingly pay windfall profits to OPEC countries for building up their economies but find intolerable windfall profits to American stockholders for reinvestment in America. A free market might exhaust oil and gas too quickly without saving reserves for future important uses and might fail to develop alternative energy sources early enough for a smooth transition in economic activity and patterns of living. In any case, a free market in energy seems politically less likely to happen than other promising alternatives.

Avoiding Government Entrapment. Government should not get into the overwhelming details of home insulation and design of products and processes. Consumption and production decisions should be taken on the basis of private self-interest rather than on the basis of financial incentives from government. Action based on government payment invites fraud. Government financial incentives require a huge bureaucracy for administration that would tie up people who are needed to work at the physical tasks of solving the energy problem. Government intervention in details will create still more conflict between government and the public.

SIMPLER AND MORE EFFECTIVE ALTERNATIVE POLICY

Heavy Tax on Oil and Gas. A heavy tax on all energy procured from oil and gas should be effective and meet the preceding criteria. The tax would apply to both imported and domestic oil and natural gas.

OPEC Already Taxing. A heavy tax on petroleum is not a new idea. In fact, it has already been implemented. OPEC is now taxing our use of oil. The high price of oil does not represent cost of production. The OPEC price is a tax to raise revenue and suppress demand. The OPEC tax is lowering the U.S. standard of living by giving OPEC a claim on our production output, creating foreign exchange problems, and jeopardizing stability of the banking system.

U.S. Tax Instead. The United States should be able to take the initiative away from OPEC. If the United States and other consuming countries were to levy a high tax on oil and gas, the OPEC countries would be less able to do so. OPEC countries are dependent on the sale of oil to sustain their present economies. If they let price plus tax rise too high, demand will fall and they will not be able to pay for imports on which they have become dependent. A U.S. tax should be able to divert revenues back from OPEC to the U.S. domestic economy. It should reduce OPEC claims on U.S. domestic production while at the same time correcting internal imbalances between energy and the economy.

Results of Tax. The oil and natural gas tax should produce four desirable results:

Discourage use of oil and gas;

Accelerate development of other energy sources;

Conserve domestic oil and natural gas for future emergencies or for uses more important than mere burning; and

Transfer the burden of solving the energy problem to private citizens where the billions of energy decisions are made.

Protect Domestic Reserves. A tax on oil and gas at their sources should not be allowed to create incentive for rapid depletion of domestic reserves. Domestic reserves should be protected for future premium and emergency uses. Therefore, it may be necessary to tax domestic supplies higher than imported supplies to adjust relative demand.

Eliminate Price Controls and Excess Profits Tax. An oil and gas tax should be accompanied by elimination of price controls and excess profits taxes related to energy. Price controls will not be needed if the tax is high enough to reestablish balance between supply and consumption so that active competition is maintained. Excess profits taxes are detrimental in the long run because they penalize efficiency, and will not be needed for social and political reasons if the correct balance is struck between taxes on domestic and imported energy.

Encourage Alternative Energy Sources. A high price for energy from oil and gas would provide the price umbrella under which the private sector could develop alternative energy sources. Now, with underpriced oil and gas, private initiative toward new kinds of energy is stifled, and expensive and inefficient government research and development programs are made to appear necessary. Using a tax to remove competition from underpriced oil and gas, which have driven other energy sources out of the picture, would encourage throughout the economy a diversity of answers to the energy dilemma. Most alternative energy sources become feasible at prices below about $30 per barrel of oil. Oil and gas at a sufficiently high price will quickly induce numerous private-sector responses to create new energy sources. Alternative energy sources are available for development on scales over the entire spectrum from small businesses to major corporations.

Tax is Fair. An oil and gas tax is inherently fair. It falls most heavily on those who use the greatest amount. It places the decision for conserving oil and gas at the point where alternatives can best be weighed.

Incentive to Conserve. At a high enough tax on oil and gas, conservation will be encouraged. The argument that higher prices will not discourage use is, in effect, to say that a particular price is not yet high enough to motivate action. OPEC has levied a tax of some $10 per barrel on oil. Much talk has resulted but not much reduction in usage has occurred. The required tax rate apparently must be substantially higher. An additional U.S. tax of $20 to $30 per barrel of oil or equivalent in gas may be required. When the price of energy from oil and gas becomes high enough to cause people to change their consumption and living habits, incentives for conservation will have permeated society.

Amount of Tax Unknown. No one can anticipate how high must be the price of oil and gas to induce a sufficiently vigorous response. Also, time is needed to take the required actions. Probably the best procedure is to apply the oil and gas tax in steps to test the degree

of response and allow time for the economy to adjust. But time is of the essence. A decade appears much too long for initiating effective action. A best compromise may be to increase the oil and gas tax at a rate of $5 per barrel-equivalent per year until it becomes clear that the necessary responses are occurring.

No Additional Burden. An oil and gas tax need not represent an additional burden on the economy. The tax should not become an excuse for higher government expenditure. The tax should not be used to support energy-related government programs because that would defeat the objective of shifting energy decisions away from government and toward consumers and businesses in the private sector.

Reduce Income Taxes. Revenues from a high tax on oil and gas will be substantial until use of oil and gas are reduced. To be politically acceptable and to avoid an increased total tax load on the economy, the oil and gas tax should be fully compensated by a general tax reduction elsewhere. The only effective place to make the compensatory reduction seems to be in rates for income tax. The tax revenue from oil and gas might replace a substantial fraction of individual and corporate income tax revenue.

Political Acceptability. A proposal for heavily taxing all uses of oil and gas must be accompanied by answers to political resistance. The principal objections will probably be based on expected personal hardships and inequities. But hardships from a tax probably are no greater than hardships from not taxing. If an oil and gas tax is compensated by reduction in other taxes, the total tax load remains constant. Prices for other goods and services should decline relative to energy. The cost of living need not be affected. Unrestrained use of oil and gas is forcing Americans to work for improving the standard of living in the Middle East rather than for helping themselves. Imbalance of trade caused by oil imports is depreciating the value of the dollar, causing other foreign goods to cost more and reducing the value of exports. No way out is free of some hardship and readjustment. Not imposing a tax on energy probably creates equal but different hardships in the form of rising costs of other products, without generating pressures toward long-term solution of the energy imbalances.

Timeliness. Members of the subcommittee may feel that decisive action to solve the energy problem is not yet politically feasible. But a time comes when timid measures are less acceptable than bold action. The country seems ready for strong initiatives. The President's call to action touched a responsive chord. But, the hurriedly developed detailed proposals do not live up to the stated urgency. We may be at one of those times when a majority of people each supports required action but each believes he is almost alone. Forceful leadership by Congress and the President might now crystallize majority support for putting our energy house in order.

Summary

The President has clearly stated the threat inherent in our confused energy situation. But, the proposed policies appear too weak and contradictory. The proposed policies move the National Government toward heavy intervention in the multiplicity of private decisions that together determine the country's response to the

energy situation. Failure of the proposed policies would become apparent during a future energy crisis and force still more government controls. Sweeping controls on the many small decisions that affect energy will alienate people, require more bureaucracy, and generate incentives for dishonesty in dealing with government. Government policy should protect the country's future options while transferring responsibility for action to individual citizens. A high tax on oil and natural gas, compensated by equal reductions in income taxes, promises simplicity, fairness, and effectiveness.

[Testimony resumes on p. 311.]

[The appendix to Mr. Forrester's statement follows:]

SOLUTION TO THE ENERGY PROBLEM
LIES OUTSIDE THE ENERGY SECTOR

by

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Concern about the so-called "energy crisis" implies a fear of too little energy for the future. Therefore, the problem tends to be identified as failure of the private sector to supply enough energy; and the solution is seen in the form of government taking an active role to supply more energy. But things are often not what they seem.

A. WHAT IS THE ENERGY PROBLEM?

The energy problem is not meaningful in isolation from other issues. Do we have an energy problem or a political problem that prevents us from adjusting to changing situations? Is it an energy shortage or a population excess that is generating unachievable demands? Is energy price the problem or is it inflation from trying to live beyond our means? Is it an energy problem or a bank stability problem from the rising financial claims being acquired by the OPEC countries? Is it an energy problem or an agricultural problem as we use more energy to mechanize food production to pay for imports? Is the energy shortage responsible for unemployment, or has too much energy caused energy and capital equipment to replace labor?

The perceived energy problem arises from expectation of less energy in the future than we used in the 1960's and 1970's. So there is to be a change in energy availability between the past and the future. But what does the change mean? Is it too little energy in the future, or too

much in the past?

We have just lived through three anomalous decades. In the recent past, energy consumption per capita has been higher than ever before in history, and probably higher than ever again in the future. But human memory is so short that we have accepted recent aberations as being the normal condition.

During the oil and gas era that is now drawing to a close, energy has been available in too great a supply and at too low a price. Even today, after the price of energy has increased, gasoline sometimes still costs less than water. Oil is brought from the Middle East, refined into gasoline, trucked to the corner filling station, and put in an automobile for less than the price of a gallon of local spring water at the local grocery store. In fact, in real terms (deflated dollars) and after recent price increases, gasoline today costs the same as in 1955. In real terms, the price of gasoline declined by almost half from 1955 to 1970 and has recently doubled back to its former position in the price structure. For several decades, oil had become more and more easily available.

Man has allowed himself to be misled by nature. The low cost of energy has seduced Western civilization into an extravagant use of energy and a substitution of energy for other inputs to economic activity. Pressurized reservoirs of petroleum and natural gas have flooded us with energy and have encouraged usage rates that cannot long continue. Easy availability, wide distribution of energy supplies, and low costs of production have induced excessive substitution of energy and capital equipment for labor. The result has become an internal imbalance in patterns of living and production.

B. IMBALANCES INVOLVING ENERGY

The "energy problem" implies imbalance between available supplies of energy and expected rate of usage. Imbalances can mean too little energy or too much demand. But how can too much demand develop?

High demand is induced for any useful commodity that is almost free. Here lies the basic cause of the energy dilemma. Energy is deeply imbedded in all processes of a modern society. Energy trades off with and affects almost everything else. Availability of increased energy, resulting from the discovery of oil, has distorted the internal balance of both economic and social affairs.

Cheap energy has favored home designs that substitute energy consumption for efficient design. Insulation has been reduced and more heat consumed. Houses have been spread across suburbia, with more transportation required.

Low-cost energy for transportation has encouraged concentration of manufacturing with wide-spread cross-shipping of products. Regional self-sufficiency has been reduced, and industrial complexity increased.

Inexpensive gasoline has caused highways and trucks to replace energy-efficient rail transportation. Manpower and capital equipment have been drawn into the infrastructure of gasoline stations and auto repair shops.

Readily available energy has encouraged capital-intensive agriculture. Machines have displaced labor from farms to swell unemployment in cities. People believe the U.S. has high efficiency in modern agriculture, but efficiency is true primarily in the sense of output per man in the field. In many other measures, agriculture has become less efficient. Some five calories of energy now go into American agriculture for each calorie of food produced. Agriculture has become a low-efficiency converter of petroleum calories into food calories.

Energy has unbalanced not only the economic system but also the social system and politics. Energy has made large social institutions possible. But large institutions dwarf the individual and generate social alienation. Large institutions seem to require a counterbalance from large government, and political power becomes concentrated.

The imbalances that have arisen from an excess supply of energy now permeate homes, businesses, social structure, and government organization.

Such imbalances are not static. They have been decades in the making. Their correction will take time. The imbalances are dynamic with changing and recurring patterns.

C. DYNAMIC IMBALANCES

In the System Dynamics Group of the Sloan School at MIT we have for 20 years been developing methods for showing how industrial policies and structure produce growth and fluctuation.* Computer simulation models show how undesirable behavior can be created by interactions between industrial policies and structures, each element of which is separately well known.

For the last five years the System Dynamics Group has been building a comprehensive model of national social and economic behavior that is now being assembled. It will contain labor movement and wage changes, the Federal Reserve and banking system, and fifteen industrial sectors. Each industrial sector produces by acquiring up to twelve factors of production, generates money flows with a balance sheet and profit and loss statement, and sets price of output. Each sector uses energy in amounts depending on its price and productivity. Energy sectors generate energy and set price. Representations of real energy supply, energy use, cost of energy, and the money streams to pay for energy flow through the model system.

Already, even in the early stages of assembly, the Systen Dynamics National Model is showing several important modes of behavior. Of special interest to the energy debate are the long wave of economic fluctuation and the life cycle of growth.

C.1 Long Wave or Kondratieff Cycle

The long wave, also called the Kondratieff cycle, is a very long-term business cycle. It appears that a market-driven economy can generate such a long-term instability. Our work indicates that interactions between

*See References 1 through 5.

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consumer sectors and capital goods sectors can produce fluctuations in economic activity of some 40 to 60 years between peaks. The Western industrial economies indeed seem to have exhibited such a long wave. Peaks have occurred around 1810, 1860, and 1920. Between the peaks have been long low valleys of depression. The 1930's represented such a valley. The present economic crosscurrents suggest we may again be at a peak. The question arises: Is another fall-off in economic activity, like that of the 1930's, possible in the 1980's and 1990's? The answer should influence choices that must be made in energy policy.

Each rising section in the economic long wave has been characterized by its own particular technology. From the energy viewpoint there have been the wood-burning wave, the coal-burning wave, and the present oil-burning wave. Each wave is built around a social and economic infrastructure characteristic of its technology. Each infrastructure is in turn disbanded and replaced.

We see the long-wave phenomenon as involving build up and decay of capital sectors in the economy. Although the long wave sweeps up and concentrates new technology into the three decades of the expansion phase, we differ from the theory proposed by Schumpeter that innovation causes the long wave. We believe the long wave would occur without technological change.* We see the peak periods as times of excess capital investment. The 1920's seem to have been such a period of over-investment. Likewise we see the 1970's, not as a period of capital shortage, but a period of excess office buildings, excess transportation systems, fully adequate social capital as in school buildings, sufficient housing, and under-utilized factory capacity. New capital investment is in the doldrums because past capital investment has already filled the needed stock of capital plant. Furthermore, technology has over-built on its basic foundations. With respect to energy, the industrial superstructure overreaches the supplies of oil and natural gas. Just as wood gave way to coal and the canals gave way to railroads, the

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*See References 6 through 8.

present oil-burning economy must give way to a new set of economic processes. The change will affect corporate structure, government functions, technology, and the style of living.

But the process of giving way to new economic patterns is slow and torturous. A huge investment exists in old capital plant. Existing physical capital can not be quickly discarded, but while it exists there is insufficient justification for building a new infrastructure. Historically, the process of replacement has been to go through a period like the 1930's during which the old capital plant was used up. While the old plant was being worn out, and new capital plant in a new technological form had not yet been launched, the capital-producing sectors were left with little to do. Old companies in the capital sectors disappeared to be replaced eventually by new enterprises shaped around new technologies.

C.2 Life Cycle of Economic Growth

An even longer-term sequence of change also has immediate consequences for energy policy. The life cycle of economic growth describes the S-shaped curve of growth giving way to maturity.* It consists of a long period of growth, a short transition interval as growth slows down, and an approach to some form of equilibrium. For the United States, growth has extended from discovery of the country until the 1960's. I believe we are now in the transition period of 20 or 30 years duration when environmental forces are squeezing out the growth processes. If so, rapidly rising population, increasing industrialization, and growing energy usage will not be the trends of the future. Instead, we should look toward an equilibrium society at nearly a constant population with demands on the natural environment that can be continuously sustained. Pressures will persist to move the economy toward replenishable energy supplies rather than the past dependence on depletable energy sources. The frontier psychology of endless open space and bountiful untapped natural resources is giving way to a society that must live in a continuing balance with nature.

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* See References 9 through 12.

History of the last hundred years can be a guide to the repetitive long wave but not to the life cycle of growth. Economic growth has been the cornerstone of social and industrial thinking since the 1600's. But, economic growth was based on empty land, ample water, abundant resources, and limitless energy. The open frontier has disappeared as a basis for economic planning. Although the 50-year long wave of economic development has repeated several times, this is the first time that the United States has encountered simultaneously a peak in the economic long wave and the transition region of the life cycle of economic growth. The transition region, when growth is giving way to equilibrium, is the time of greatest social and economic pressure as historic forces of economic growth are counteracted by environmental pressures. The day of upward sweeping exponential growth in population and industrialization is ending. The future is an approach to constant population and constant GNP. The challenge is to adjust the ratio of GNP to population so that there is a satisfactory per capita standard of living.

The life cycle of growth tells us that the ultimate fundamental compromise is the compromise between population and standard of living. Given any geographical area and state of technology, the higher the population, the lower will be the standard of living. Almost every country in the world has now reached the point where it must face the tradeoff between population and quality of life. Population versus environmental capacity is just as much an issue for the developed countries as for the developing countries. The energy shortage is but a symptom that we face a limit to the population that can be supported in the manner to which we have become accustomed.

D. ENERGY--TOO COMPLICATED FOR GOVERNMENT

The energy problem involves every aspect of society and industry. Abundant energy has distorted almost all that we do. The imbalances involve everything in relationship to everything else.

But a national government can not simultaneously focus on a wide variety of tightly interrelated issues. National debate is unable to

simultaneously decide the future of atomic power, whether or not to emphasize coal, the fraction of oil that should be saved for petrochemical uses, how to deal with OPEC, how close people should live to their work, the composition of car pools, the merits of public transportation, the style of home construction, and the proper national birth rate. Yet all are directly involved in the energy question.

I believe the energy problem can not be solved within the energy sector. Thus far the country has reacted to energy shortage as implying little more than necessity for procuring more energy. But the energy shortage is suggesting a need for sharply curtailing population growth, shifting to more labor-intensive production, establishing internal self-sufficiency without so much dependence on imports and exports, redistributing population, and changing lifestyle. These are not responses that Congress can deal with by setting up an Energy Research and Development Administration or an Energy Department.

Over the last five years governmental reaction to energy shortage has been to rush toward short-term solutions. Emergency study groups have been established to develop future energy policy with deadlines of a few weeks to write their reports. Frantic response is out of keeping with the 40 years over which the problem has been developing and the decades that will be required for working out solutions. Reports and action have been ineffective because they have been of the wrong kind for the complexity of the energy issue.

The press and public expect a national energy policy. But what does that mean? Does a government policy mean an active program by government to supply energy, or does it mean establishing a framework within which energy can find its proper balance with other aspects of the economy?

Before debating a national energy policy, the country should debate the form of that policy. Is it to be an activist policy in which the government does the research and development, installs home insulation, decides how to heat water, enforces conservation, designs automobiles, and provides energy? Or, is the more effective role of government to establish ground rules that induce individual and corporate creativity toward long-term

solutions, with the government acting as referee while others in the economic system provide the action?

Energy imbalances permeate the economy, institutional structures, and social values. The changing energy situation will affect everything we do. Impending changes are too numerous and too detailed for government to address directly. Simple ways must be found to transfer the resolution of energy imbalances into the day-by-day multiplicity of private decisions.

E. RESPONSE TO THE ENERGY PROBLEM

The country has operated within a set of attitudes that have led to the present energy-related imbalances. Two major faults lie within those guiding attitudes:

a. When difficulties arose, government has more and more taken on the task of detailed control, rather than the task of establishing processes that force responsibility for detailed decisions onto the private sector.

b. Short-run considerations have come to dominate both the private sector and government to the detriment of long-term development of the socio-economic system.

E.1 Government Action to Shift Detailed Decisions into the Private Sector

Government controls are not a suitable mechanism for making each of the multiplicity of detailed decisions that establish the balance between energy and functioning of the country. Yet a change in government policy is needed to encourage private decisions that will reduce the dependence on oil and gas.

Energy policy established by government should meet several operating criteria:

a. It should be simple;

b. It should operate through leverage points that will radiate pressures into the many private decisions that relate energy to the economy;

c. It should be easy to implement without a large bureaucracy.

The objectives of a government energy policy should be to:

a. Conserve energy, especially as related to oil and natural gas supplies;

b. Encourage diversity in energy supply so that different ideas will be tried and the most effective demonstrated;

c. Create an umbrella of energy pricing that will encourage private initiative to develop the more expensive alternative energy sources;

d. Set in motion internal socio-economic forces that will produce a more suitable balance between energy, capital investment, and labor;

e. Stress long-term considerations to counteract short-term pressures in the private sector.

The energy problem arises primarily from depletion of oil and gas. No one use of petroleum is more a cause of concern than any other. Gasoline use in automobiles should be discouraged but so should all other uses of oil and gas.

Government should not get into the overwhelming details of storm windows, weather stripping and design of equipment and processes. Action should be taken on the basis of private self-interest rather than on the basis of financial incentives from the government. Action based on government payment invites fraud. It would require a huge bureaucracy for administration that would tie up people who are needed to work at the physical tasks of solving the energy problem. Government intervention in details will create still more conflict between government and the public.

For meeting the preceding operating criteria and objectives, the most effective governmental action seems to be a heavy tax on all energy procured from oil and gas. This would apply to both imported and domestic supplies. A heavy tax on petroleum is not a new idea. In fact, it has already been implemented.

OPEC is already taxing our use of oil. The high price of oil does not represent cost of production. It is a tax to raise revenue and suppress demand. The tax is lowering the U.S. standard of living by giving OPEC a claim on our production output, creating foreign exchange problems, and jeopardizing stability of the banking system.

If the United States and other consuming countries were to levy a high tax on oil and gas instead, the OPEC countries would be less able to do so. OPEC countries are dependent on the sale of oil to sustain their present economies. If they let price plus tax rise too high, they would weaken their balance of trade position. A United States tax should be able to divert revenues back from OPEC to the domestic economy. It should reduce OPEC claims on U.S. domestic production output while at the same time correcting internal imbalances between energy and the economy.

The oil and gas tax should have two objectives: First, to discourage total use of oil and gas and cause a shift to other energy sources; second, to adjust the balance between the amount of domestic oil used compared to imported oil.

A tax on oil and gas at their sources should not be allowed to create incentive for rapid depletion of domestic reserves. Domestic reserves should be protected for future premium and emergency uses. Therefore, it may be necessary to tax domestic supplies higher than imported supplies to adjust relative demand.

An oil and gas tax should be accompanied by elimination of price controls and excess profits taxes related to energy. Price controls will not be needed if the tax is high enough to reestablish balance between supply and consumption. Excess profits taxes are detrimental in the long run because they penalize efficiency and will not be needed for social and political reasons if the correct balance is struck between taxes on domestic and imported energy.

A high price for energy from oil and gas would provide the price umbrella under which the private sector would be able to develop alternative energy sources. Now, with under-priced oil and gas, private initiative toward new kinds of energy is stifled, and expensive and inefficient government research and development programs are made to appear necessary. Using a tax to remove competition from under-priced gas and oil, which has driven other energy sources out of the picture, would encourage throughout the economy a diversity of answers to the energy dilemma. Most alternative

energy sources are available at prices equivalent to some $30 per barrel of oil. Oil and gas in such a price range will quickly induce numerous private-sector responses to create new energy sources. Alternative energy sources seem available for development on scales over the entire spectrum from small businesses to major corporations.

An oil and gas tax is inherently fair. It falls most heavily on those who use the greatest amount. It places the decision for conserving oil and gas at the point where alternatives can best be weighed.

A high oil and gas tax would raise the price of energy to all users. At a high enough tax, conservation will be encouraged. The argument that higher prices will not discourage use is, in effect, to say that a particular price is not yet high enough to motivate action. OPEC has levied a tax of $6.00 or more per barrel of oil. Much talk has resulted but not much reduction in usage has occurred. The required tax rate apparently must be substantially higher. A tax of $20 to $30 per barrel of oil or equivalent in gas may be required. When the price of energy from oil and gas becomes high enough to cause people to change their consumption and living habits, incentives for conservation will have permeated society.

No one can determine reliably how high must be the price of oil and gas to induce a sufficiently vigorous response. Also, time is needed to take the required actions. Probably the best procedure is to apply the oil and gas tax in steps to test the degree of response and allow time for the economy to adjust. But time is of the essence. A decade appears much too long for initiating effective action. A best compromise may be to increase the oil and gas tax at a rate of $5.00 per barrel equivalent per year until it becomes clear that the necessary responses are occurring.

Such an oil and gas tax need not represent an additional burden on the economy. The tax should not become an excuse for higher government expenditure. The tax should not be used to support energy-related government programs because such would defeat the objective of shifting energy decisions away from government and toward consumers and businesses in the private sector.

Revenues from a high tax on oil and gas will be substantial for a number of years until use of oil and gas are reduced and other energy sources are developed. To be politically acceptable and to avoid an increased total tax load on the economy, the oil and gas tax should be fully balanced by a general tax reduction elsewhere. The only effective place to make the compensatory reduction seems to be in rates for income tax.

A proposal for heavily taxing all uses of oil and gas must be accompanied by answers to political resistance. The principal objections will be based on alleged personal hardships and inequities. But hardships from a tax may be no greater than hardships from not taxing. If the oil and gas tax is compensated by reducing other taxes, the total tax load remains constant. Unrestrained use of oil and gas is forcing Americans to work to improve the standard of living in the Middle East rather than for themselves. Imbalance of trade caused by oil imports is depreciating the value of the dollar, causing other foreign goods to cost more, and reducing the value of exports. No way out is free of some hardships and readjustment. Not imposing a tax on energy probably creates equal but hidden hardships in the form of rising costs of other products, without generating pressures toward long-term solution of the energy imbalances.

E.2 Leadership Toward Long-Term Objectives

More is required than a tax to shift incentive for solving the energy problem to the private sector. The multiplicity of private decisions will be made more smoothly and more effectively if a national consensus has been formed about the broad nature of the future.

Both the public and private sectors have become trapped in short-range objectives. Focusing on the immediate future would do no harm if short-term objectives were consistent with long-term well-being. But the reverse is more usually true.

With regard to most decisions, over-emphasis on the near-term leads to difficulty in the more-distant future. The energy situation serves as an example. The inevitable exhaustion of oil was foreseen by

responsible people two decades or more ago. But as long as oil lasted, business, politics, and public advantage could all be served by ignoring the day of reckoning that must follow excessive dependence on oil and gas. Modern society has lost a once traditional concern for the future and for succeeding generations.

If the country is to take a longer-term viewpoint, there must be a forceful constituency for long-term objectives within the public. Government acts in response to active constituencies. Where is the public constituency for thinking ahead? Where is the public clamor for understanding what the post-petroleum world will be like?

Leadership in achieving a healthy balance of long-term objectives against short-term pressures must come from individuals banding together to lead in new directions. Governmental processes are not well adapted for exerting leadership at times when major change in society is necessary. By its very nature, major change is contrary to current public expectations. At the beginning there is no political constituency for major change. Major new directions must first be developed and articulated by a nucleus of individuals.

Almost everyone wants the private enterprise system to survive. Very few want government to dictate details of everyday life and work. Yet the trends are toward government intervention. Why?

A market-directed economy has in the past exhibited certain inherent defects. It generates short-term business cycles. It generates a medium-term capital cycle of some 15 to 25 years duration. It creates the long wave or Kondratieff cycle that produces major depressions some 50 years apart. In the life cycle of growth, it tends to encroach too heavily on environmental limits. It is unbalanced in favor of short-run decisions at the expense of long-run public good.

Although these defects may be far less serious than the counterpart defects in other forms of economic organization, the stresses generated in a free-enterprise, market-directed economy are strong enough to induce public demand for more government intervention. Government intervention

is made more likely when proponents of the free enterprise system do not understand its behavior, can not explain it effectively, do not admit its defects, and are not taking effective action to correct short comings through means other than detailed government intervention. The challenge for those who want to see the free-enterprise system survive is to band together to understand that system better, to learn why it sometimes misbehaves, to explain it more fully, and to modify it based on knowledge and not based on emotional public desparation.

The challenge ahead is more serious, the opportunities greater, and the impending change more sweeping than at any time since the founding of the country and the writing of the U.S. Constitution. But where are the counterparts of the founding fathers--like Jefferson, Hancock, and Franklin--devoting personal time to working out a framework for the future?

The 50-year long wave of economic fluctuation suggests that we are at the end of the current oil-based industrial system. Short-term views will do little good. If we simply try to build on the immediate past and extend the existing system, we create a more and more unstable superstructure built on a declining foundation of oil and natural gas. If we look forward only 10 or 15 years, all we see is disintegration of the industrial system based on oil.

The time horizon must be bolder. The challenge is to perceive that new infrastructure built around enduring energy sources. Such a system would evolve, according to historical precedent, after 15 or 20 years of economic decline during which the old capital plant was wearing out and experiments were being tried with new directions.

If we do not want to wait for the historical sequence of decay and self-correction, we must look further ahead and start now to build the kind of society that must eventually emerge. Only on the distant horizon is there guidance for traversing the valley before us.

The country needs statesmen from the private sector and government to work out the answers, to educate the public, and to lead toward a viable future. The economic long wave and the life cycle of growth become a framework within which to evaluate economic opportunity and social change. The energy crisis establishes the incentive to look further ahead than has been customary. Now is the time for a leadership nucleus around which to coalesce a constituency for the future.

REFERENCES

1. Forrester, Jay W. Industrial Dynamics (MIT Press, Cambridge, Massachusetts, 1961).

2. Forrester, Jay W. Urban Dynamics (MIT Press, Cambridge, Massachusetts, 1969).

3. Forrester, Jay W. Principles of Systems (Wright-Allen Press, Inc., Cambridge, Massachusetts, 1968).

4. Goodman, Michael R. Study Notes in System Dynamics (Wright-Allen Press, Inc., Cambridge, Massachusetts, 1974).

5. Mass, Nathaniel J. Economic Cycles: An Analysis of Underlying Causes (Wright-Allen Press, Inc., Cambridge, Massachusetts, 1975).

6. Forrester, Jay W. "Business Structure, Economic Cycles, and National Policy," Futures (London, June 1976). Also available in less complete form in Business Economics, January 1976.

7. Forrester, Jay W., Nathaniel J. Mass and Charles J. Ryan. "The System Dynamics National Model: Understanding Socio-Economic Behavior and Policy Alternatives," Technological Forecasting and Social Change, Vol. 9 (July 1976).

8. The System Dynamics Group. The System Dynamics National Project Annual Report 1976 (The System Dynamics Group, MIT, Cambridge, Massachusetts, 1976), D-2453-4.

9. Forrester, Jay W. World Dynamics (Wright-Allen Press, Inc., Cambridge, Massachusetts, second edition, 1973).

10. Meadows, Donella H., et al., The Limits to Growth (Universe Books, New York, 1972).

11. Meadows, Dennis L. and Donella H. (editors), Toward Global Equilibrium: Collected Papers (Wright-Allen Press, Cambridge, Massachusetts, 1973).

12. Meadows, Dennis L., et al., Dynamics of Growth in a Finite World (Wright-Allen Press, Inc., Cambridge, Massachusetts, 1974).

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Mr. DINGELL. The committee thanks you for a very helpful and thoughtful statement.

Dr. Gibbons.

STATEMENT OF JOHN H. GIBBONS

Mr. GIBBONS. Thank you, Mr. Chairman. I also have brought a summary of my remarks which I have left with the Clerk and with your permission I will simply summnarize those remarks.

The Carter administration provides fodder sufficient for all observers and analysts to thrive on for many months. It has been labelled as unrealistically dependent on conservation; too weak on conservation—a lamb in wolf's clothing; too much regulation; too dependent upon pricing and not enough regulation; and so on. It seems there is sufficient substance in the plan for all parties of interest to have something to say.

In listening to and reading about the various commentaries on the plan one tends to be more attentive to criticism than praise.

This can lead to an erroneous conclusion about the situation—that the plan is weak in principle rather than insufficient in detail. My position is that over the past 150 days the administration has developed a remarkably credible plan, fully worthy of detailed analysis, strengthening and modifying in a few places, and implementation as quickly as possible In a variety of meetings over the past month I have sensed that the consensus about the plan contains the following features:

(A) The plan gives badly needed Presidential involvement and leadership in facing the realities of the U.S. energy scene. This leadership for the first time properly underscores the gravity and immediacy as well as the fundamental long-range nature of the energy problem. We must simultaneously move ahead in three ways:

(1) Increase the efficiency with which we use energy, substituting our technological ingenuity and capital investment for brute-force energy consumption;

(2) Provide for a shift away from almost complete dependence upon oil and gas (especially the former) to a broader variety of energy resources and lessened dependence upon imports;

(3) Move ahead more aggressively in developing long-term sustainable energy supplies to succeed fossil fuels; and to develop and further improve ways to maintain amenities of life with less energy consumption.

(B) The second surmise I make of the plan is the plan gives important, if perhaps insufficient, cognizance to the fact that the "market" price for energy has been badly distorted, particularly by prior public policies. These policies included tax subsidies; environmental, health, and safety externalities; price controls; and compromises to our national security. There is widespread agreement that these past policies must be revised so that energy prices reflect more accurately the true total cost of energy. In addition to the price distortions due mostly to subsidies we now are faced with energy replacement costs that are much higher than present average price but the consumer sees only the average cost. These two effects combine to signal to the energy consumer that he shouldn't worry about energy.

(C) The plan gives major attention to nuclear proliferation and other issues surrounding nuclear power. The very basis of some of the technical attractiveness of plutonium causes it to be a major potential problem in the world. We are given an opportunity—perhaps our last one—by the plan to explore and evaluate more deliberately the other options that could be used in advanced nuclear fuel cycles. At a minimum this new emphasis will result in more secure international controls on weapons materials.

(D) The plan places heavy emphasis upon fuller utilization of domestic coal resources, especially over the next several decades. By finally coming to grips with the national issue of mine reclamation and by stressing coal utilization, the private sector will have an improved environment for long-term investment in coal production. However, the technologies to burn coal in an acceptable manner will require a very high level of development.

(E) Finally and most important, the plan recognizes for the first time the great number and variety of cost-effective ways to reduce energy demand growth while simultaneously maintaining progress toward personal and national goals. The plan reflects the realization that while energy and GNP are closely tied together in the short run (e.g., over months to years) they are only loosely associated over the long run, as energy consuming capital stocks are replaced. This simple but fundamentally important point, made possible largely by the dynamics of technological ingenuity, provides us with a way to greatly lessen energy demand growth in future years. As a consequence our existing supplies can last longer, a given emergency reserve can make us more resilient, and we have more time in which to put new supply options into place.

Even at present prices a large number of cost-effective opportunities to save energy exist. As a nation we should not just do those things which both save energy and money; rather we should undertake all actions which can save energy at least to the point of "break-even," if not more. The private incentives do not go this for but the national incentive is clearly there. This provides perhaps the most important basis for major governmental involvement in transforming (through the plan) our national self-interest into sufficient private self-interest that appropriate actions will be taken.

IMPACTS OF THE PLAN

The National Energy Plan, for a variety of reasons, stresses actions that will provide significant relief over the next decade. However, we must also be about the business of doing those things that will provide the bigger pay-off in decades ahead.

In dealing with matters of energy supply and utilization we must always keep in mind the fact that major short-term changes (e.g., in less than a decade) cannot be made without considerable trauma. Because of past inattention to the problem we are now in a situation that unfortunately has and will cause some trauma. Further delay will only worsen the situation. Considerable progress can be made by improving the energy-consumption characteristics of our existing capital stock but the largest and most cost-effective gains come about as we build energy-efficient new cars, appliances, buildings, and industrial plants. These latter gains appear over a time corresponding to the turn-over rate of stocks, that is over 10 to 40 years.

Without having to assume any major future technical breakthroughs we can provide double today's living standards (measured in terms of GNP) with only about today's level of energy consumption, given enough time to produce the more efficient system. Is this not a worthy goal? Even at that point we would still be far away from limits on efficiency imposed by natural law.

The demand side of the energy supply/demand equation was given virtually no attention over the past half-century except to devise new ways of using our ever-cheapening energy supplies. Little wonder, then, that our existing system is so inefficient and that there are so many opportunities to improve things.

Detailed studies of a variety of major energy consuming items (e.g., buildings, refrigerators, autos, industrial processes) show one very common trait: That is that the energy efficiency can be

markedly increased (in redesigned, new units over present units) with very small increases in production cost. Typically, given time for production changeover, the improvements can increase efficiently by 50 percent for less than 10 percent increase in first cost. Such a change is generally cost-effective at present energy price [see figs. 1–3].

One issue regarding the National Energy Plan is its emphasis on reduction of demand growth versus expansion of supply. Another issue is the extent to which demand will tend to grow if the plan is implemented.

The issue of relative emphasis is largely overstated. Even under the Carter Plan the Federal Government makes a much smaller commitment of resources to energy utilization than to supply development. A massive expansion of ERDA's and FEA's conservation budget will, I estimate, still result in less than 10 percent of Federal energy expenditures applied to demand and more than 90 percent to supply. Can that be truthfully labelled as putting too much attention to conservation? Given the variety and magnitude of opportunities for both R&D and action programs in conservation I would rather claim that the Carter Plan only begins to mount a sensible, balanced national plan.

The extent to which energy demand will grow over the coming years is not easy to project. Clearly higher prices will result in a lower growth rate. So too will slower population growth and the "saturation" that is beginning to appear in such areas as automobile travel.

With the assistance of several colleagues and use of a number of detailed studies I estimate that if we assume the relatively high economic growth assumed in the plan and at most slowly increasing prices, U.S. demand could reach about 96 quads (quadrillion Btu's) in 1985 without implementation of the plan. If the plan were implemented as proposed, demand in 1985 could be kept to 86 or 87 quads. If one discounts the plan to a more likely level of implementation than the plan implies at face value the demand could be about 90 quads. Such a reduction of growth (at least 6 quads by 1985) would be of inestimable value in reducing oil imports, lightening the burden on coal utilization, and providing us with more time.

The amount of coal use in 1985 inferred from the Carter Plan seems very ambitious, especially the amount that is to be expected to be used by conversion of industrial energy uses. Certainly that amount could ultimately be utilized by industry but it seems likely that more time will be required or that various existing constraints (e.g., environmental discharge clearances) will have to operate more expeditiously.

The plan should be strengthened, for example, by giving more attention to accelerated improvement of efficiency in the commercial sector. Such additional measures should be given prompt attention. The plan could also be weakened, for example, by not going ahead with a comprehensive program to improve auto efficiency as rapidly as possible. If we fail to put in place "belt and suspenders" such as the gas guzzler excise tax (or other disincentives to fuel-inefficient cars) and stand-by gasoline tax we could lose one of our most cost-effective opportunities to replace imported oil with American technological ingenuity.

Clearly we have, unlike some other problems we face, many opportunities to productively respond to the energy problem. If we begin now and commit our national genius we can make progress at home as well as provide leadership for the world. We can devise an energy legacy for future generations as well as for the developing nations to replace that rich inheritance of fossil fuels we consumed to achieve our economic growth over the past century.

We began our Nation by forgoing present material comforts in order to achieve that even more precious ingredient of life: Freedom. I trust and pray that we will make that same kind of response in our time.

[Figs. 1-3 follow:]

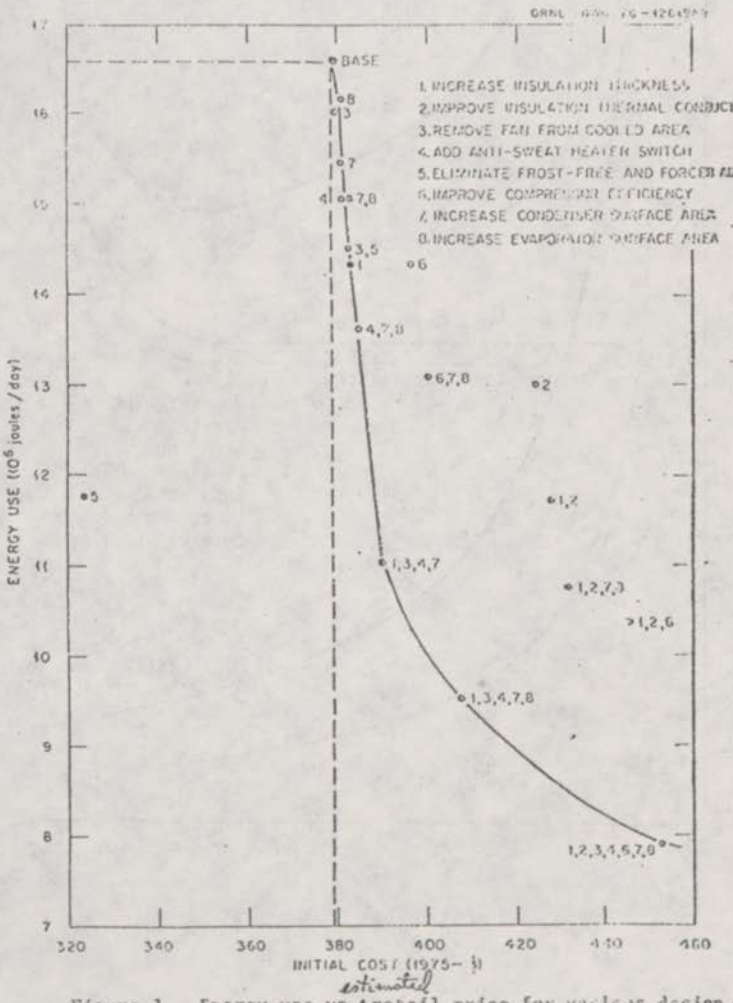
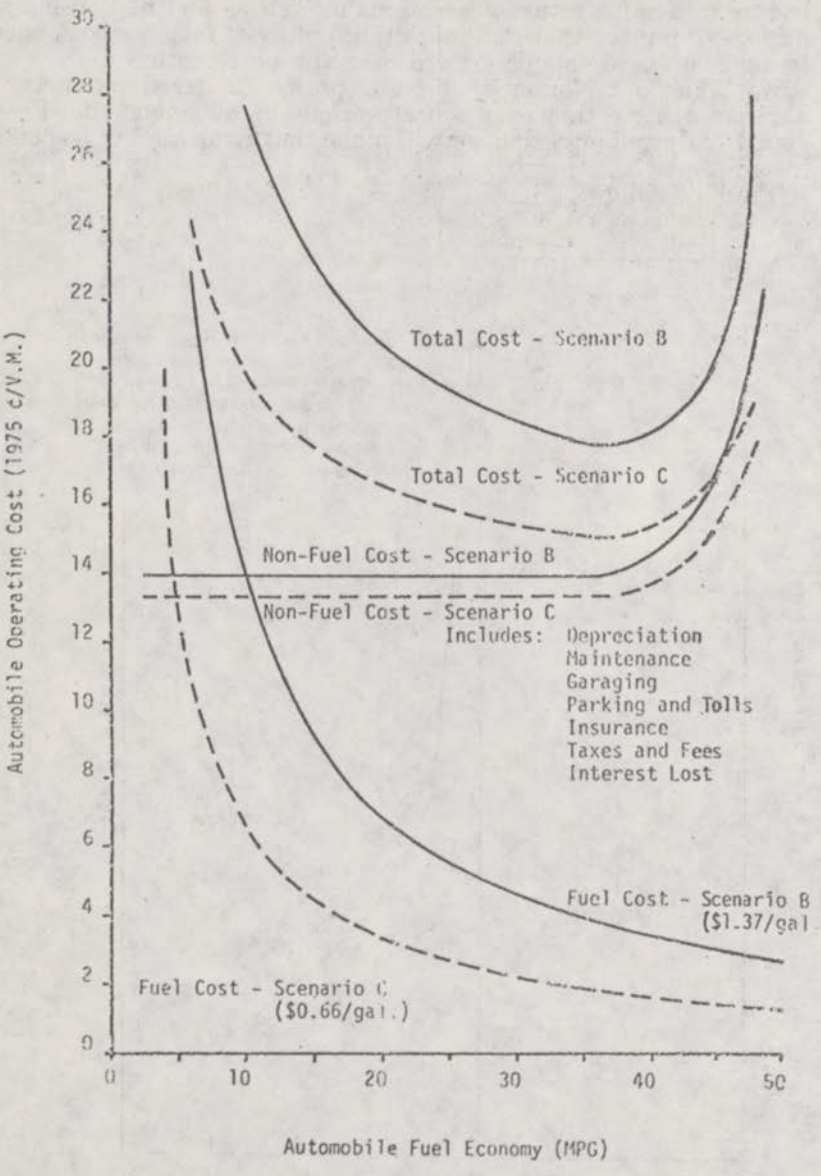


Figure 1. Energy use vs. retail price for various design changes for a 0.45 m^3 (16 ft^3) top-freezer refrigerator.

Figure taken from Eric Hirst "Energy and Cost Analysis of Residential Refrigerators," Oak Ridge National Laboratory, January 1977.

Figure 2 Plot of Automobile Operating Costs Versus Fuel Economy



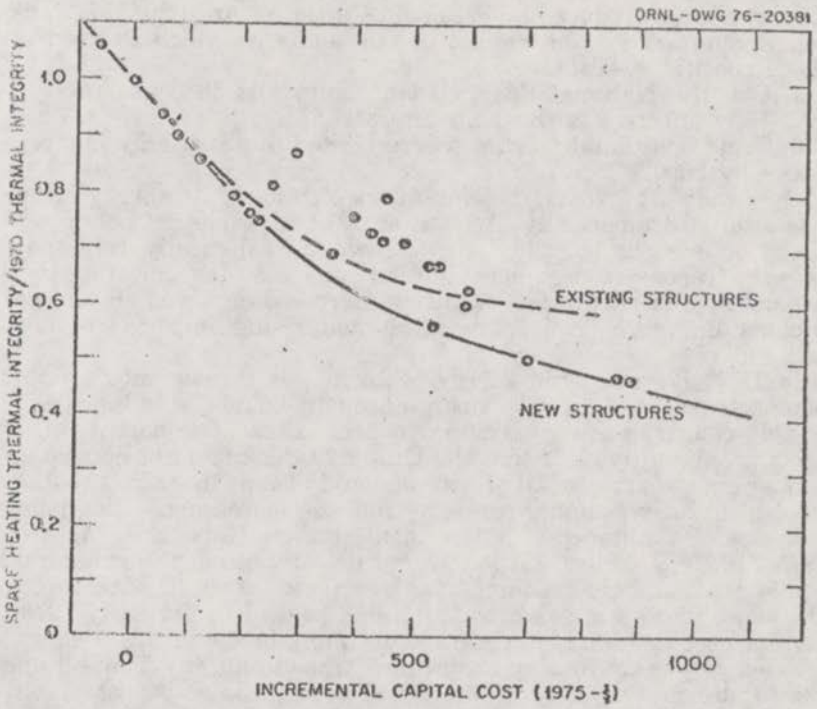


Fig. 3. Space heating thermal integrity for single-family units versus increased capital costs.

Mr. DINGELL. Doctor, we thank you.
Dr. Naill.

STATEMENT OF ROGER F. NAILL

Mr. NAILL. Chairman Dingell, and other members of the subcommittee, it is my pleasure to testify before you on such an important matter. I, like others before me, have more detailed testimony which I would like to have inserted into the record.

Mr. DINGELL. Without objection, the document entitled, "FOSSIL1 Evaluation of the National Energy Plan," will be inserted.

It is an excellent document; I have been reading it.

Mr. NAILL. In 1975, members of the Dartmouth System Dynamics Group were contracted by ERDA's Division of Fossil Energy to build an energy policy model. The model's purpose was to serve as a simulation device to evaluate the magnitude of the United States energy transition problem, and to assess the impacts of various energy policy options on the United States energy system. Thus, the FOSSIL1 model was conceived and constructed.

We recently applied the policy-testing capabilities of FOSSIL1 to perform an evaluation of the long-term effectiveness of the National

Energy Plan introduced by President Carter on April 20, 1977. This report summarizes the results of our analysis, which focused on these specific questions:

1. Can the National Energy Plan achieve its 1985 goals?
2. How effective is the plan after 1985?
3. Could additional policies secure United States energy independence by 2000?

Over the past 5 years, the Nation's perception of its energy future has altered dramatically. As late as 1972, U.S. energy policy was based on a vision of the future drawn unrealistically from past growth trends—energy consumption was seen as continuing to expand at historical rates, requiring increased domestic oil and gas production, more nuclear reactors, and rising imports to meet demand.

In 1973, however, the energy problem was thrown into graphic perspective. The Arab oil embargo brought home the vulnerability of this country's energy system to price rises in imported oil. It became eminently clear that the United States could not depend on this energy source to satisfy its demand. Then, in 1975, the U.S. Geological Survey, under pressure from the increasingly convincing evidence of a number of independent studies (Hubbert 1974; NAS 1975; Moody & Geiger 1975), lowered its estimate of the remaining domestic oil and gas resource base by a factor of six (USGS 1975, p. 4). Domestic oil and gas production had peaked in the early 1970's and now seemed likely to continue declining in the future. Demand for energy was continuing to spiral. A transition away from oil and gas to alternative energy sources was recognized as the only solution by which the United States could produce enough energy domestically to meet demand. Yet it was also clear that this transition could not be made overnight.

Today, the energy policy options open to this country must be weighed carefully, with full recognition of the difficulties inherent in the transition. Each possible alternative energy source—nuclear power, coal, synthetic fuels, breeder reactors, solar power—presents major problems as an immediate substitute for cheap, clean, convenient oil and gas. Technological, environmental, economical, and ethical questions must be answered about each option. The energy policymakers must somehow determine the tradeoffs implicit in the support of one or more of these options, and choose a combination of policies which will assure adequate short-term and long-term energy supplies. Furthermore, if the transition is to be a smooth one, energy policy must be directed not only toward increasing production, but toward decreasing consumption through strong energy conservation measures.

The National Energy Plan sets forth ambitious energy goals for 1985.

Because the FOSSIL1 model focuses only on the long-term interactions of the Nation's energy supply and demand system, we limited our analysis to those three goals which address the system on an aggregate level—total energy demand, oil imports and coal production. The first chart compares the results of the FOSSIL1 BAU and NEP projections with the President's goals in 1985.

Demand: Gross energy demand is reduced from 102 quads in 1985 under BAU to 95 quads with the National Energy Plan. This represents a growth rate of 2.2 percent per year, close to the President's goal of 2 percent per year over this period. The decline in the rate of growth in demand is the result of NEP policies which both raise the price of energy directly (standby gasoline tax, crude oil equalization tax) and also offer incentives for users to respond to price increases (gas guzzler tax and rebate, fuel efficiency standards). While the FOSSIL1 model is not capable of capturing the detailed response of consumer demand to price changes, our aggregate analysis indicates that the energy savings proposed as a goal for the country in the National Energy Plan are within reach.

Oil Imports: United States demand for oil imports increases to 35 quads (16 mbpd) in 1985 under BAU in the FOSSIL1 model. With the implementation of the National Energy Plan, oil imports drop 8 quads to 27 quads per year (13 mbpd). While this represents a significant savings, this level is still double the NEP goal of 12 quads (6 mbpd). The difference lies in our estimates of petroleum production. While the NEP goal assumes a modest increase in oil production (10 percent) by 1985, the FOSSIL1 model projects that the current downward trend will continue, resulting in a net decrease in domestic petroleum production (to 11 quads or 5 mbpd). Almost all of the model's projected 8-quad decrease in oil imports under NEP is accomplished by lowered demand, rather than by increased production.

Coal Production: The National Energy Plan sets a goal of increasing coal production to 1.2 billion tons per year in 1985. Our analysis suggests that coal production may fall slightly short of that goal, reaching 1.08 billion tons per year. The limitations to coal production result from demand constraints over the short term, when coal is used primarily as a boiler fuel in either the industrial sector or in electricity generation. While it appears possible to achieve the industrial usage goals with a major coal conversion program, coal usage in utilities falls about 150 million tons short of the NEP goals by 1985. The utilities' demand for coal is limited by the reduction in electricity demand growth accompanying the NEP (which limits the number of new coal-fired plants constructed in this time period), and by the restricted ability of existing plants to convert to coal.

Summary: In summary, the FOSSIL1 projections suggest that although both the demand and the coal production goals set by the National Energy Plan may be generally achievable by 1985, the plan will fall short of attaining its most important goal. Oil imports will rise to 27 quads (13 mbpd) in 1985 with the plan, instead of dropping to 12 quads (6 mbpd). As disturbing as this discrepancy may be in the short term (up to 1985), it is even more critical over the long term. The FOSSIL1 model projects that a world oil shortage could begin in the early 1980's; a miscalculation in our level of dependence on foreign oil would dramatically increase the stress that such a shortage would place on the U.S. economy.

The FOSSIL1 model indicates that the United States is on a path toward increasing imports to 1985, no matter what policies are implemented today. It is too late to affect 1985 imports—because of the long time lags in the energy system, the decisions leading to

1985 have already been made. Yet, there is still time to shape the post 1985 future. The National Energy Plan goes a long way toward improving the long-term energy prospects of the United States, as our year 2000 analysis shows. Highlights of that analysis are as follows:

Demand: Energy demand grows at 2.5 percent per year to the year 2000 under BAU, and only 1.8 percent per year with the plan. The National Energy Plan package of conservation and energy tax policies therefore could reduce energy demand growth below the NEP target level of 2 percent per year over the long term. Yet even with reduced demand, the oil and gas burden is sizable to the year 2000—these fuels still must satisfy the bulk of United States energy consumption over the transition period (50 percent by the year 2000 with the NEP).

Mr. DINGELL. We have, regretfully, a vote on the floor.

Will you gentlemen forgive us for leaving you? We will be back as quickly as we can.

The committee will stand in recess and we will return as soon as possible.

[Brief recess.]

Mr. DINGELL. The subcommittee will come to order.

When we were interrupted, Dr. Naill was making his statement. Doctor, we apologize and recognize you again.

Dr. NAILL. Thank you, Mr. Chairman.

Before your departure, we were discussing the long-term impacts of the National Energy Plan on domestic oil supply and demand, and I will begin again at that point, if I could.

Oil: United States oil supply and demand are strongly affected by the policies of the National Energy plan. The conservation and tax policies of the plan reduce demand for oil by 20 quads (mbpd) in 2000. However, the benefits of reduced oil demand are partially offset by the plan's net depressive effects on domestic oil production (6 quads or 3 mbpd less in 2000). Domestic production is controlled largely by the world oil price over the next 25 years.

The plan's conservation programs lower United States demand for foreign oil, and therefore lower the world oil price, over the long term, resulting in reduced incentives for domestic production during this period. Although domestic production is lower, the net effect of the plan on the oil sector is positive, United States demand for imported oil is reduced 12 quads (5 mbpd) to 25 quads (12 mbpd) in 2000.

Prices: Consumer prices are increased slightly over the short term, before 1985, with the plan, as the plan's consumer tax policies take effect. Yet the conservation package of the plan creates an offsetting downward pressure on prices over the long term, due primarily to the reduction of world oil prices.

The various taxes on petroleum increase the price paid by oil consumers about 40 percent in the NEP projection. Yet when these taxes are combined with the lower world oil prices resulting from the plan, there is almost no net change in the consumers' average energy price between the BAU and NEP prjections. In both cases, the average price paid by consumers for energy increases by a factor of three above current 1977 levels in real dollars by the year 2000.

OPEC: The supply and demand for oil from the oil-exporting nations defined here as OPEC, is shown in the second chart. In the BAU projection, world demand for oil from the oil-exporting nations exceeds their capacity to produce in the early 1980's. A world oil shortage develops, even though the OPEC nations have expanded their production capacity steadily to 45 mbpd by 1985. The United States contributes significantly to the crisis; the chart shows that its share of total world demand for imports escalates from less than 20 percent before 1970 to 35 percent in 1985. As the shortage develops, the world oil price "breaks" from its current $13.50 per barrel level and begins to rise to the marginal cost of oil substitutes, priced near $25 per barrel.

Because the United States is likely to become a major oil importer under the BAU, any reduction in United States imports could produce significant repercussions in the world oil market. The large United States oil savings projected with the National Energy Plan, as much as 9 mbpd, are not enough to avoid a world energy shortage entirely; this crisis seems inevitable given the limited resource base of the OPEC nations. Yet the National Energy Plan postpones the world oil shortage for 10 years. That is illustrated in the second graph.

This delay is crucial for the development of United States energy policy, buying the country 10 additional precious years to bring alternative energy sources on line. If the strong conservation program of the National Energy Plan were supplemented with additional policies that stimulated supply, the United States could achieve energy independence by the year 2000. Under these circumstances, the United States would be insulated from the direct effects of a world oil shortage.

In view of the previous results, we tested two alternative energy plans with FOSSIL1. Both strategies modify the National Energy Plan to increase incentives for domestic energy production, in order to insulate the United States against a world oil shortage over the long term. The results of these alternative energy plans are summarized in the third chart.

Even if the United States were to return to free market energy pricing, adequate domestic energy supplies would still not be forthcoming; foreign oil would remain the most attractive alternative, even at $13.50 a barrel. Under our accelerated supply projection, the Government intervenes to stimulate domestic supply by modifying the National Energy Plan with the following policies:

Oil and gas prices are deregulated over a 5-year period;

No oil and gas users taxes are imposed;

A substantial tariff is imposed on imported oil, bringing its price to $22.50 per barrel, significantly above the world oil price.

Deregulation allows oil and gas producers to price their products nearer to their replacement costs. The oil tariff ensures that the cheapest replacement will be domestic oil and gas, rather than imported oil. By removing the user taxes and perhaps by regulating investment flows, the additional revenues from higher oil and gas prices flow to new domestic investments.

The chart illustrates the net effects of the accelerated supply plan on the energy balances in the year 2000. United States demand for

foreign oil is decreased to 12 quads (6 mbpd) by 2000, which is the goal of the National Energy Plan. As with the original NEP projection, the world oil shortage is postponed almost to 2000 due to the United States' conservation efforts. By the time the oil shortage erupts, the United States is well along toward a path to energy independence.

Although in the previous plan the Government intervened to accelerate future domestic energy supply above expected free-market levels, it allowed the energy market to choose which of the many supply alternatives would be exploited. Within the limitations of existing law, the market responded by choosing the cheapest and most profitable alternatives, primarily nuclear power and coal-based energy sources over the next 25 years.

Yet there are environmental and political tradeoffs implicit in any energy strategy which aren't accounted for in the current energy market. For example, environmentalists argue that nuclear power poses greater risks than coal as an energy option, for its problems are more long lived and intractable than coal. Is nuclear power crucial to the United States energy future? Could reliance on coal alone protect this country from the world oil shortage?

To answer these questions, we ran the FOSSIL1 model with the same policies as the previous run NEP plus accelerated supply, and added the following policies: A nuclear moratorium, and loan guarantees for synfuel projects.

As shown in the chart in the final column the answer is yes, national goals could be met over the long term without major increases in nuclear power. Domestic energy production increases to 110 quads when the accelerated coal policies are added, a 15 percent increase over BAU.

Coal production increases to over 70 quads, 3 billion tons per year, in 2000, and provides over 60 percent of the Nation's energy in that year.

Oil imports are reduced to 9 quads, 4 mbpd, which is lower than the earlier plans that included nuclear power. The NEP plus accelerated coal projection shows that an energy transition heavily based on coal should at least be considered as a feasible option.

In summary, our analysis of President Carter's proposed National Energy plan has led us to the following conclusions:

First, the National Energy Plan is first and foremost an energy conservation strategy, and as such we strongly endorse it. From our perspective, however, it does not go far enough, the plan does not fully recognize the severity of the long term problem.

Second, the Carter administration's 1985 goal of a reduction in imports is overly optimistic. Our analysis projects that imports will increase to 13 mbpd even if the plan is implemented. The energy system's inertia along its present course will carry the country towards increasing imports to 1985, no matter what policies are enacted now.

Third, over the longer term to 2000, the plan has measurable positive effects. By reducing United States energy demand, the plan postpones the world oil shortage for 10 years, to the mid-1990's. While the plan does not totally circumvent the domestic impact of the oil shortage, United States demand for foreign oil is still 13

mbpd in 1995 when the oil shortage hits, the added 10 years buys this country time to bring alternative energy sources on line.

Fourth, by adding to the plan policies that accelerate supply, United States' dependence on foreign oil could be reduced to 5 mbpd by 2000. This plan would achieve the President's medium term energy goal, effectively insulating the United States from a world oil shortage.

Fifth, with the major reduction in demand that is a consequence of the plan, nuclear power is no longer a critical part of the United States' energy supply future. Our analysis indicates that even with a moratorium on nuclear power, the goals of the National Energy Plan could be met by accelerating coal production and use. In fact, oil imports could be drop even further to 4 mbpd when accelerated coal policies are added to the National Energy Plan.

Central to our analysis is the concept that there is a strong conflict between the economy's short term and long term well-being. The policies that improve the long term behavior of the energy system require significant short term sacrifices by the American people; 1985 energy prices under the alternative energy plans are as much as 30 percent higher than those in the business as usual projection. This prospect is not a popular one for the country, its leaders, the individual consumers, already feel the serious side effects of rising energy prices.

Yet over the long term, there is little doubt that the benefits of a National Energy Plan will more than offset its short term costs. Many studies have come to refer to their business as usual projections as "surprise-free," indicating that these scenarios conform to most people's current expectations of the future.

However, our business as usual projection is full of unpleasant surprises. Major energy price increases seem inevitable, even under the business as usual scenario. Moreover, there is mounting evidence from both our analysis and others—CIA 1977, WAES, 1977—that the Business as Usual path leads to a world oil shortage, perhaps as soon as 5 years from now. The implementation of a strong National Energy Plan should be this country's most pressing order of business.

Thank you, Mr. Chairman.

[Testimony resumes on p. 399.]

[The document, FOSSIL1, referred to follows:]

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FOSSIL1
EVALUATION OF THE NATIONAL ENERGY PLAN

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EVALUATION OF THE NATIONAL ENERGY PLAN

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I. INTRODUCTION

Over the past five years, the nation's perception of its energy future has altered dramatically. As late as 1972, United States energy policy was based on a vision of the future drawn unrealistically from past growth trends--energy consumption was seen as continuing to expand at historical rates, requiring increased domestic oil and gas production, more nuclear reactors, and rising imports to meet demand.

In 1973, however, the energy problem was thrown into graphic perspective. The Arab oil embargo brought home the vulnerability of this country's energy system to price rises in imported oil. It became eminently clear that the United States could not depend on this energy source to satisfy its demand. Then, in 1975, the U. S. Geological Survey, under pressure from the increasingly-convincing evidence of a number of independent studies (Hubbert 1974; NAS 1975; Moody & Geiger 1975), lowered its estimate of the remaining domestic oil and gas resource base by a factor of six (USGS 1975, p.4). Domestic oil and gas production had peaked in the early 1970's and now seemed likely to continue declining in the future. Demand for energy was continuing to spiral. A transition away from oil and gas to alternative energy sources was recognized as the only solution by which the United States could produce enough energy domestically to meet demand. Yet it was also clear that this transition could not be made overnight.

Today, the energy policy options open to this country must be weighed carefully, with full recognition of the difficulties inherent in the transition. Each possible alternative energy source--nuclear power, coal, synthetic fuels, breeder reactors, solar power--presents major problems as an immediate substitute for cheap, clean, convenient oil and gas. Technological, environmental, economical, and ethical questions must be answered about each option. The energy policymakers must somehow determine the tradeoffs implicit in the support of one or more of these options, and choose a combination of policies which will assure adequate short-term and long-term energy supplies. Furthermore, if the transition is to be a smooth one, energy policy must be directed not only toward increasing production, but toward decreasing consumption through strong energy conservation measures.

In 1975, members of the Dartmouth System Dynamics Group were contracted by ERDA's Division of Fossil Energy to build an energy policy model. The model's purpose was to serve as a simulation device to evaluate the magnitude of the United States energy transition problem, and to assess the impacts of various energy policy options on the United States energy system. Thus, FOSSIL1, an expanded version of the COAL1 system dynamics model developed under a grant from the National Science Foundation, was conceived and constructed.

The model's completion in early 1977 seems particularly fortuitous, considering the evolution of the world energy situation. FOSSIL1 can provide the type of analysis desperately needed by ERDA and other federal energy agencies--it can forecast the integrated dynamic behavior of the energy system. In addition, FOSSIL1 can test the effects of the wide spectrum of policies which are available to the federal government and the private energy sector.

We recently applied these policy-testing capabilities of FOSSIL1 to perform an evaluation of the long-term effectiveness of the National Energy Plan introduced by President Carter on April 20, 1977. This report summarizes the results of our analysis, which focused on three specific questions:

1. Can the National Energy Plan achieve its 1985 goals?

2. How effective is the Plan after 1985?

3. Could additional policies secure United States energy independence by 2000?

II. ANALYZING THE NATIONAL ENERGY PLAN

To evaluate the effectiveness of the National Energy Plan, we compared the Plan to a Business as Usual projection, which assumed no changes in current energy policies. It is important to realize when judging these comparisons that the dates and numbers of quads cited in this analysis (or any analysis accomplished with the aid of a model) should not be viewed as absolute predictions--the large uncertainties involved in any long-term projection preclude that. They should be interpreted rather as indicators of the relative magnitude of change that can be expected from one projection in comparison with another.

In the Business as Usual projection, government policies remain at their current (May, 1977) status. Oil and gas prices continue to be regulated. (A ceiling price that returns 12 percent per year to the oil and gas industries is enforced.) No mandatory conservation programs are imposed--consumers conserve energy voluntarily in response to energy price increases. No new taxes or tariffs are initiated. No new environmental legislation is imposed (and, perhaps as important, current environmental legislation--SO_2 standards and the 1969 Coal Mine Health and Safety Act--remains in force). ERDA's Research, Development and Demonstration (RD&D) programs for advanced energy technologies are continued at their current scheduled pace. None of the policy options proposed in the National Energy Plan are implemented.

The National Energy Plan (NEP) projection incorporates into the model the roughly 40 major energy policies comprising President Carter's Energy Plan (see The National Energy Plan, Executive Office of the President, April, 1977). The salient features of the Plan, which we translated into the model via a total of 35 structural and parametric changes,* include policies meant to:

- increase energy conservation and fuel efficiency;
- raise the price of oil and natural gas;
- encourage the conversion to coal;
- promote limited development of nuclear power;
- stimulate the long-term development of renewable resources.

* A description of how the NEP policies were represented in the FOSSIL1 model is included as APPENDIX A.

In general, the FOSSIL1 model's structural representation of energy decision-making* allowed us to capture the effects of specific policies within the Plan in rich detail. Conservation policies were represented by enhancing the energy users' responsiveness to price changes. For the same price increase, consumers reduce their energy usage by a largeramount and switch to more energy-efficient end-use technologies. The Plan's fuel-specific energy tax packages were incorporated directly into the model structure, for FOSSIL1 energy prices are broken down by fuel / type.

The myriad of regulatory restrictions concerning prohibition of new oil- and gas-fired utilities, scrubber requirements for coal-fired plants, strip mining legislation, bans on breeder reactors and commercial reprocessing and recycling, reductions in light water reactor siting delays, and accelerated research and development in advanced energy technologies were also represented directly in the model structure.

We had difficulty identifying structural changes we could make in the model to represent the National Energy Plan's oil and gas pricing rules, which peg prices to fixed or target price levels (for example, $13.50 per barrel for new oil). While such levels may be perfectly appropriate in 1977 or even into the 1980's, they certainly cannot be expected to remain unchanged to the year 2000. The original FOSSIL1 BAU pricing structure contains a flexible representation of regulatory pricing that adds enough profits to average oil and gas costs to allow the industry a fair rate of return (the historical total industry average of 12 percent per year after taxes). In fact, this pricing structure projected future oil and gas price paths that seemed an appropriate representation of the NEP pricing scheme. Thus our assumption is that the price increases called for in the NEP would have occurred anway under the BAU. The Plan clearly does not include any major structural changes in oil and gas pricing, such as deregulation.

*A detailed description of the FOSSIL1 model structure and assumptions is included in APPENDIX B.

III. CAN THE NATIONAL ENERGY PLAN ACHIEVE ITS 1985 GOALS?

The National Energy Plan sets forth ambitious energy goals for 1985. These goals are:

- reduce the annual growth of total energy demand to below 2 percent;
- reduce gasoline consumption 10 percent below its current level;
- reduce oil imports from a potential level of 16 million barrels per day to 6 million, roughly one-eighth of total energy consumption;
- establish a Strategic Petroleum Reserve of 1 billion barrels;
- increase coal production by two-thirds, to more than 1 billion tons per year;
- bring 90 percent of existing American homes and all new buildings up to minimum energy efficiency standards; and
- use solar energy in more than two and one-half million homes.

Because the FOSSIL1 model focuses only on the long term interactions of the nation's energy supply and demand system, we limited our analysis to those three goals which address the system on an aggregate level--total energy demand, oil imports, and coal production. Figure 1 compares the results of the FOSSIL1 BAU and NEP projections with the President's goals in 1985.

Demand

Gross energy demand is reduced from 102 quads in 1985 under BAU to 95 quads with the National Energy Plan (see Figure 1). This represents a growth rate of 2.2 percent per year, close to the President's goal of 2 percent per year over this period. The declining growth in demand is the result of NEP policies which both raise the price of energy directly (standby gasoline tax, crude oil equalization tax) and also offer incentives for users to respond to price increases (gas guzzler tax and rebate, fuel efficiency

VARIABLE	1976	1985 NEP GOAL	FOSSIL1 PROJECTIONS 1985 BAU	1985 NEP
DEMAND	Quads: 77	96	102 (101-103)*	95 (90-97)
OIL IMPORTS	MPBD: 7.3 Quads: 15	6 12	16.5 35 (32-37)	12.7 27 (24-29)
COAL PRODUCTION	10^9 Tons: 0.66 Quads: 15	1.2 26	0.94 20 (20-21)	1.08 24 (23.5-24.5)

Figures in parentheses indicate high and low values from sensitivity tests on imports, prices, demand elasticity, conversion technology costs, and oil and gas resource estimates.

FIGURE 1: EVALUATION OF THE NATIONAL ENERGY PLAN TO 1985

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standards). While the FOSSIL1 model is not capable of capturing the detailed response of consumer demand to price changes, our aggregate analysis indicates that the energy savings proposed as a goal for the country in the National Energy Plan are within reach.

Oil Imports

United States demand for oil imports increases to 35 quads (16 mbpd) in 1985 under BAU in the FOSSIL1 model. With the implementation of the National Energy Plan, oil imports drop 8 quads to 27 quads per year (13 mbpd). While this represents a significant savings, this level is still double the NEP goal of 12 quads (6 mbpd). The difference lies in our estimates of petroleum production. While the NEP goal assumes a modest increase in oil production (10 percent) by 1985, the FOSSIL1 model projects that the current downward trend will continue, resulting in a net decrease in domestic petroleum production (to 11 quads or 5 mbpd). Almost all of the model's projected 8-quad decrease in oil imports under NEP is accomplished by lowered demand, rather than by increased production.

Coal Production

The National Energy Plan sets a goal of increasing coal production to 1.2 billion tons per year in 1985. Our analysis suggests that coal production may fall slightly short of that goal, reaching 1.08 billion tons per year. The limitations to coal production result from demand constraints over the short term, when coal is used primarily as a boiler fuel in either the industrial sector or in electricity generation. While it appears possible to achieve the industrial usage goals with a major coal conversion program, coal usage in utilities falls about 150 million tons short of the NEP goals by 1985. The utilities' demand for coal is limited by the reduction in electricity demand growth accompanying the NEP (which limits the number of new coal-fired plants constructed in this time period), and by the restricted ability of existing plants to convert to coal.

In summary, the FOSSIL1 projections suggest that although both the demand and the coal production goals set by the National Energy Plan may be generally achievable by 1985, the Plan will fall short of attaining its most important goal. Oil imports will rise to 27 quads (13 mbpd) in 1985 with the Plan, instead of dropping to 12 quads (6 mbpd). As disturbing as this discrepancy may be in the short term (up to 1985), it is even more critical over the long term. The FOSSIL1 model projects that a world oil shortage could begin in the early 1980's; a miscalculation in our level of dependence on foreign oil would dramatically increase the stress that such a shortage would place on the United States economy.

IV. HOW EFFECTIVE IS THE PLAN AFTER 1985?

The FOSSIL1 model indicates that the United States is on a path toward increasing imports to 1985, *no matter what policies are implemented today*. It is too late to affect 1985 imports--because of the long time lags in the energy system, the decisions leading to 1985 have already been made. Yet, there is still time to shape the post-1985 future. The National Energy Plan goes a long way toward improving the long-term energy prospects of the United States, as our year 2000 analysis shows.

Demand

Figure 2 illustrates the FOSSIL1 model's projections of gross and net energy demand (by fuel type) under BAU and the Plan. Gross energy demand is shown to grow to 142 quads per year in the year 2000 under BAU, compared to 118 quads with the Plan. Energy demand grows at 2.5 percent per year to the year 2000 under BAU, and only 1.8 percent per year with the Plan. The National Energy Plan package of conservation and energy tax policies therefore could reduce energy demand growth below the NEP target level of 2 percent per year over the long term. Yet even with reduced demand, the oil and gas burden is sizeable to the year 2000--these fuels still must satisfy the bulk of United States energy consumption over the transition period (50 percent by the year 2000 with the NEP).

Oil

Figure 3 demonstrates that United States oil supply and demand are strongly affected by the policies of the National Energy Plan. The conservation and tax policies of the Plan reduce demand for oil by about 20 quads (9 mbpd) in 2000. However, the benefits of reduced oil demand are partially offset by the Plan's net depressive effects on domestic oil production (5 quads or 3 mbpd less in 2000). Domestic production is controlled largely by the world oil price under the National Energy Plan. The Plan's conservation programs lower United States demand for foreign oil (and therefore lower the world oil price) over the long term, resulting in reduced incentives for domestic production during this period. Although domestic production is lower, the net effect of the Plan on the oil sector is positive--United

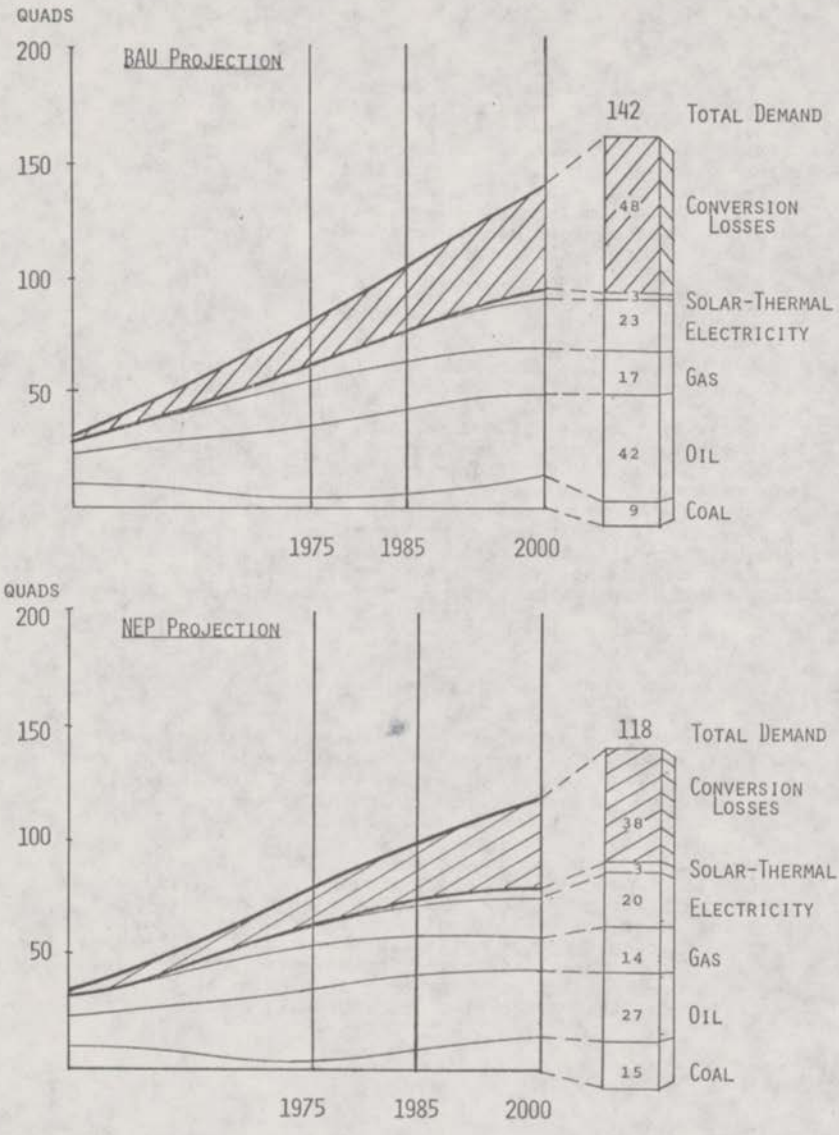

FIGURE 2: FOSSIL1 DEMAND PROJECTIONS

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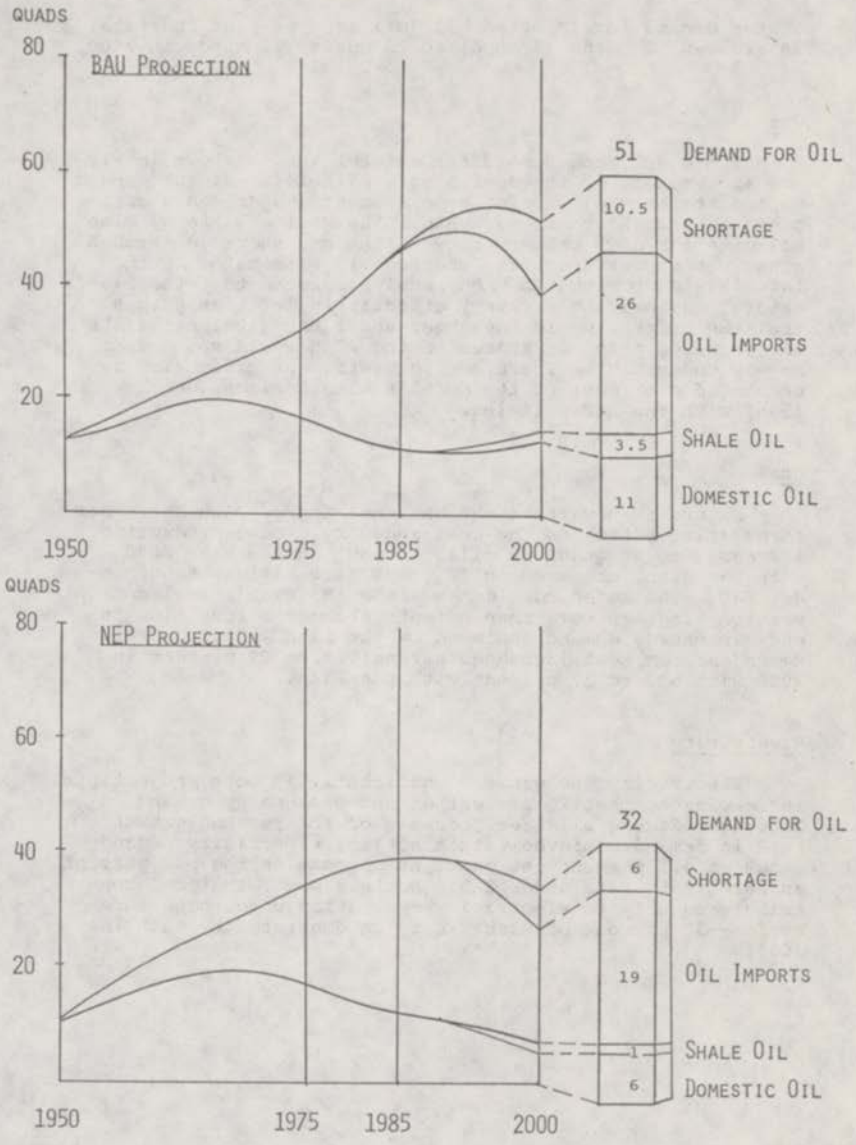

FIGURE 3: FOSSIL1 OIL PROJECTIONS

States demand for imported oil (oil imports plus shortage) is reduced 12 quads (5 mbpd) to 25 quads (12 mbpd) in 2000.

Gas

The supply and demand for natural gas is shown in Figure 4. Because of the declining availability of gas, the United States would suffer a persistent, major gas shortage over the next 25 years with BAU. The National Energy Plan policies cut down the severity of the gas shortage through conservation measures; the shortage is eliminated by the late 1990's with the Plan. Our analysis found that the Plan's natural gas pricing strategy effectively left gas prices the same as they would have been under BAU (indicating that the proposed price increases of the Plan would soon occur anyway under BAU). Therefore, domestic gas production is unchanged over most of the model's time horizon (until 1995) with the NEP policies.

Coal

Figure 5 shows that the National Energy Plan has a net stimulative effect on the coal industry. Coal production increases to 44 quads (2 million tons) in the year 2000 with the Plan, compared to 39 quads (1.8 million tons) under BAU. The added coal demand from the Plan's coal conversion programs more than offsets the major reduction in end-use energy demand achieved by the Plan. United States dependence on coal increases strongly from 29 percent in 2000 with BAU to 37 percent with the Plan.

Electricity

Electricity use grows significantly in both projections, increasing to meet 25 percent of end-use energy demand in 2000 (see Figure 6). Yet, because of the reduced growth rate in demand achieved with the Plan, electricity demand grows at 4.5 percent per year, as opposed to the 5.2 percent annual growth rate under BAU. Nuclear power and coal contribute equally to electricity generation under both scenarios--35 percent of electricity is generated by each in 2000.

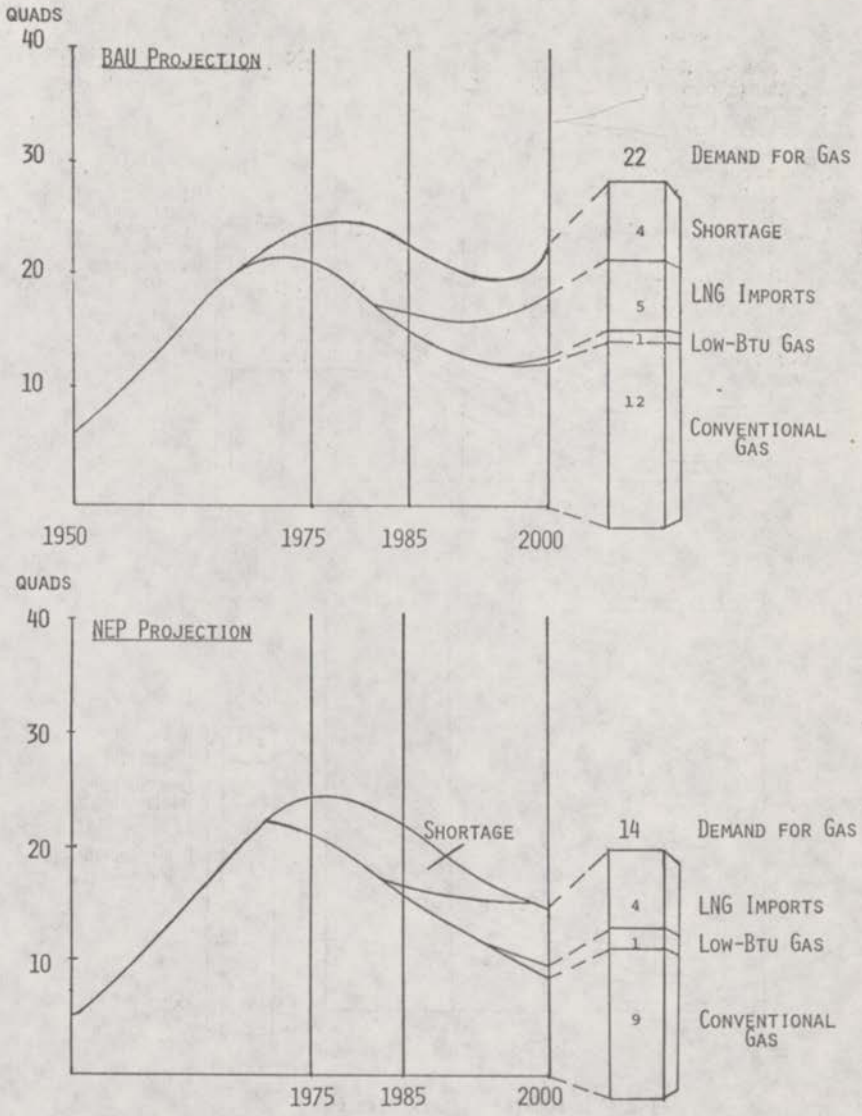

FIGURE 4: FOSSIL1 GAS PROJECTIONS

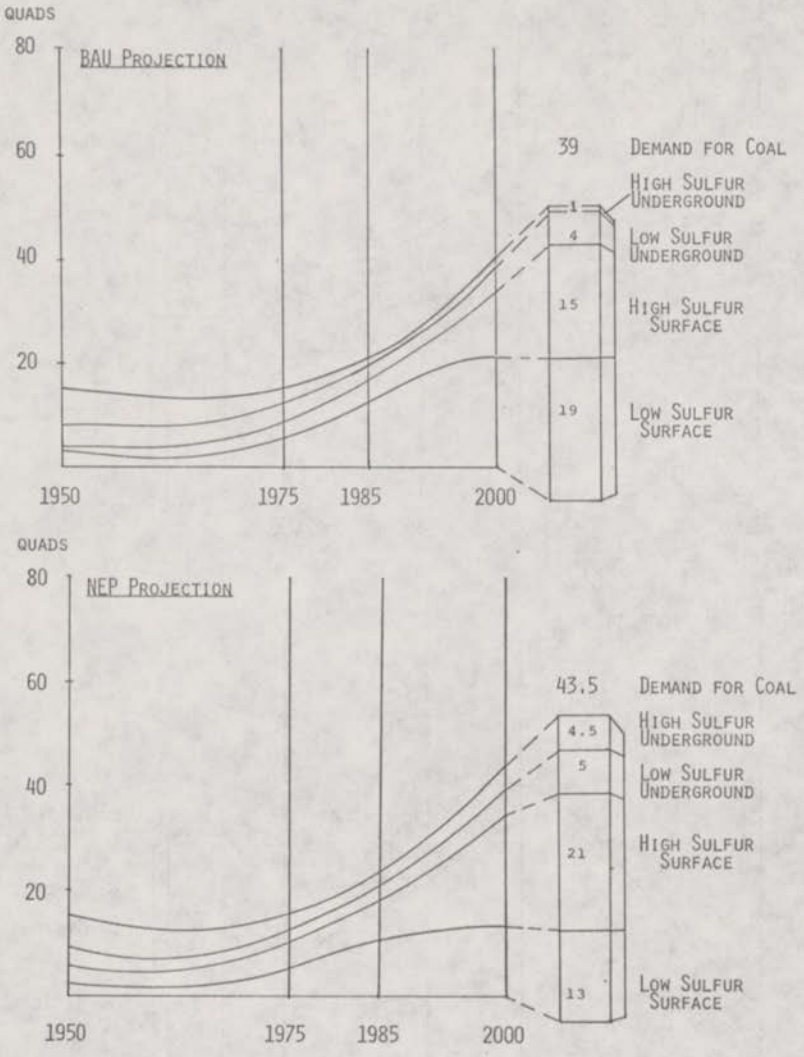

FIGURE 5: FOSSIL1 COAL PROJECTIONS

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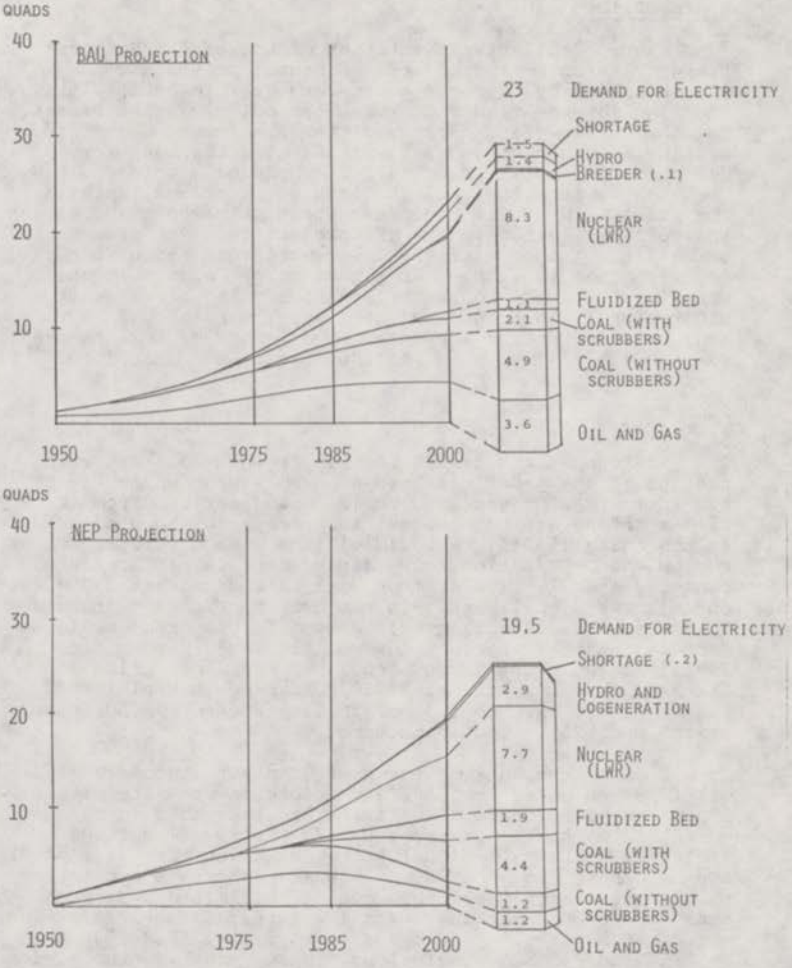

FIGURE 6: FOSSIL1 ELECTRICITY PROJECTIONS

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Energy Prices

Figure 7 illustrates the net effect of the National Energy Plan on energy prices. Consumer prices are increased slightly over the short term (before 1985) with the Plan, as the Plan's consumer tax policies take effect. Yet the conservation package of the Plan creates an offsetting downward pressure on prices over the long term, due primarily to the reduction of world oil prices. Figure 7 shows that the various taxes on petroleum increase the price paid by oil consumers about 40 percent above the world oil price in the NEP projection. Yet when these taxes are combined with the lower world oil price resulting from the Plan, there is almost no net change in the consumers' average energy price between the BAU and NEP projections. In both cases, the average price paid by consumers for energy increases by a factor of three above current (1977) levels in real dollars by the year 2000.

OPEC

The supply and demand for oil from the oil-exporting nations (loosely defined here as OPEC) is shown in Figure 8. In the BAU projection, world demand for oil from the oil-exporting nations exceeds their capacity to produce in the early 1980's. A world oil shortage develops, even though the OPEC nations have expanded their production capacity steadily (to 45 mbpd by 1985). The United States contributes significantly to the crisis; Figure 8 shows that its share of total world demand for imports escalates from less than 20 percent before 1970 to 35 percent in 1985. As the shortage develops, the world oil price "breaks" from its current 13.50 dollar per barrel level, and begins to rise to the marginal cost of oil substitutes, priced near 25 dollars per barrel.

Because the United States is likely to become a major oil importer under the BAU, any reduction in United States imports could produce significant repercussions in the world oil market. The large United States oil savings projected with the National Energy Plan (as much as 9 mbpd) are not enough to avoid a world energy shortage entirely--this crisis seems inevitable given the limited resource base of the OPEC nations. Yet *the National Energy Plan postpones the world oil shortage for ten years*, from 1983 to 1993 in the FOSSIL1 simulations. This delay is crucial for the development of United States energy policy, buying the country ten additional precious years to bring alternative energy sources on line. If the strong conservation program of the National Energy Plan were supplemented with additional policies that stimulated supply, the United States could achieve energy independence by the year 2000. Under these circumstances, the United States would be insulated from the direct effects of a world oil shortage.

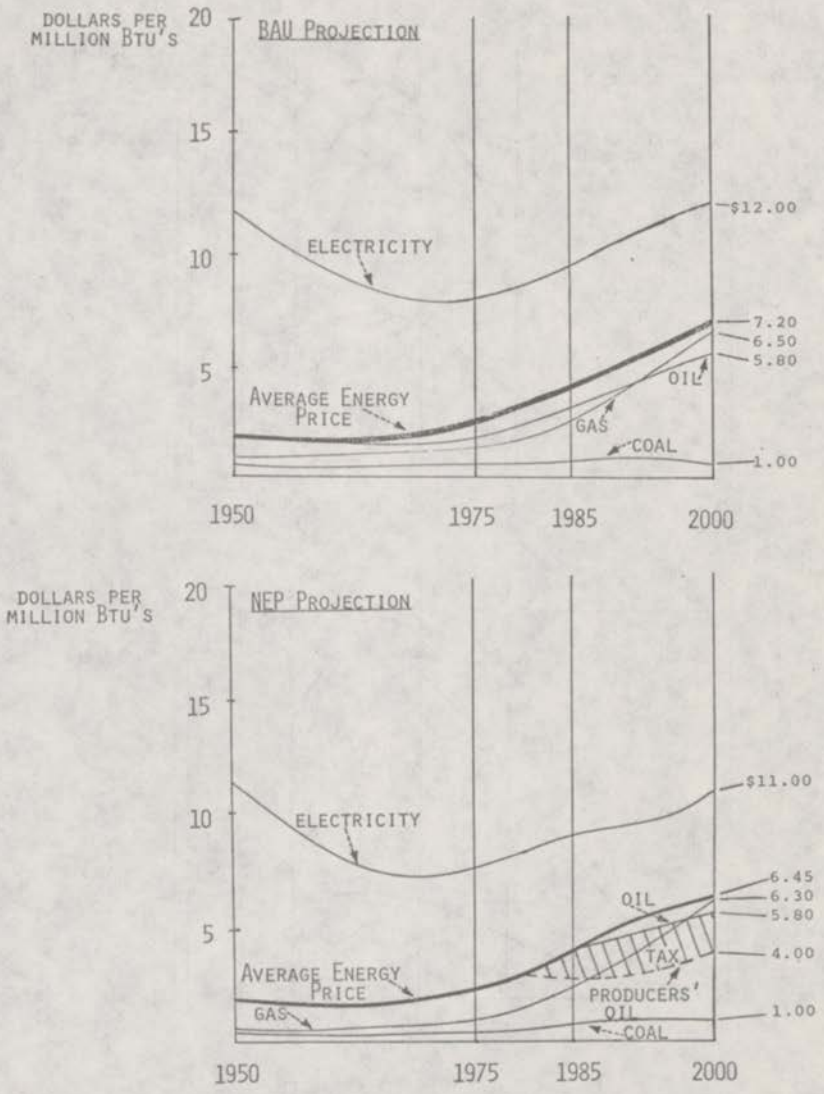

FIGURE 7: FOSSIL1 PRICE PROJECTIONS

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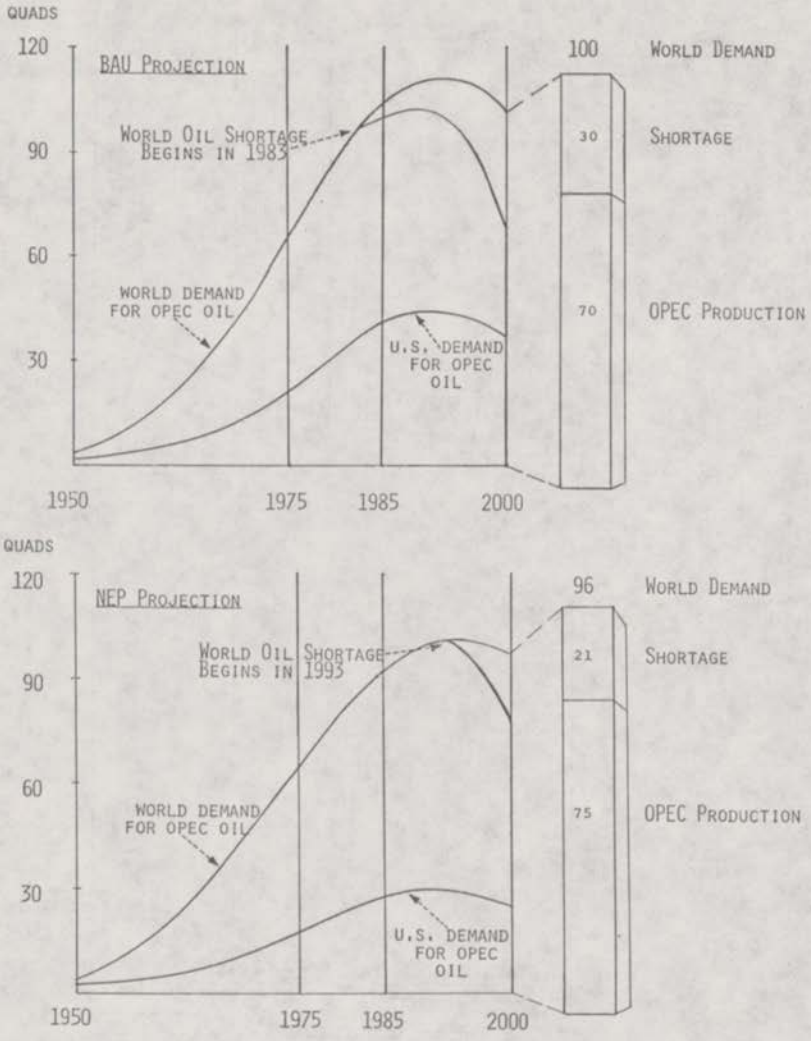

FIGURE 8: FOSSIL1 OPEC OIL PROJECTIONS

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V. ALTERNATIVE ENERGY PLANS

In view of the previous results, we tested two alternative energy plans with FOSSIL1. Both strategies modify the National Energy Plan to increase incentives for domestic energy production, in order to insulate the United States against a world oil shortage over the long term.

NEP Plus Accelerated Supply

This plan acknowledges that even if the United States were to return to free-market energy pricing, adequate domestic energy supplies would still not be forthcoming; foreign oil would remain the most attractive alternative, even at $13.50 per barrel. Under our Accelerated Supply projection, government intervenes to stimulate domestic supply by modifying the National Energy Plan with the following policies:

- Oil and gas prices are deregulated over a five-year period;
- No oil and gas users' taxes are imposed;
- A substantial tariff is imposed on imported oil, bringing its price to $22.50 per barrel.

Deregulation allows oil and gas producers to price their products nearer to their replacement costs. The oil tariff ensures that the cheapest replacement will be domestic oil and gas, rather than imported oil. By removing the users' taxes (and perhaps by regulating investment flows), the additional revenues from higher oil and gas prices flow to new domestic investments.

Figure 9 summarizes the net effects of the Accelerated Supply Plan on the energy balances in the year 2000. United States demand for foreign oil (imports plus shortage) is decreased to 12 quads (6 mbpd) by 2000, the goal of the National Energy Plan. As with the original NEP projection, the world oil shortage is postponed almost to 2000 due to the United States' conservation efforts. By the time the oil shortage erupts, the United States is well along toward a path to energy independence.

	BAU (quads)	NATIONAL ENERGY PLAN (quads)	NEP & ACCELERATED SUPPLY (quads)	NEP & ACCELERATED COAL (quads)
DEMAND	142	118	118	121
DOMESTIC SUPPLY	96	89	103	110
OIL	14	7	18	18
GAS	12	9	11	11
COAL	40	44	45	73
NUCLEAR	25	23	23	1
OTHER	5	5	6	6
IMPORTS	31	23	14	11
OIL	26	19	11	9
GAS	5	4	3	2
SHORTAGE	15	6	1	--
OIL	11	6	1	--
GAS	4	--	--	--

FIGURE 9: COMPARISON OF ALTERNATIVE ENERGY PLANS: YEAR 2000

NEP Plus Accelerated Coal

Although in the previous plan the government intervened to accelerate future domestic energy supply above expected free-market levels, it allowed the energy market to choose which of the many supply alternatives would be exploited. Within the limitations of existing law, the market responded by choosing the cheapest and most profitable alternatives--primarily nuclear power and coal-based energy sources over the next 25 years.

Yet there are environmental and political tradeoffs implicit in any energy strategy which aren't accounted for in the current energy market. For example, environmentalists argue that nuclear power poses greater risks than coal as an energy option, for its problems are more long-lived and intractable than coal's. Is nuclear power crucial to the United States energy future? Could reliance on coal alone protect this country from the world oil shortage?

To answer these questions, we ran the FOSSIL1 model with the same policies as the previous run (NEP plus Accelerated Supply), and added the following policies:

- a nuclear moratorium;
- loan guarantees for synfuel projects.

As shown in Figure 9, the answer is yes--national goals could be met over the long term without major increases in nuclear power. Domestic energy production increases to 110 quads when the Accelerated Coal policies are added, a 15 percent increase over BAU. Coal production increases to over 70 quads (3 billion tons per year) in 2000, and provides over 60 percent of the nation's energy in that year. Oil imports are reduced to 9 quads (4 mbpd), which is lower than the plans that included nuclear power. The NEP plus Accelerated Coal projection shows that an energy transition heavily based on coal should at least be considered as a feasible option.

V. CONCLUSIONS

With the aid of the FOSSIL1 energy model developed at the Thayer School of Engineering, the Dartmouth System Dynamics Group has tested the long-term impact of President Carter's proposed National Energy plan. Our analysis leads us to the following conclusions:

- The National Energy Plan is first and foremost an energy conservation strategy, and as such we strongly endorse it. From our perspective, however, it does not go far enough--the Plan does not fully recognize the severity of the long-term problem.

- The Carter Administration's 1985 goal of a reduction in imports is overly optimistic. Our analysis projects that imports will increase to 13 mbpd even if the Plan is implemented. The energy system's inertia along its present course will carry the country towards increasing imports to 1985, no matter what policies are enacted now.

- Over the longer term (to 2000), the Plan has measurable positive effects. By reducing United States energy demand, the Plan postpones the world oil shortage for ten years, to the mid-1990's. While the Plan does not totally circumvent the domestic impact of the oil shortage (United States demand for foreign oil is still 13 mbpd in 1995), the added ten years buy this country time to bring alternative energy sources on line.

- By adding to the Plan policies that accelerate supply, United States' dependence on foreign oil could be reduced to 5 mbpd by 2000. This plan would achieve the President's medium-term energy goal, effectively insulating the United States from a world oil shortage.

- With the major reduction in demand that is a consequence of the Plan, nuclear power is no longer a critical part of the United States' energy supply future. Our analysis indicates that even with a moratorium on nuclear power, the goals of the National Energy Plan could be met by accelerating coal production and use. In fact, oil imports could drop even further to 4 mbpd when accelerated coal policies are added to the National Energy Plan.

Central to our analysis is the concept that there is a strong conflict between the economy's short-term and long-term well being. The policies that improve the long-term behavior of the energy system require significant short-term sacrifices by the American people--1985 energy prices under the alternative energy plans are as much as 30 percent higher than those in the Business as Usual projection. This prospect is not a popular one, for the country, its leaders, and individual consumers already feel the serious side-effects of rising energy prices.

Yet over the long term, there is little doubt that the benefits of a National Energy Plan will more than offset its short-term costs. Many studies have come to refer to their Business as Usual projections as "surprise-free," indicating that these scenarios conform to most people's current expectations of the future. However, our Business as Usual projection is full of unpleasant surprises. Major energy price increases seem inevitable, even under the Business as Usual scenario. Moreover, there is mounting evidence from both our analysis and others (CIA 1977, WAES 1977) that the Business as Usual path leads to a world oil shortage, perhaps just five years from now. The implementation of a strong National Energy Plan should be this country's most pressing order of business.

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REFERENCES

CIA 1977 — Central Intelligence Agency, The International Energy Situation: Outlook to 1985. No. ER77-10240 U (April, 1977).

Hubbert 1974 — M. K. Hubbert, U. S. Energy Resources: A Review as of 1972. U. S. Senate Committee on Interior and Insular Affairs, pursuant to S. Res. 45--A National Fuels and Energy Policy Study, Serial No. 93-40 (92-75) (1974).

Moody & Geiger 1975 — J. D. Moody and R. E. Geiger, "Petroleum Resources: How Much Oil and Where?", Technology Review, vol. 77, no. 5 (March/April, 1975).

NAS 1975 — National Academy of Sciences, Mineral Resources and the Environment. NAS, Washington, D.C. (1975).

NEP 1977 — Executive Office of the President, The National Energy Plan. U. S. Government Printing Office, Washington D.C. (April, 1977).

WAES 1977 — Workshop on Alternative Energy Strategies, Energy: Global Prospects 1985-2000. McGraw-Hill, New York (1977).

APPENDIX B:

INTRODUCTION TO THE FOSSIL1 MODEL

I. INTRODUCTION: THE ROLE OF SYSTEM DYNAMICS MODELS IN ENERGY POLICY ANALYSIS

The United States energy system is a complex and unwieldly social system, whose behavior is characterized by a number of perplexing properties: interia, interconnectedness, unforeseen side effects, and short-term verus long-term tradeoffs. Years may pass before a policy change alters behavior; such a change may produce ramifications in a part of the system far away from its expected area of effectiveness; some of these ramifications may be unpredictable and perhaps even undesirable; and a policy designed to improve long-term behavior may have unpopular short-term results.

These qualities are all characteristic of a class of systems called multiple-loop nonlinear feedback systems. All complicated social systems tend to be composed of interrelated "positive" and "negative" feedbacks, the positives tending to amplify changes or disturbances, the negatives tending to counter or control those disturbances. When several such loops interconnect, the consequences of any change become difficult to predict, especially as each loop takes its toll over different periods of time. For example, deregulation of natural gas prices might lead to a short-term increase in supply. However, domestic gas production might actually decrease more quickly over the long term with deregulation, as increased short-term production uses up the cheaper domestic resources, leaving lower resource levels for production over the long term.

System dynamics is a modeling technique developed specifically to analyze the behavior of such complex, nonlinear systems. The field integrates three distinct disciplines to analyze social systems: feedback control theory, organizational behavior, and computer simulation technology. The focus on the interrelationship between system stocks and flows (implying the existence of feedback loops) is drawn from feedback control theory. The idea that social systems -- systems involving human decision-making processes -- can be modeled with the same techniques as physical systems stems from the field of organizational behavior. Computer simulation techniques provide the means to analyze complex, nonlinear systems.

Thus system dynamics, the modeling technique used in FOSSIL1, was designed specifically to model systems like the United States energy system. From its inception in the study of industrial systems, system dynamics has grown to provide a framework for understanding the behavior of urban, world, economic, and energy systems whose elements interact through time to produce system changes. System dynamics has several specific advantages over other formal modeling techniques in analyzing the energy system.

1. Focuses on dynamic behavior. The FOSSIL1 model is a fully dynamic, disequilibrium model of the United States energy system. It does not assume that markets always clear or that they function in an optimal manner. Instead, the model portrays the actual decision rules governing the flow of investment, resources, and energy-consuming goods. The current energy problem is a manifestation of disequilibrium behavior--rapid resource depletion, rising energy prices, and a massive shift in investment toward alternative energy sources.

2. Displays a causal theory of behavior. The FOSSIL1 model generates behavior modes such as oil and gas production life cycles from the interaction of internal mechanisms. The model structure therefore represents a causal theory of the energy problem. This feature is critical if the model is to be used as an input to policy decisions. A causal model allows policymakers to better understand the genesis of the energy problem, and provides a milieu to experiment with policy changes designed to improve system behavior.

3. Incorporates system nonlinearities. The FOSSIL1 model incorporates a number of nonlinear relationships that are central to the United States energy transition problem. Nonlinear relationships are needed to show, for example, how energy production costs and prices rise as a result of resource depletion, or how consumers change their use of fuels as incomes rise or relative energy prices change. By incorporating a full range of nonlinear relationships, the FOSSIL1 model is able to explain how shifts in the behavior mode of the energy system may arise. For example, the model shows how behavior can shift from a period of rapid energy growth, low imports, and low prices, to a period of inflated energy prices, slower growth in demand, and chronically rising imports. By generating such behavioral shifts internally, the model should help to anticipate future problems and develop appropriate policy responses.

Does this mean that the FOSSIL1 model can effectively be used to analyze all the problems of the United States energy system? Definitely not. Because of the inherent limitations in any model's ability to capture both the structure and parameters of a complex socioeconomic system, the projections of FOSSIL1 must not be expected to produce exact quantitative predictions. The model was designed to investigate the dynamic behavior modes of the energy system over time. It provides a policy tool for identifying the direction and relative magnitude of

changes in system behavior induced by a change in energy policy.

The strength of such a model is that it becomes a learning tool by which the user can enlarge and clarify his own understanding of the energy system. He can observe exactly how his assumptions fit together, interact, and result in a complex long-term behavior pattern. As he observes how and why alternative assumptions change the system's behavior, he can begin to derive a deeper perception of the general principles by which the system is guided, and his role as an effective energy policy-maker can be greatly enhanced.

II. FOSSIL1 OVERVIEW

This chapter describes how the design and structure of FOSSIL1 work to approximate the behavior of the United States energy system. Because the system is characterized by complex supply and demand mechanisms, FOSSIL1 has been divided into two corresponding segments, a general demand sector and four supply sectors.

Energy Demand and Supply Sectors

The FOSSIL1 model projects energy demand, gross energy production, and net energy use for the United States. Figure B-1 illustrates the distinction between gross energy production and net energy use embodied in the model. Energy consumers (from the residential, commercial, transportation, and industrial sectors of the economy) demand a certain amount of energy each year as oil, gas, coal, or electricity. Producers attempt to meet this demand by extracting, refining, and converting adequate amounts of energy. Because the conversion of energy always incurs significant energy losses, gross energy production is always greater than net energy use. In 1975, for example, conversion losses amounted to 19 percent of gross energy production (USDI 1976, p.57). Conversion losses should increase in the future as the nation shifts to less efficient (but perhaps more readily available) energy forms such as electricity or synthetic fuels from coal.

In addition to the demand sector, the model contains four major energy supply sectors--oil, gas, electricity, and coal. These four sectors must produce enough of each energy product to satisfy demand. Figure B-2 illustrates the alternative sources of oil, gas, electricity, and coal represented in the FOSSIL1 model.

Energy Flows and Constraints in FOSSIL1

The flow of United States energy from primary resources to satisfaction of end-use demand represented in the FOSSIL1 model is illustrated in Figure B-3 (without overlay). From this perspective, the United States energy system extracts, refines, and converts primary energy into five delivered energy products: electricity, coal, oil, gas, and "decentralized" energy (representing solar-thermal heating of homes).

FIGURE B-1 ENERGY SUPPLY AND DEMAND IN FOSSIL1

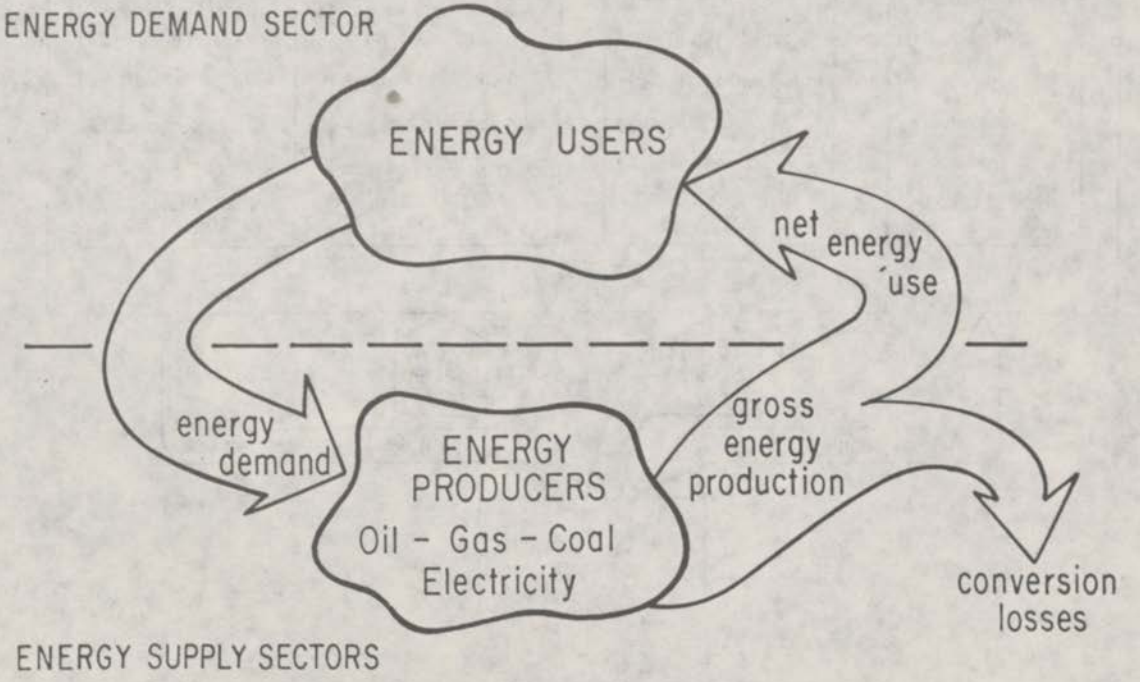
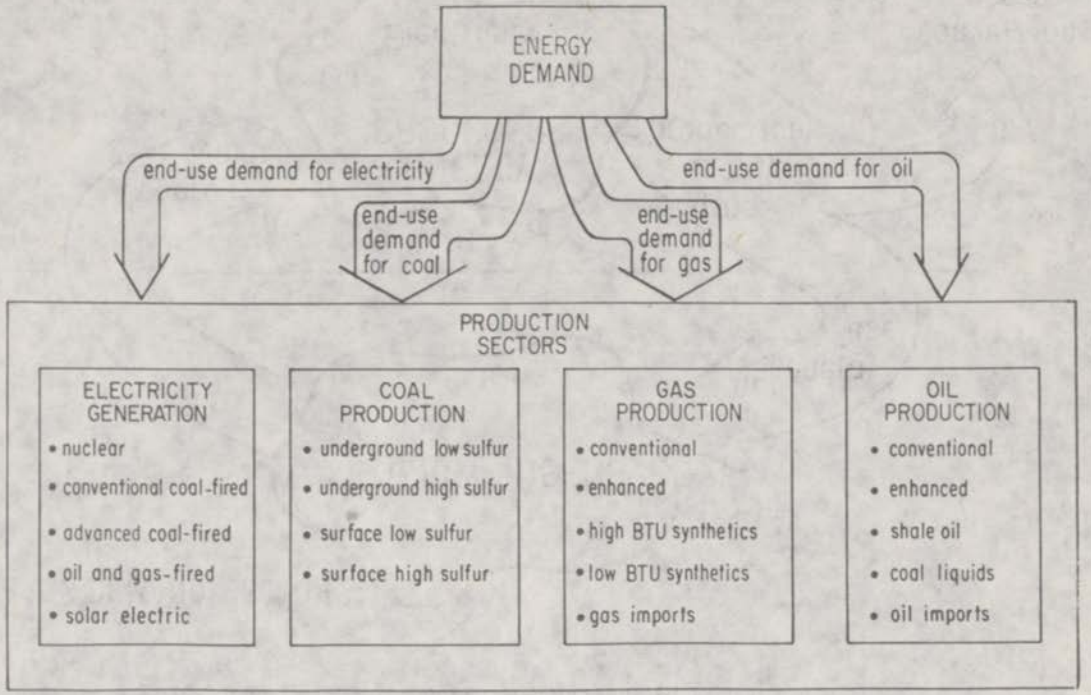


FIGURE B-2: SOURCES OF ENERGY SUPPLY IN FOSSIL1



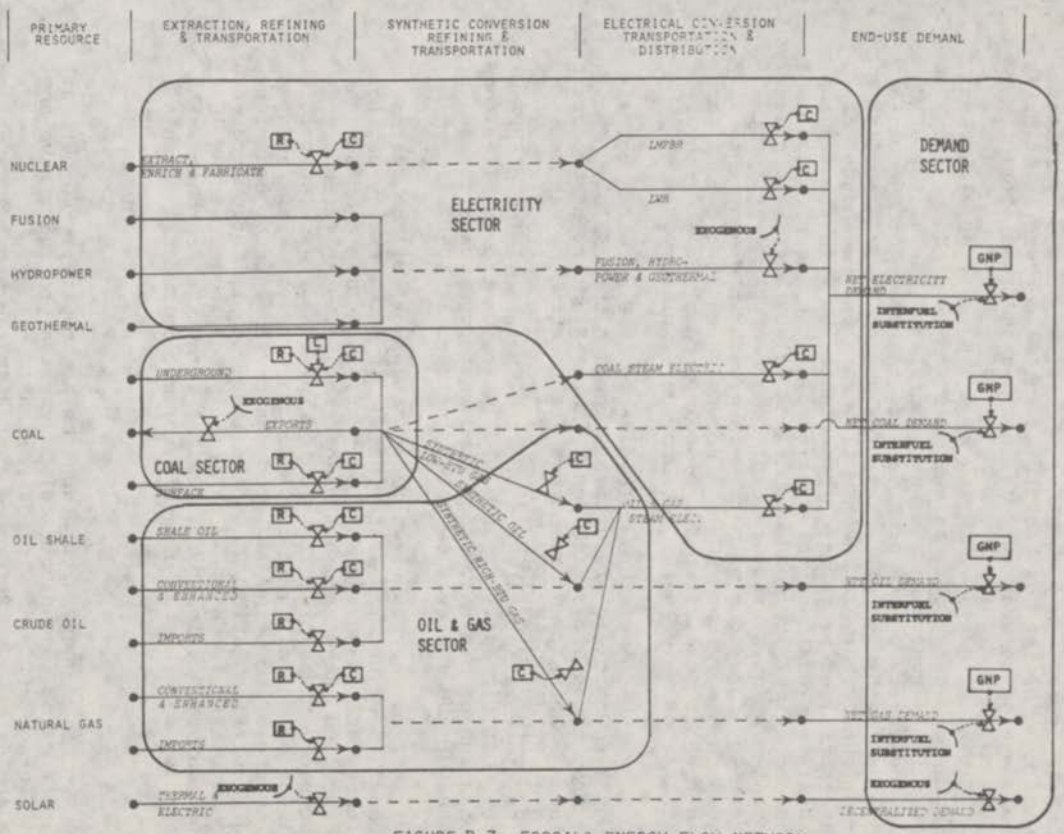


FIGURE B-3: FOSSIL ENERGY FLOW NETWORK

Energy is lost in each stage of refining and conversion, with most of the loss occurring in the conversion of primary energy to synthetic oil and gas and to electricity.*

The solid arrows in the energy network of Figure B-3 represent energy flow rates, measured in quads per year in FOSSIL1. (Equivalent to one quadrillion Btu's, the quad is the energy unit appropriate to the scale of the United States energy system.) The overlay for Figure B-3 (in red) shows that each energy flow rate can be thought of as controlled by a valve (represented by ⧖ in the diagram. FOSSIL1 is designed to explain how these flows change through time. The end-use demand valves have been steadily opening at an average rate of 3 percent per year for the past 25 years, due primarily to growth in energy-intensive goods and services (GNP). Increasing end-use demand for energy has necessitated a rise in production and conversion of primary energy resources over history.

Each of the energy flows shown in Figure B-3 corresponds to specific production processes in FOSSIL1. The energy flows are controlled by three "factors of production"--labor, capital, and resources (represented by the red boxes [L], [C], and [R]. These factors are called levels (or state variables), and are the basic building blocks of the FOSSIL1 model. Figure B-3 indicates the specific combination of capital, labor, and resources, that constrain each of the energy flow rates included in FOSSIL1.

It is easy to visualize a "snapshot" of the system shown in Figure B-3 at an instant in time: energy capital, labor, and resources are constant and define a steady energy flow rate through each of the valves.** In reality, however, the availability of energy resources, capital, and labor are changing in complex ways over time: oil and gas resources are being depleted, energy investment decisions are shifting rapidly, and the labor supply for underground coal mining is becoming an increasingly constraining input to coal production. The FOSSIL1 structure reproduces the complex interaction of geologic, economic, environmental,

* Synthetic conversion processes are typically 60 percent efficient, and electrical conversion processes have an average efficiency of 34 percent.

** The Brookhaven Reference Energy System provides such snapshots for selected years (Brookhaven 1974).

and technological factors that control the dynamics of energy labor, capital, and resources.

Ideally, domestic energy flows from primary resources should be sufficient to meet end-use demand; there should be little need for imports as an energy source. Yet due to oil and gas depletion and regulation of domestic oil and gas prices, domestic energy flows have fallen well behind demand over the past 25 years. Oil imports have consequently increased to 20 percent of United States energy consumption in 1975. A unified national energy policy is needed to bring the energy system back into balance.

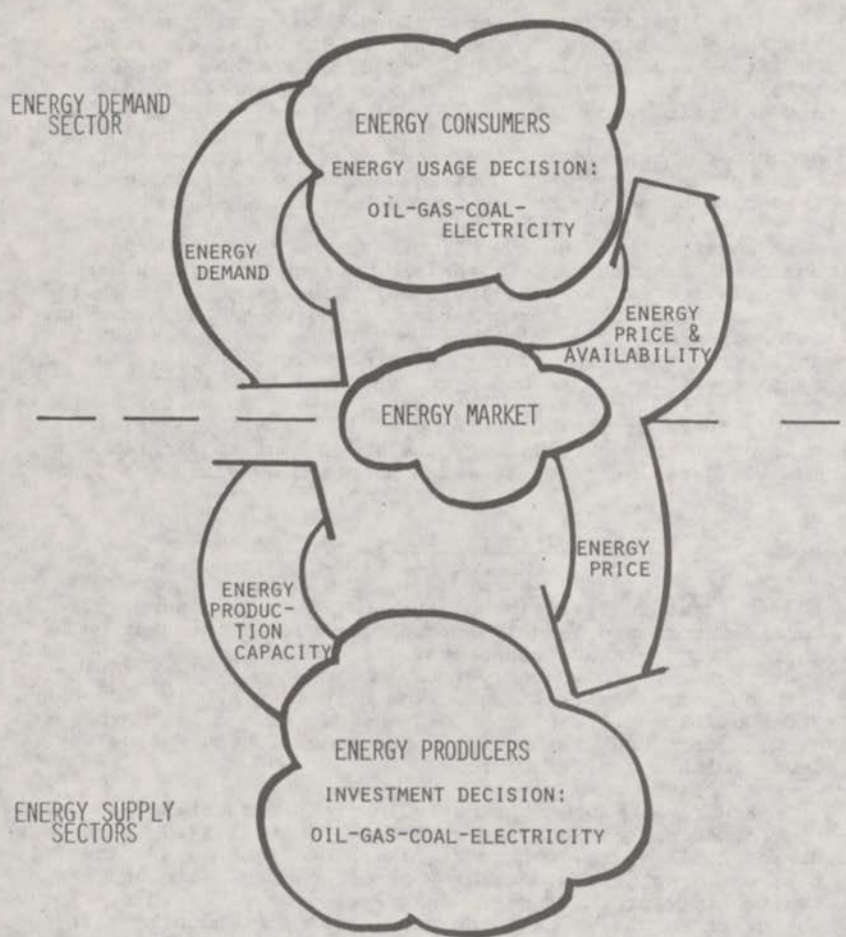
However, as Figure B-3 implies, the influence that policymakers command over the flow of energy through our energy system is at best indirect. Government energy policies (such as price deregulation, research and development, or environmental legislation) work to influence the availability of the three factors of production, but they must operate within the economic and physical decision-making structure that constrains the behavior of the United States energy system. The FOSSIL1 model simulates this decision-making environment, allowing the model user to alter the model's decision rules to match proposed government policies.

Dynamic Mechanisms of Energy Supply and Demand

The future direction of the United States energy system is determined largely through the market interaction of energy producers and consumers. If deemed necessary, government energy policies can perturb the system by interfering with the normal market mechanisms of energy supply and demand. The FOSSIL1 model captures both the decision-making processes of producers and consumers and the major government policy levers within its structure.

Figure B-4 shows the basic interactions between energy producers and consumers included in FOSSIL1. In the demand half, energy consumers make a decision to utilize oil, gas, coal, or electricity based on both price and availability of the fuels. Energy producers, in turn, choose to invest in the product that maximizes the industry rate of return (or minimizes the average cost of production), subject to environmental constraints (SO_2 restrictions or water availability) or market limitations (low-Btu gas can satisfy only a fraction of final gas demand because it is unecomonic to transport long distances through existing pipelines).

FIGURE B-4: BASIC MARKET-CLEARING MECHANISMS IN FOSSIL1



Both end-use consumption decisions and producers' investment decisions accumulate through time to determine the net demand and production capacity for each fuel. If an imbalance develops between demand and capacity, then energy prices adjust through market forces to restore the balance (in the absence of price regulation).

Figure B-5 illustrates the basic dynamic mechanism of the energy transition problem--the depletion of oil and gas. As conventional resources are depleted, both the costs and the prices of oil and gas rise. On the demand side, price increases encourage consumers to conserve energy and shift away from oil and gas toward coal and electricity. On the supply side, rising conventional production costs stimulate domestic oil and gas producers to develop alternative sources of oil and gas.

Although energy price variations tend to balance energy supply and demand over time, several dynamic features of the energy system make the current energy imbalance unusually difficult to resolve:

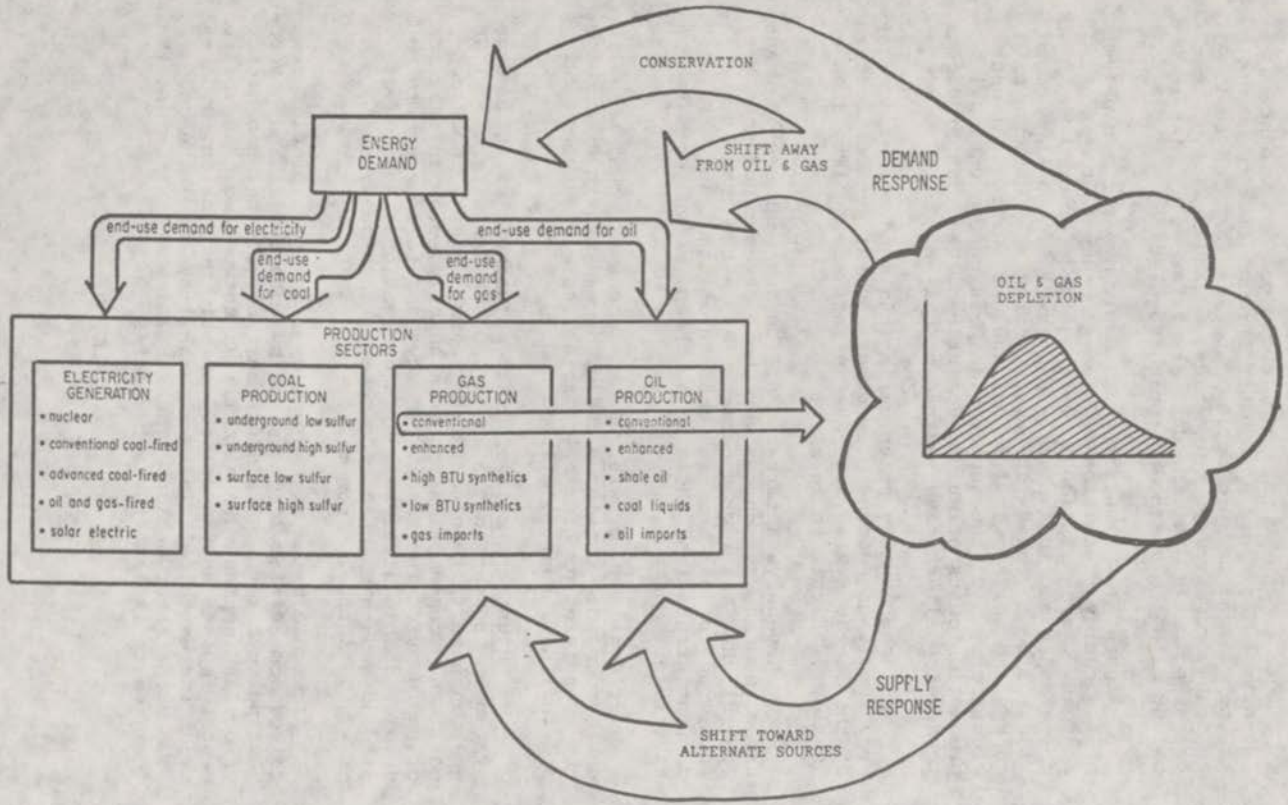
1. Expensive alternatives. During past energy transitions, new energy sources were both cheaper and more convenient than their predecessors (as in the transitions from wood to coal and from coal to oil and gas). In the current transition, there is no cheap, convenient alternative to oil and gas.

2. Continued growth. As the economy grows, so will energy demand. Continued energy demand growth exacerbates the transition problem by creating increasing needs for a dwindling resource: oil and gas.

3. Adjustment delays. Full adjustment of the energy system to changes in the price and availability of oil and gas can take fifteen to thirty years. Energy users cannot change consumption patterns quickly, even in the face of rapid price increases. Energy producers need time to develop viable alternatives to conventional sources of oil and gas--new enhanced recovery techniques, shale oil, or synthetic fuels from coal.

The resolution of the energy transition problem requires some difficult decisions by both public and government policymakers. Tradeoffs must be made between higher prices and decreased availability, between adverse environmental impacts and increased domestic production, and between increased political vulnerability and increased government intervention. The FOSSIL1 model structure is designed to isolate these tradeoffs.

FIGURE B-5: BASIC MECHANISMS OF THE ENERGY TRANSITION



III. ENERGY DEMAND

The FOSSIL1 demand sector forecasts the response of energy demand (specified by fuel type) to change in GNP, energy prices, fuel availability, and fuel convenience. Figure B-6 illustrates the two central mechanisms at work in the demand sector of the model.

Size of Demand

Total energy demand (the size of the pie in Figure B-6), is determined by GNP and the average price of energy. Energy demand grows with increasing GNP, but at a less than proportional rate. Thus the energy /GNP ratio declines with increasing GNP as output shifts to services and light industrial goods, which are less energy-intensive than heavy industrial production. Energy price increases can also induce further energy savings, as consumers shift to more energy-efficient end-use devices (for example, higher-mileage cars, or improved insulation). Because of the long lead time required to replace end-use capital with new, more energy-efficient goods, the full effects of price-induced energy conservation are not felt for an average of fifteen years.

Energy demand is projected to grow significantly slower than GNP in the FOSSIL1 model, due primarily to rapid energy price increases. Figure B-7 illustrates that although GNP increases at an average rate of 3.2 percent per year from 1975 to 2000, net energy demand grows at only 1.8 percent per year in the FOSSIL1 Business-as-Usual (BAU) projection, and 0.9 percent per year with the Accelerated Coal and Conservation (ACC) policies.

Market Share of Demand

The demand market shares for each fuel (oil, gas, electricity, and coal) in FOSSIL1 change over time in response to changes in their prices, their availability, and their convenience. The causal determinants of energy demand are indicated in Figure B-8. The arrows of the figure trace out a simplified picture of the feedback structure through which the price, availability, and convenience of each fuel affect that fuel's market share. Changes in fuel

FIGURE B-6: DYNAMIC MECHANISMS THAT CHANGE ENERGY DEMAND IN FOSSIL1

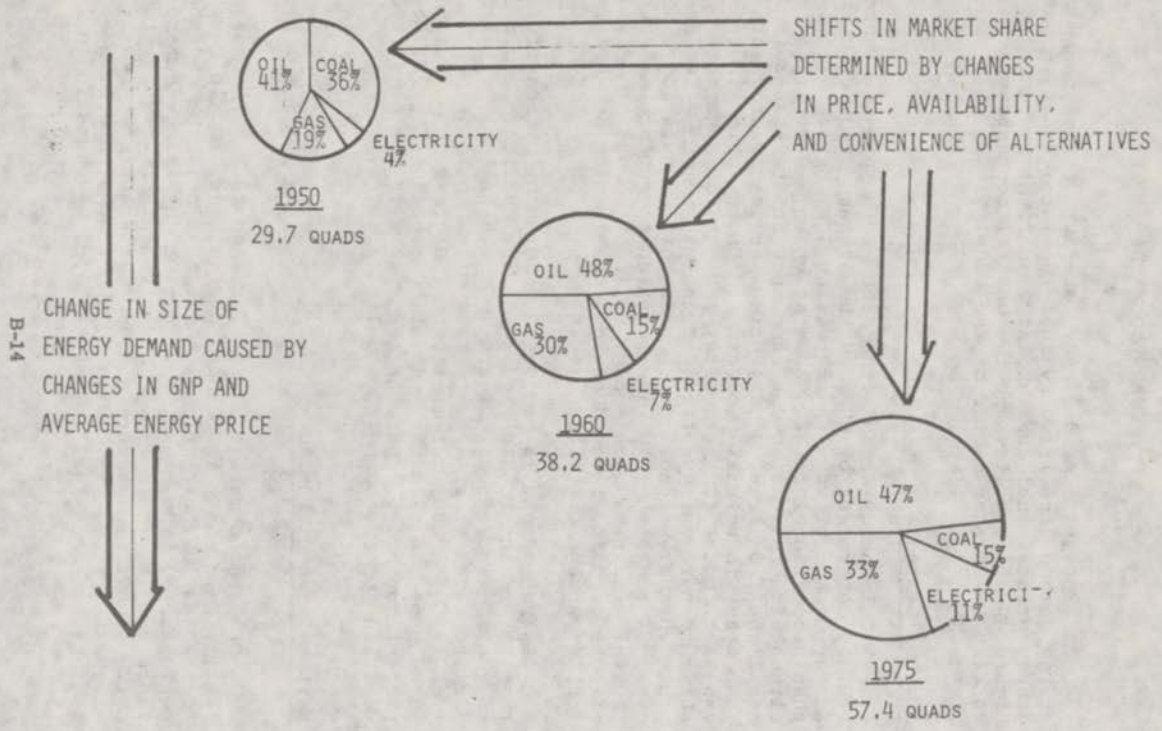
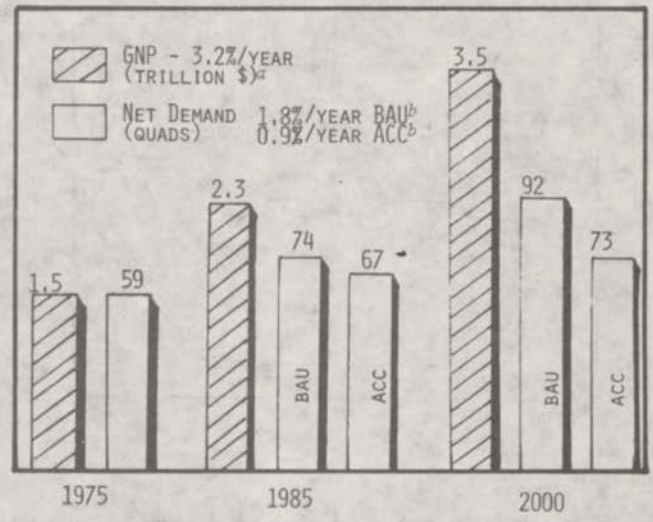


FIGURE B-7: COMPARISON OF GNP AND DEMAND GROWTH IN FOSSIL1



a 1975 dollars
b BAU (Business as Usual) and ACC (Accelerated Coal and Conservation) are two FOSSIL1 scenarios described in Chapter 4 of this report.

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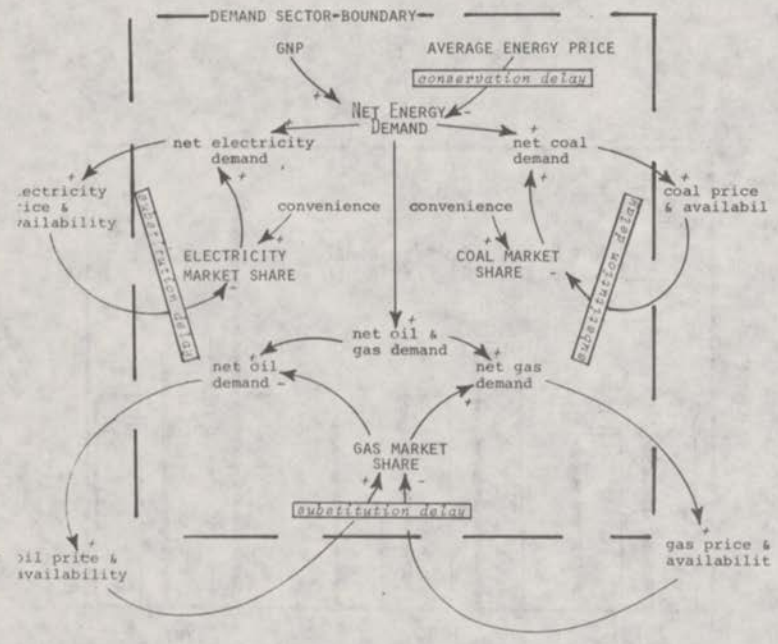
FIGURE B-8: FOSSIL1 DEMAND SECTOR CAUSAL DIAGRAM



The diagrammatic conventions used in such causal loop diagrams are as follows:

An arrow indicates the causal influence of one element on another.

A plus sign indicates the influence is direct -- as the element at the tail of the arrow increases, the element at the head of the arrow also increases (or as the first decreases, the second also decreases).

A minus sign indicates an inverse relationship -- as the first element increases, the second decreases, and vice versa.

market share affect the size of the slices of the demand pie in Figure B-6.

Changes in fuel prices (and fuel availability) can shift market shares significantly in FOSSIL1. Given extreme economic incentives, it is possible within the model structure to capture as much as 70 percent of the end-use market (compared to its 1975 share of 11 percent) and coal to increase its share to 25 percent (compared to its 1975 share of 8 percent). As in the determination of the size of energy demand, the full effects of a price change on demand market shares are not felt for fifteen years, due to the time required to replace user capital equipment.

Fuel convenience has had an important historical impact on consumer demand for energy. Although coal has remained inexpensive relative to its fuel competitors, its market share has declined from 35 percent of net demand in 1950 to only 8 percent in 1975. Coal is dirty, difficult to transport, environmentally damaging, and plainly undesirable for most end uses. The historical shift away from direct coal use is explained almost entirely by its growing inconvenience. Conversely, electricity's market share has grown significantly over history, due in part to its declining relative price and its relative convenience as a fuel form. Convenience is modeled in FOSSIL1 as an income effect: as consumers become wealthier, they shift away from inconvenient fuels (coal) and toward more convenient fuels (electricity).

Figure B-9 shows the changes in demand market shares projected by FOSSIL1. Oil and gas decrease their market share from over 80 percent in 1975 to near 60 percent in 2000. Gas's market share decreases particularly rapidly (from 33 percent to 20 percent in the BAU projection) because of the worsening shortage. Coal and electricity each increase their share of net demand, with electricity yielding the biggest gains (growing to 24 percent in 2000).

Intermediate Sector Demands

In addition to the fuel-specific net demands for energy generated by the demand sector, a number of intermediate energy demands are generated by the four energy supply sectors in FOSSIL1. These demands represent the feedstock input needs of energy conversion facilities (electric utilities and synthetic coal conversion plants).

FIGURE B-9: FOSSIL1 DEMAND MARKET SHARE PROJECTIONS

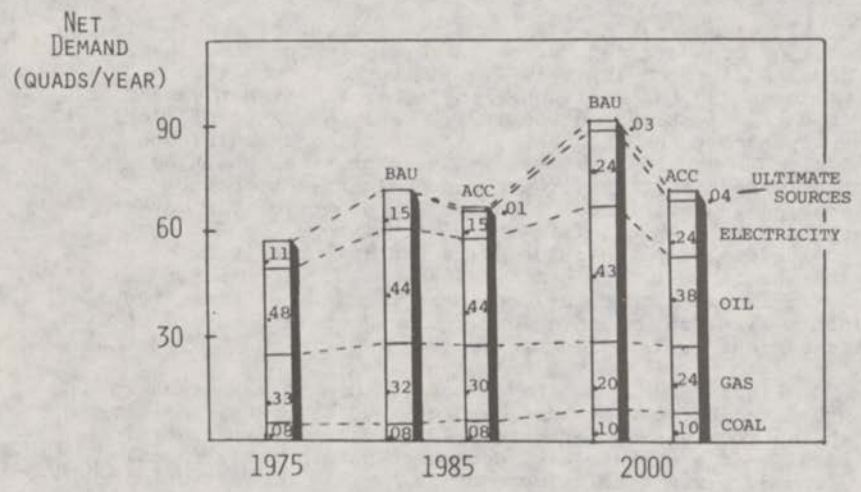
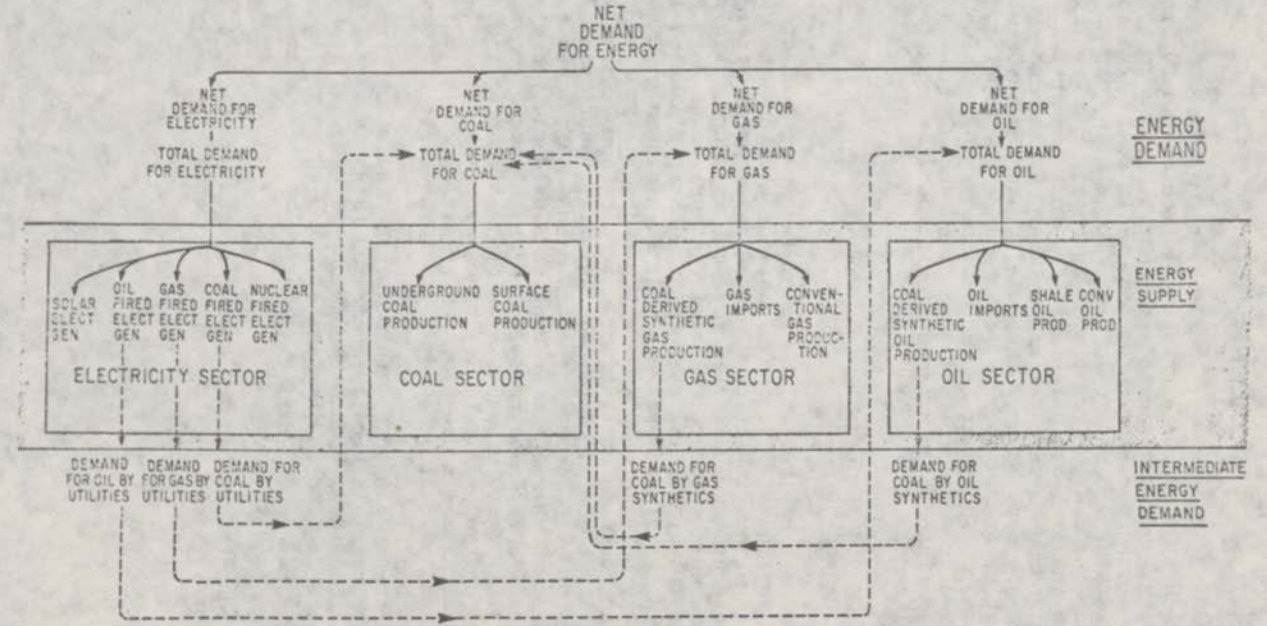


Figure B-10 illustrates the intermediate sector demands generated in FOSSIL1. Fuel-specific intermediate demands add to end-use demands to determine the total demand for each energy form. Intermediate energy demands can be substantial: coal demanded by electric utilities, for example, was almost 60 percent of total coal demand in 1975 (USDI 1976, p.57). The total (net plus intermediate) demand for each fuel must be met from alternative fuel supply sources.

FIGURE B-10: INTERMEDIATE SECTOR DEMANDS IN FOSSIL1



NOTE: NET SECTOR DEMAND + INTERMEDIATE SECTOR DEMAND = TOTAL SECTOR DEMAND

IV. ENERGY SUPPLY

Each of the four energy supply sectors in FOSSIL1 represents an aggregate industry whose purpose is to satisfy the demand for one of the four basic fuels used in the United States economy (oil, gas, electricity, and coal). Although the energy products of and government restrictions on each industry are different, the four industries share certain common structural properties. Each industry must finance new capital investment, allocate the investment to alternative energy sources, and convert the capital, labor, and resource inputs it has accumulated into a finished energy product. The following sections describe the generic industry financing and production structures used in the FOSSIL1 model.

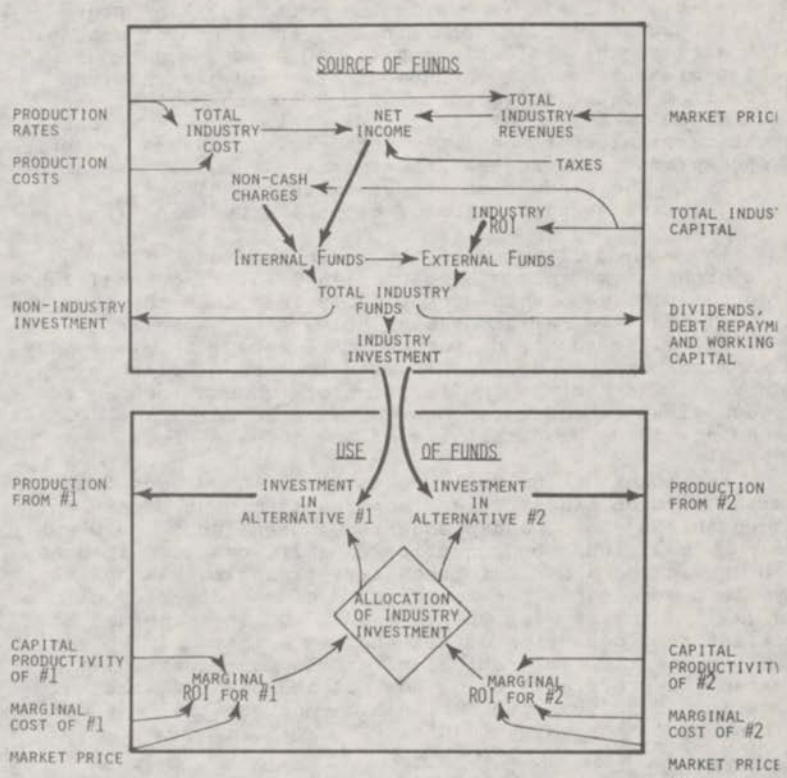
Energy Financing

Because capital is the major factor of production in the energy industries, the financing decision--the generation and allocation of new funds--is the major determinant of future production levels for each industry. Figure B-11 illustrates the general financing structure used in each of the FOSSIL1 production sectors. Industry financing is divided in the diagram between sources and uses of funds.* Funds may be generated from either internal sources (net income and non-cash charges) or external sources (debt and equity) in FOSSIL1. Internal funds represent funds from operations--net income (revenues minus costs minus taxes) and non-cash charges (depreciation plus depletion plus amortization expenses). Both are calculated endogenously in FOSSIL1. Net income is a volatile stream of funds that depends on the profitability of current operations. Non-cash charges are a steadier source of funds, typically calculated as a fixed percentage of the capital stock.

External financing (through debt and stock issues) can supplement internally-generated funds in times of increased financial need. The amount of external financing available is tied to the financial health of the industry, measured by the average industry return on investment (ROI)

*Excellent references for energy financing concepts and data are Hass, Mitchell, and Stone 1974, and Chase 1974.

FIGURE B-11: FOSSIL1 FINANCING STRUCTURE



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in FOSSIL1. If the industry has a history of high rates of return, the debt capacity of the industry is expanded.

The use of funds (shown in the bottom half of Figure B-11) in each sector is determined by an allocator mechanism which divides the available capital between the various production alternatives. (The number of these alternatives varies from sector to sector.) The allocator weighs the marginal ROI's for each alternative, shifting investment as the marginal cost, capital productivity, and market price of each production process affect that alternative's marginal ROI. The production process with the highest ROI gets the greatest proportion of capital investment funds.

Figure B-12 illustrates the source and use of funds for a group of petroleum companies in 1974. The total funds invested in fixed assets are normally less than the sum of internal and external funds available, since some funds are typically allocated to dividends, debt repayment, increases in working capital, or are diverted to more profitable non-industry investments. The fraction of funds allocated to fixed capital expenditures can vary in the FOSSIL1 model, depending on the profitability of new investments.

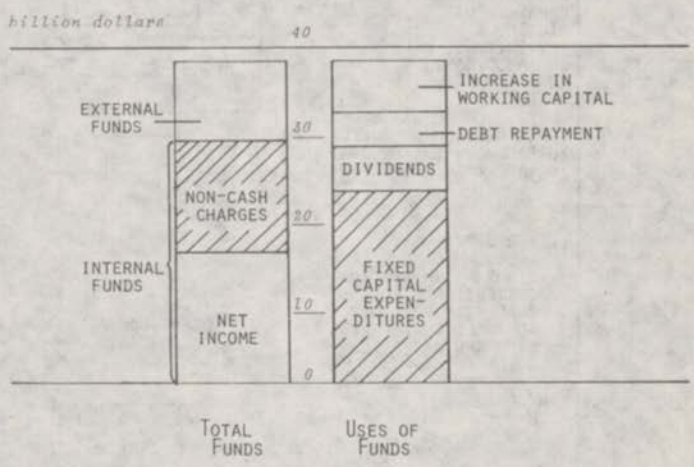
The amount of internal and external investment funds available to an industry is a major determinant of its future ability to expand production. When funds are plentiful, new additions to production capacity can keep in step with growing demand. Unfortunately, financing has not always been sufficient, as in the case of the domestic oil and gas industries over the last decade. The combined effects of the regulation of oil and gas prices and the rapid rise in domestic exploration and development costs have decreased the profitability of new oil and gas investment. Domestic oil and gas production has consequently been declining since the early 1970's.

Energy Production Functions

The production capabilities of each of the energy supply options is determined by a dynamic production function in FOSSIL1. The production functions relate some or all of three factors of production--capital, labor, and resources--to the production capacity of each specific fuel type. Figure B-13 illustrates the variety of production functions included in the FOSSIL1 model. The production functions can be categorized into two types: primary energy production and energy conversion.

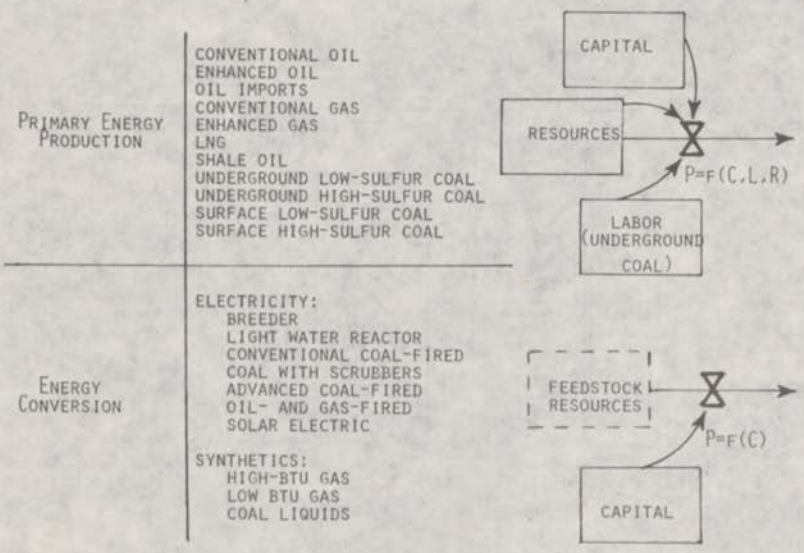
FIGURE B-12: SOURCE AND USE

OF PETROLEUM INDUSTRY FUNDS IN 1974



Source: Chase 1974, p. 16.

FIGURE B-13: FOSSIL1 PRODUCTION FUNCTIONS



The production of primary energy assumes that energy is extracted from a finite and ultimately depletable resource base; this implies that energy production is resource-limited over the long term. Production capacity, for extraction processes, is therefore a function of resources, physical capital, and, in the case of underground coal, labor availability. In the case of energy conversion technologies, the energy feedstock is produced in another fuel sector of the model (outside of its immediate boundary). Production capacity of a conversion technology is therefore limited by the availability of physical capital (and only indirectly by resources through feedstock availability).

Because of its central importance to the energy transition problem, the dynamics of energy production are modeled in some detail in FOSSIL1. As an example, Figure B-14 illustrates the conventional oil production structure. To model the depletion of oil, FOSSIL1 makes the distinction between undiscovered resources and proven reserves.* Oil resources represent the total inventory of geologic deposits, and can only decrease through time. Reserves, however, may either increase or decrease over time, depending on the relative rates of discovery (including new additions, extensions, and revisions) and production. The level of reserves determines the maximum production capacity of conventional oil in FOSSIL1, for reserves cannot be drained below a minimum reserve/production ratio (typically eight to ten years), due to the limitations of current oil recovery technologies and reservoir characteristics (NPC 1972, p.67). The future behavior of reserves (and thus conventional oil production capacity) will be determined primarily by the rate of discovery of new oil reserves.

Oil discoveries are dependent on two factors in FOSSIL1: capital investments in new drilling activity and resource depletion. These factors tend to move discoveries in opposite directions: capital accumulation tends to increase discoveries, while resource depletion tends to decrease discoveries through a decline in capital productivity (measured by annual production in quads per dollar of fixed capital investment). Capital productivity declines over time through a decrease in returns to drilling (measured in discoveries per foot drilled). Figure B-15 illustrates the dramatic drop in returns to drilling for the United States oil industry. Discoveries per foot are projected to decrease further in the future as oil resources are depleted to their minimum recoverable levels.

*Resources are supplies which are hypothesized to exist, but which have not been proven to exist through exploratory drilling. Reserves have been demonstrated to exist through the drilling and capping of wells. Unlike oil and gas, resources and reserves are aggregated into one stock for coal and uranium, since the major cost of production for the latter fuels is incurred in extraction, not exploration and development.

FIGURE B-14: CONVENTIONAL OIL PRODUCTION STRUCTURE

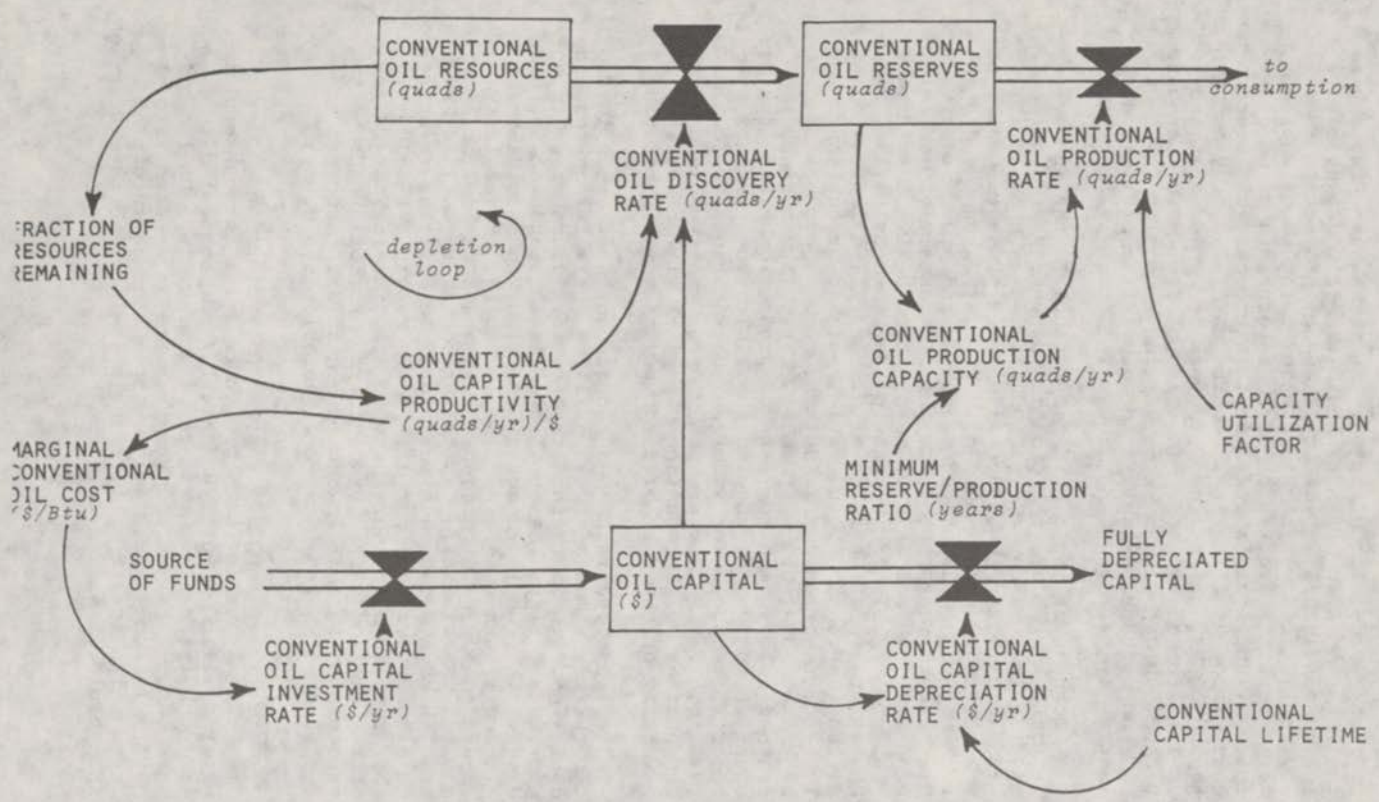
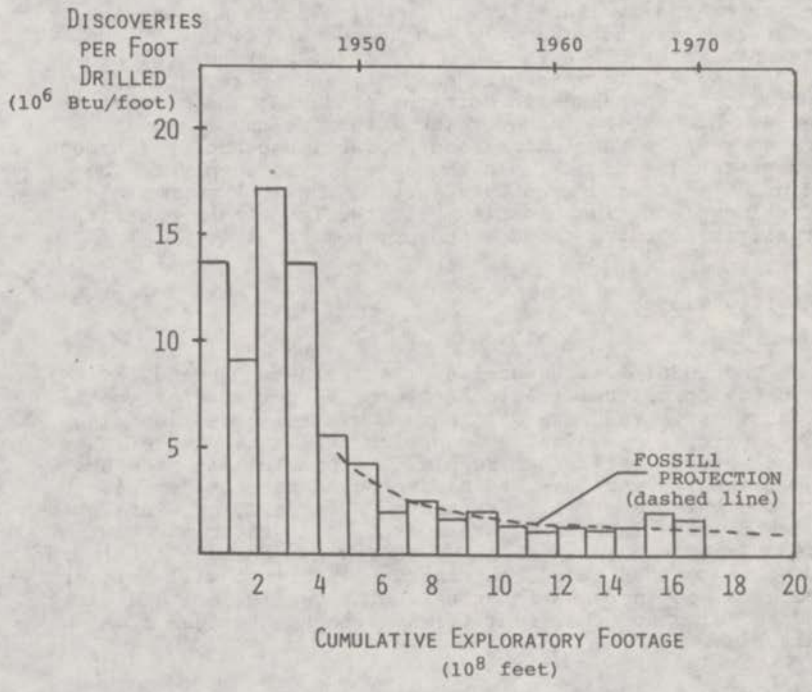


FIGURE B-15: RETURNS TO DRILLING
FOR THE U.S. PETROLEUM INDUSTRY



Source: Hubbert 1972, p. 20.

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V. SUPPLY/DEMAND MECHANISMS

Figure B-16 shows how the supply/demand balancing structure included in FOSSIL1 determines the quantity produced and the price of each fuel. The structure shown in Figure B-16 is a dynamic counterpart to the static microeconomic supply/demand analysis. (See, for example, Samuelson 1970, p.357.)

In the FOSSIL1 model, adjustments in supply and demand happen continuously in response to changes in both the price and availability of fuels. Yet at any one instant in time, total supply and demand are fixed. These elements interact in the supply/demand "marketplace" shown in Figure B-16 to determine quantity and price. This information then passes to both the producing and consuming sectors of FOSSIL1 to determine future demand (through consumer choice decisions) and production capacity (through investment decisions). In the short term, supply can be adjusted to meet demand by adjusting the utilization of existing production capacity. In the long term, capacity itself is adjusted through the price mechanism.

Quantity Produced

The FOSSIL1 structure assumes that when demand is at or below normal utilization factors (80 percent for most industries), producers will absorb minor fluctuations in demand simply by adjusting capacity utilization. Yet when demand grows faster than supply, the possibility of a shortage exists. Producers are hard-pressed to meet demand, and operating costs rise rapidly. Eventually a point is reached where facilities are operating at their maximum output, above which a capacity shortage occurs. If this point is reached, the resulting fuel shortage will trigger the model to increase imports (in the case of oil and gas) and to shift to other fuel forms through interfuel substitution.

Price

The FOSSIL1 structure calculates price as the direct sum of costs and profits (Figures B-16 and B-17.) Costs

FIGURE B-16: SUPPLY/DEMAND MECHANISM IN FOSSIL

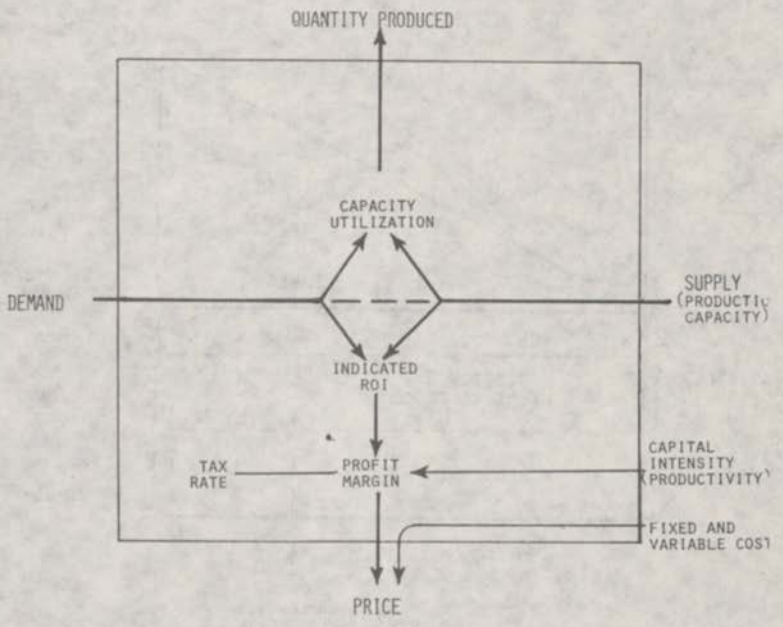

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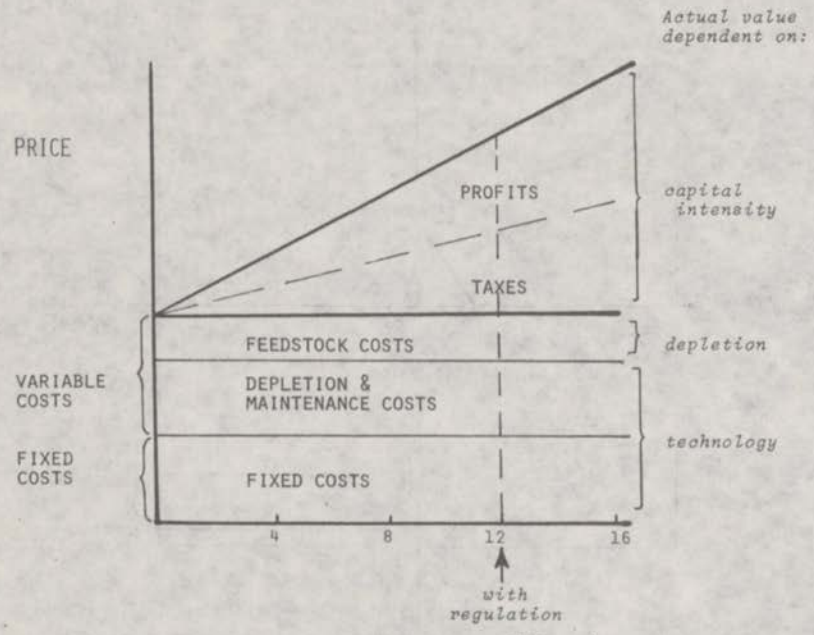
FIGURE B-17: COSTS AND PRICES IN FOSSIL1



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may be fixed or may vary as a function of both technology and the extent of depletion. Profits may be regulated (as in the oil, gas, and electric utility industries) or unregulated. The regulated profit margin is set to allow a particular maximum return on investment (ROI), based on statutory guidelines. Unregulated profit margins fluctuate in response to changing supply/demand market forces. When supply and demand are balanced, prices are set in the model to return a normal, industry-average ROI (eight to twelve percent annually, depending on the industry).

Imbalances in supply and demand can have a major impact on price. As shown in Figure B-17, these imbalances can cause the ROI to range along the horizontal scale, producing potentially wide variations in price. The capital intensity of the supply technology is also important, for prices can vary by as much as a factor of two among capital-intensive technologies (such as synthetic fuels). Taxes, which increase along with profits, add to the costs which are passed on to consumers. These three factors--supply/demand imbalance (which affects unregulated ROI), capital intensity, and taxes--interact dynamically to determine the price of each industry fuel in FOSSIL1.

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VI. FOSSIL1 PARAMETERS

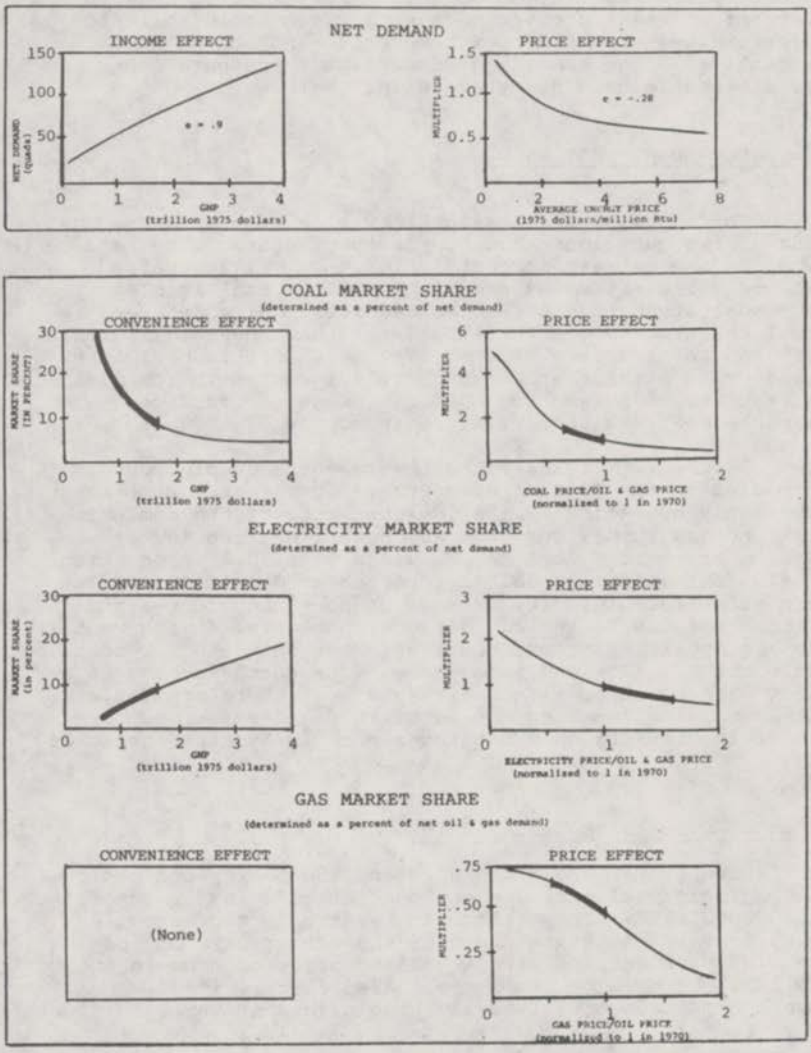
The United States energy system works within certain constraints or parameters, which have been identified and approximated in FOSSIL1. These parameters are mathematical estimates of key factors in the production and demand processes, a sample of which have been selected to demonstrate the assumptions made in the FOSSIL1 model.

Energy Demand Elasticities

The responsiveness of energy demand to changes in consumer income or fuel price is often measured by a number representing its elasticity. (For a general discussion of elasticity, see Samuelson 1970, pp.359-64.) Figures B-18a and b illustrate the various energy demand elasticities assumed in FOSSIL1. The top set of elasticities indicates the long-term responsiveness of total demand to changes in income and energy price; the numbers .9 (income) and -.28 (price) measure the percentage change in final demand caused by a 1 percent change in income and price. For example, a price elasticity of -.28 implies that a 100 percent increase in energy prices would decrease energy demand by 28 percent (if all other variables remained constant).

Figure B-18b shows that the market share of coal, electricity, gas, and oil are determined in the model by (1) a "convenience" effect (a GNP-induced shift in fuel choice) and (2) relative changes in energy prices. In FOSSIL1, the convenience of using oil and gas as fuels is chosen as a reference point. Electricity is assumed to be more convenient than oil and gas, and coal less convenient. As incomes rise, consumers shift to the more convenient fuel. Hence on the left-hand "convenience" side, Figure B-18b shows that as GNP increases, the market share of coal drops and the market share of electricity rises. (There is no convenience effect for gas, for oil and gas are assumed equally convenient). On the right-hand "price" side, price increases in coal and electricity (again, relative to oil and gas) lead to decreases in their market shares. The gas price effect is shown relative to oil price.

FIGURE B-18: FOSSIL1 ENERGY DEMAND ELASTICITIES



Sources: Net demand elasticities are derived from historical regression, and MIT, Cornell, and FEA estimates. Historical data regions for market shares are shown as heavy lines. Market saturation points (extreme values of market share labled are derived from engineering estimates; 70% maximum for electricity; 25% maximum

Each of the market-share elasticities is nonlinear, due to market saturation effects. For example, only 70 percent of the economy's end-use devices could shift to electricity, even under extreme price and convenience incentives. The remaining 30 percent represents non-substitutable uses of other fuels.

Resource Supply Estimates

To determine the availability of a resource, one must answer two questions: how big is the resource base, and what is the extraction cost? Figure B-19 illustrates the resource estimates used in FOSSIL1. Coal is clearly our most abundant depletable resource. United States coal resources are actually greater than the total foreign oil and gas resource stocks. Yet much of this coal is expensive to extract and high in sulfur content. The most attractive coal resource option--low-sulfur surface-minable coal--is quite limited in supply.

Figure B-20 illustrates the resource supply curves embodied in the FOSSIL1 structure.* Our energy system is currently operating on the low-cost ends of the domestic oil and gas supply curves. As costs rise, the energy system tries to "jump" to resources with lower production costs (for example, coal or imported crude) if the fuels are substitutable. Yet because of non-economic restrictions (end-use technology designs, potential environmental damage, political considerations), the shift to low-cost resources is slow and incomplete. The energy system is left with no cheap alternative and must therefore deplete the remaining, more expensive oil and gas resources, or shift to high-priced substitutes such as syncrude or shale oil.

Cost of Conversion Technologies

Figure B-21 shows the costs of the energy conversion technologies (electricity and synthetic fuels) encorporated into FOSSIL1. Perhaps the most remarkable fact about energy conversion is its expense--the electricity options (excluding solar) require a selling price of nine to twelve dollars per million Btu's (delivered electricity). The synthetic fuels are similarly high-priced at three to five

*The model structure actually includes a functional relationship between resources remaining and capital productivity.

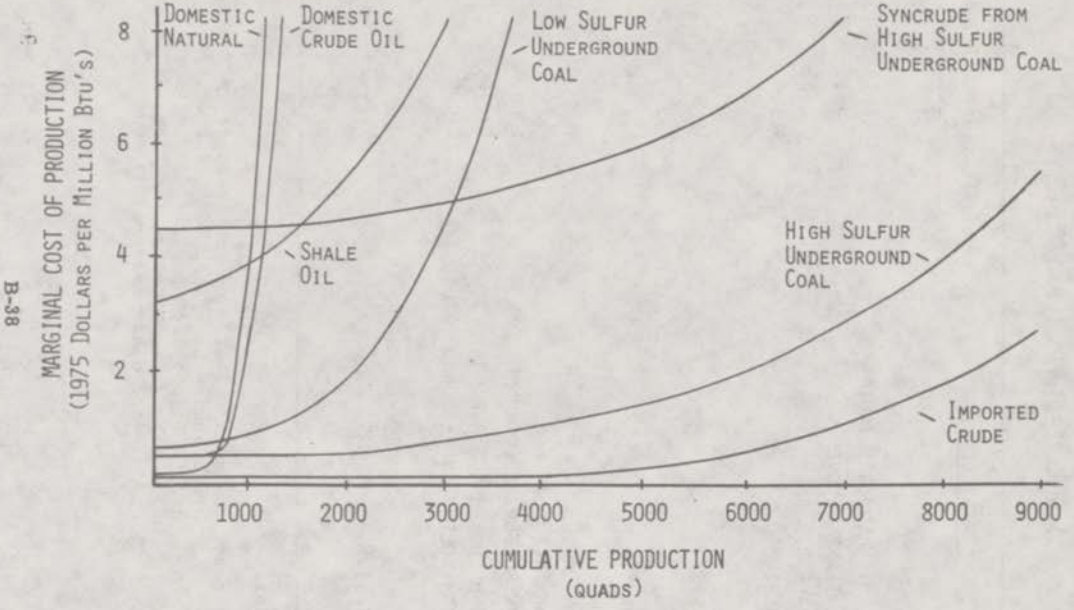
FIGURE B-19: FOSSIL1 RESOURCE ESTIMATES

RESOURCE CATEGORY	RECOVERABLE RESOURCES AS OF 1975 (quads)
OIL (INCLUDING LIQUIDS)	800
TERTIARY RECOVERY	394
SHALE OIL	5,800
FOREIGN OIL	9,500
GAS	775
ENHANCED GAS	250
FOREIGN GAS	5,200
LOW-SULFUR SURFACE COAL	800
LOW-SULFUR UNDERGROUND COAL	4,000
HIGH-SULFUR SURFACE COAL	1,600
HIGH-SULFUR UNDERGROUND COAL	11,000
URANIUM *($30/lb U_3O_8)*	1,800[a]

[a] *Assumes 33% conversion efficiency*

Sources: Conventional oil and gas resource estimates are a consensus of NAS 1975, Hubbert 1974, and USGS 1975 (95% probability) estimates. Coal resource estimates from USBM 1971 and USGS 1973. Other resource estimates from ERDA 77-1.

FIGURE B-20: REPRESENTATIVE SET OF RESOURCE SUPPLY CURVES EMBODIED IN FOSSIL1



Source: Oil and gas supply curves are derived from returns to drilling data in Hubbert 1974. Shale oil supply curves from FEA Oil Shale 1974. Coal supply curves are derived from U.S. Bureau of Mines Circulars 8535 and 8531, USBM 1974, and Zimmerman 1975.

FIGURE B-21: COSTS OF CONVERSION TECHNOLOGIES

ELECTRICITY

FACILITY	CAPITAL COST ($/kw)*	IMPLIED ELECTRICITY SELLING PRICE ($/million Btu's)
OIL AND GAS	290	10.60
STANDARD COAL	355	10.30
COAL WITH SCRUBBERS	445	10.70
FLUIDIZED-BED COAL	400	9.50
LWR	585	11.20
BREEDER	690	11.10
SOLAR	1275	50.00

*1975 dollars

SYNTHETIC FUELS

	PLANT COST[a] (millions)[b]		IMPLIED SELLING PRICE ($/million Btu's)	
	1st generation technologies[c]	2nd generation technologies[d]	1st gen.	2nd gen.
SHALE OIL	970	500	3.25	2.00
COAL LIQUIDS	1000	900	4.55	4.25
LOW-BTU GAS	750	600	3.75	3.20
HIGH-BTU GAS	1000	900	4.80	4.30

[a] 10^9 Btu/day rated output
[b] 1975 dollars
[c] available today
[d] advanced processed under development

Selling prices of electricity based on utility pricing (12%/year allowed ROI). Selling prices of synfuels based on 15%/year ROI (Discounted Cash Flow pricing method). All feedstock prices are variable in FOSSIL1. The following prices were assumed as representative: oil and gas - $1.50/million Btu's; coal - $.75/million Btu's; low-sulfur coal - $1.00/million Btu's; uranium fuel - $.80/million Btu's.

Source: ERDA 77-1

dollars per million Btu's for the average consumer. From this perspective, even the second-generation synthetic conversion technologies, with their increased efficiencies and reduced capital costs, are an expensive option.

Delays

The FOSSIL1 model includes a number of structures that introduce delays in the response of the energy system to outside influences. As shown in Figure B-22 the demand sector requires a full fifteen years to turn over its capital (in order to move toward more efficient end-use technologies) in response to an energy price increase. External financing of new investment tends to respond to a five-year history of a firm's financial health. The planning and construction of new energy supply facilities requires three to ten years. Once constructed, facilities are not normally replaced until fully depreciated--and energy capital lifetimes are up to 35 years in length. These delays combine to create the considerable inertia exhibited by the energy system, making it difficult for policymakers to alter the course of our energy future.

Financial Ratios

Although the basic structures of the four financial subsectors of FOSSIL1 are similar, each has been parameterized with financial ratios characteristic of the individual industry (Figure B-23). The aggregate energy industry has been fairly typical of total business, financing about 40 percent of its new investment externally over its history (see Hass, Mitchell, and Stone 1974, p.108). Electric utilities provide the exception: they tend to operate with lower profits, yet have financed over 60 percent of their new investment from outside sources.

Many of the financial ratios reported in Figure B-23 actually change in the FOSSIL1 model with the financial health of each industry. For example, Figure B-23 illustrates only the target return on investments for each industry--the actual ROI depends on the dynamics of production costs, supply/demand balances, and any regulatory procedures that may be enforced. External financing (determined by the external/internal financing ratio) is also a variable in FOSSIL1. As the industry's ROI varies, its ability to attract external funds is affected. For example, if the energy industries earn greater than their target ROI's, they can increase their external/internal financing ratios above the norms shown in Figure B-23 in the model. As will be shown in the next section, the financial health of the energy industry can be greatly affected by government policy.

FIGURE B-22: SELECTED MATERIAL AND INFORMATION DELAYS IN FOSSIL1

DELAY STRUCTURE	LENGTH (YEARS)
DEMAND ADJUSTMENT (END-USE CAPITAL LIFETIME)	15
FINANCING OF INVESTMENT	5
OIL AND GAS DISCOVERY	3
SYNTHETIC OIL AND GAS FACILITIES CONSTRUCTION	8
NUCLEAR PLANT CONSTRUCTION	10
OPENING A NEW SURFACE COAL MINE	3
OPENING A NEW UNDERGROUND COAL MINE	5
LIFETIME OF OIL AND GAS DRILLING EQUIPMENT	7
SYNFUELS PLANT LIFETIME	20
ELECTRICITY GENERATION PLANT LIFETIME	35

FIGURE B-23: FINANCIAL RATIOS IN FOSSIL1

RATIO	OIL	GAS	ELECTRICITY	COAL
DEPRECIATION/TOTAL CAPITAL	.11	.11	.03	.07
TAX RATE	.5	.5	.25	.50
DIVIDEND PAYOUT	.5	.5	.66	.25
NORMAL EXTERNAL/INTERNAL FINANCING RATIO	30/70	30/70	50/40	40/60
TARGET ROI *(%/year)*	12	12	8[a]	12

[a] *before interest and taxes*

Sources: Oil and gas data from Chase 1974; electricity data from EEI 1974; coal data from USBM 1976.

REFERENCES

Brookhaven 1974 — E. A. Cherniavsky, Topical Report: Brookhaven Energy System Optimization Model. Brookhaven National Laboratory Report BNL 19569. Brookhaven National Laboratory, Upton, NY 11973 (December, 1974).

Chase 1974 — Chase Manhattan Bank, Financial Analysis of a Group of Petroleum Companies. Energy Economics Division (Chase Manhattan Bank), 1 Chase Manhattan Plaza, New York, NY 10015 (1975).

EEI 1974 — Edison Electric Institute, Statistical Yearbook of the Electric Utility Industry: for 1974, No. 42. EEI, 90 Park Avenue, NY 10016 (November, 1975).

ERDA-48 1975 — Energy Research and Development Administration, A National Plan for Energy Research, Development, and Demonstration: Creating Energy Choices for the Future, ERDA-48, vol. 1. U.S. Govt. Printing Office, Washington, D.C. (1975).

ERDA 76-1 — Energy Research and Development Administration, A National Plan for Energy Research, Development, and Demonstration: Creating Energy Choices for the Future, ERDA 76-1. U.S. Govt. Printing Office, Washington, D.C. (1976).

ERDA 77-1 — Energy Research and Development Administration, A National Plan for Energy Research, Development, and Demonstration, ERDA 77-1 draft. ERDA, Washington, D.C. (1977).

FEA-Oil Shale 1974 — Federal Energy Administration, Project Independence Blueprint Task Force Report - Potential Future Role of Oil Shale: Prospects and Constraints. U.S. Dept. of the Interior, Washington, D.C. (November, 1974).

References - Continued

Hass, Mitchell, and Stone 1974 — J. E. Hass, E. J. Mitchell, and B. K. Stone, Financing the Energy Industry. Ballinger Books, Cambridge, MA (1974).

Hubbert 1974 — M. K. Hubbert, U.S. Energy Resources: A Review as of 1972. U.S. Senate Committee on Interior and Insular Affairs, pursuant to S. Res. 45--A National Fuels and Energy Policy Study, Serial No. 93-40(92-75) (1974).

Lewin 1976 — Lewin and Associates, The Potential and Economics of Enhanced Oil Recovery, Report for FEA. Lewin and Associates, Washington, D.C. (April, 1976).

Moody & Geiger 1975 — J. D. Moody and R. E. Geiger, "Petroleum Resources: How Much Oil and Where?" Technology Review, vol. 77, no. 5. (March/April, 1975).

NAS 1975 — National Academy of Sciences, Mineral Resources and the Environment. NAS, Washington, D.C. (1975).

NPC 1972 — National Petroleum Council, U.S. Energy Outlook. NPC, 1625 K St., N.W., Washington, D.C. 20006 (December, 1972).

Samuelson 1970 — P. A. Samuelson, Economics. McGraw-Hill, New York (1960).

USBM 1971 — U.S. Bureau of Mines, Strippable Reserves of Bituminous Coal and Lignite in the United States, Information Circular 8531. U.S. Dept. of the Interior, Washington, D.C. (1971).

USBM 1972 — U.S. Bureau of Mines, Cost Analyses of Model Mines for Strip Mining of Coal in the United States, Information Circular 8535. U.S. Dept. of the Interior, Washington, D.C. (1972).

References - Continued

USBM 1974	U.S. Bureau of Mines, Demonstrated Coal Reserve Base of the United States on January 1, 1974, Mineral Industry Survey. U.S. Dept. of the Interior, Washington, D.C. (June, 1974).
USBM 1975a	Patrick A. Hamilton, et al., The Reserve Base of U.S. Coals by Sulfur Content, Part 1, Bureau of Mines Information Circular 8680. U.S. Dept. of the Interior, Washington, D.C. (1975).
USBM 1975b	Patrick A. Hamilton, et al., The Reserve Base of U.S. Coals by Sulfur Content, Part 2, Bureau of Mines Information Circular 8693, U.S. Dept. of the Interior, Washington, D.C. (1975).
USBM 1976	T. T. Tomimatsu and R. E. Johnson, The State of the U.S. Coal Industry, Bureau of Mines Information Circular 8707. U.S. Dept. of the Interior, Washington, D.C. (1976).
USDI 1976	U.S. Dept. of the Interior, Energy Perspectives. U.S. Govt. Printing Office, Washington, D.C. (1976)
USGS 1973	D. A. Brobst and W. P. Pratt, United States Mineral Resources, Geological Survey Professional Paper 820. U.S. Govt. Printing Office, Washington, D.C. (1973).
USGS 1975	U.S. Geological Survey, Geological Estimates of Undiscovered Recoverable Oil and Gas Resources in the United States, Geological Survey Circular 725. USGS, Washington, D.C. (1975).
Zimmerman 1975	M. B. Zimmerman, The Supply of Coal in the Long-Run: The Case of Eastern Deep Coal, Report No. MIT-EL 75-021. MIT Energy Laboratory, Cambridge, MA (September, 1975).

Mr. DINGELL. The committee thanks you.

The Chair recognizes my colleagues for questions.

Mr. Gore?

Mr. GORE. Thank you, Mr. Chairman.

It's a real pleasure to hear these witnesses today, particularly Mr. Gibbons from my home State.

We have been arguing for a long time, Mr. Chairman, that Tennessee has more talent in the energy field than we can use, and we would make a great contribution to the Nation by sharing some of it, and I think that has been proven out here today.

Mr. DINGELL. Dr. Gibbons has been before this committee on many occasions and has always been most helpful, as has Dr. Forrester and Dr. Naill.

Mr. GORE. I appreciate the testimony of all three people.

I was noticing in your testimony, Dr. Gibbons, you say the President's program has been labeled as a lamb in wolf's clothing. I read yesterday that someone noted MEOW was the acronym for the moral equivalent of war.

Mr. Forrester, you propose a simplified version of the energy plan, which consists solely of an extreme tax on gas and oil. It's an interesting proposal. I think one of the difficulties that we see with the President's program is the effort to balance regional interests, and differing political elements.

I was just wondering how you think the American people would respond to such a plan?

Mr. FORRESTER. I believe that we have arrived at a time in this country when the public is ready for decisive action and is disappointed in the lack of leadership toward a real solution to the energy situation.

We may be at a time when a majority of people agree to the need for decisive action, and yet each person thinks he is in a minority and that nothing can be done.

I have been testing the idea of a high energy tax with many kinds of people. I have spoken to local citizen groups, filling station operators, business leaders, and executives of oil companies. Support for a high energy tax in exchange for extensive government intervention has been strong.

I talked to an audience the other day where from the questions I sense opposition. I thought I would take a show of hands, and it was nine to one in favor of a strong, forceful program of the kind I have recommended.

I suspect that Washington is misreading the public sense of urgency, and the public willingness to go along.

Mr. GORE. I am glad to hear you say that, because that has been my feeling also as I have talked to my constituents. I think the public is much farther along in this area than the common wisdom would lead us to believe. I think they are ready for strong action.

Witness after witness comes before this subcommittee and reflects that public attitude by saying well, we agree with the President's program, we think strong action is called for, we finally have a comprehensive agenda, but there are some specifics that we disagree with. Every single witness said that, and it's difficult to deal with it.

Your testimony interested me again because you see the unemployment problem as the other side of the coin of the energy shortage, which I think is a real insight. It involves a basic conflict with the way this country has developed, it seems to me. Historically America has been made what it is by the combination of our people's industriousness and cheap, plentiful supplies of energy leading to increasing productivity.

Increasing productivity has been a function of a higher ratio of energy use per worker, and what you are saying is that that trend, however, meritorious as the results have been, has distorted the basic equation between energy and employment.

Mr. FORRESTER. We must be careful what we mean by cheap energy. If by cheap energy we mean there is lots of it within our own country, then, indeed, that has been historically the situation, and you are quite right that our industrial progress and rise in standard of living has been based on cheap energy.

But cheap energy obtained in a different way, by holding down the price while we pay a high tax to OPEC, or cheap energy which is subsidized, is quite a different matter because the cost must be paid somewhere in the economy. It's no longer free energy. We are paying for it in hidden ways, so we must be careful not to carry the idea of cheap energy over into a pseudo cheap energy that, in fact, we are paying for somewhere else.

Mr. GORE. Thank you for that eloquent response. I think your point is well taken.

Dr. Gibbons, you have emphasized conservation throughout your career, and I wonder if you saw the article in yesterday's Post comparing the number of quads we are expected to save through conservation with the number of quads we are going to produce from coal and nuclear, and in light of that article, if you have read it, and the assumptions on which that article was based, do you think the President's plan puts enough emphasis on conservation?

Mr. GIBBONS. Are you speaking of the article, Mr. Gore, summarizing the Congressional Budget Office review?

Mr. GORE. I guess it was Sunday, the Barry Commoner article. He has written it in a number of publications, including the Post on Sunday. Basically his thesis is that the perception of the President's plan as primarily relying on conservation or relying a great deal on conservation is inaccurate, that in reality it relies much more heavily on coal and nuclear than it does on conservation and the reliance on conservation is really minimal.

Dr. GIBBONS. I have not seen the article. However, I would, I guess, underscore my feeling on the statement many people have made—that the plan basically puts all of the burden on conservation—is in fact, a misstatement.

Analysis of the Federal resources flowing into the energy problem, even under a greatly expanded conservation budget, would show that still more than 90 percent of the Federal budget would be directed toward increased supply. To that extent, I guess I would have to agree with Mr. Commoner. However, I do believe the plan brings for the first time a very serious Federal recognition of the value and importance focused on the demand side of the equation.

While in detail the President's plan greatly accentuates conservation over its past level of accent, but still we are a Nation attuned to solving problems through expansion—in this case, of energy supplies. In fact we must not only increase our supplies but also replace our growing dependence on foreign oil with yet more increased domestic supplies. I think, therefore, that the plan, if anything, should receive more attention on accelerating the rate at which we replace energy consumption with ingenuity in the way we use energy. We have more prospects for ingenuity, I think, than traditional energy resources in future years.

Mr. GORE. What are some examples of what might be missing?

Mr. GIBBONS. One example is given as an attached figure to my testimony today, but I did not have a chance to review that in my testimony. If one looks simply at refrigerators, as an example of an energy intensive item widely distributed throughout our national economy—figure 1 in my testimony—one notices that a roughly 15-percent increase in production cost of a refrigerator can result in a 50-percent in the efficiency of that refrigerator.

That means, for a typical electricity rate, that the increased investment in first cost will be repaid by lower electricity bills in less than 2 years, perhaps in less than 1 year. This is simply a substitution of engineering know-how for brute force energy consumption. It does not mean the sacrifice of amenity. In fact, it means an improvement in our standard because we get the same amenity for less total cost.

Mr. GORE. I have visited the demonstration work at Oak Ridge where these figures are being proved out with water heaters and other appliances, and I certainly think that this is an important element of an intelligent energy plan.

A lot of these gaps are going to have to be filled in by people such as yourself over the next year or two when we perfect this plan. It cannot be adopted in perfect form under the rigorous schedule that the Congress is following here. Unfortunately, that is just the case. We are going to adopt a comprehensive approach and then it will be up to others, it will be up to us after the comprehensive agenda is laid out, to perfect it.

You had a comment?

Mr. FORRESTER. Almost everywhere you look you find a potential 50 percent reduction in energy use. We would be quite comfortable in this room with half of those tubes in the ceiling turned off. If you look at the street, you find one passenger per car, where a little ingenuity would usually double that number.

Almost anyplace in our society you will see that there is a potential 50 percent energy reduction without great inconvenience or reduction in the quality of life. We are at this very high level of energy consumption because it has been almost free.

We just don't spend effort or thought to reduce energy use, and we won't until there is a personal incentive on each individual person, all through the day and in everything that he does, to be conserving.

Mr. GORE. Do you agree with that, Dr. Naill?

Mr. NAILL. Yes, I do, to a large extent. However, I think that the time lags involved in any conservation program make the achievement of specific energy reduction goals more difficult. A lot of times much of this reduction has to be made by replacement of capital equipment. The only part of our analysis that disagrees with any optimism on the demand side is the length of time it takes for capital turnover.

Mr. GORE. Yes.

Mr. FORRESTER. I call attention to a discussion in the appendix that I left for the record about the nature of capital plant acquisition in this country. We suspect that the country is in a situation like the 1920's, a period that was characterized by excess capital investment. Almost, anywhere you look in this country you see

excess capital plant, empty office space, plants that are underutilized, and condominiums half finished and abandoned. Potentially this implies a period out in the 1980's not unlike that in the 1930's, which is a period for wearing out of the old capital plant before building again based on a new technology.

The technology of the 1950's and 1960's was different from the technology of the 1900's up through the 1920's. We have had great waves in 50-year cycles of replacement of our capital plant. Capital construction is not done uniformly.

It is done in huge bursts that potentially lies before us anyway; it probably dominates this whole energy picture, without people realizing it, and it opens up some opportunities, because if we can accelerate the incentive to go more efficient in capital plant, we will perhaps begin to rebuild the capital plant in the next decade rather than 30 years from now, and fill in that valley like the 1930's with activity to solve the problem rather than sitting and waiting for the urgencies of the situation to be thrust upon us.

Mr. GORE. Yes, Doctor, go ahead.

Mr. GIBBONS. I would only add to Professor Forrester's comment by saying if one looks at these natural turnover rates and one sees the great problems we face over the next 10 to 20 years, then one finally picks out those items that consume significant energy and that have a reasonably short turnover rate. Thus the focus on changing the characteristics of new automobiles and household appliances that have a 10 to 15 year replacement rate.

The important but less cost effective measures of refitting existing stock should focus on buildings and on industrial plants and processes which don't turn over so fast that we can afford to ignore changing the use of those that presently exist.

Mr. GORE [presiding]. Let me thank all three of you again for providing the subcommittee the kind of longer term prospective that is most useful in designing a wise energy policy, and I can assure you it will be of enormous interest as we review these policies.

Thank you again for appearing here today.

I will ask the patience of the next witness, Dr. Russell Thompson, while the subcommittee has a temporary recess of 10 minutes to meet a vote on the floor, and we will come back in session in 10 minutes.

[Brief recess.]

Mr. GORE. The subcommittee will come to order. We are going to hear now from Dr. Russell G. Thompson, Professor of Quantitative Management Science, at the College of Business Administration, University of Houston, on the economic impacts of energy policy alternatives.

Doctor, welcome. Without objection, the full text of your statement will be inserted in the record, and please proceed to summarize or present any or all of it as you see fit.

STATEMENT OF RUSSELL G. THOMPSON, PROFESSOR OF QUANTITATIVE MANAGEMENT SCIENCE, COLLEGE OF BUSINESS ADMINISTRATION, UNIVERSITY OF HOUSTON

Mr. THOMPSON. Thank you, Mr. Chairman, and members of the Subcommittee on Energy and Power.

I am pleased to have the opportunity to testify today before this important energy committee of the U.S. House of Representatives.

I have organized my testimony in two parts. As you have indicated, Mr. Chairman, I have, number one, a summary statement of our energy modeling evaluations, and, two, I have two supporting technical reports for the hearing record. One is entitled, "Energy Supplies, Demands, and Prices for the U.S. Economy in 1985" and the other one, "Policy, Economics, and Forecasts of Oil and Gas Reserves in the lower 48 States."

Mr. KRUEGER [presiding]. By unanimous consent, without objection, those two supplementary documents will be inserted in the record.

Mr. THOMPSON. What I will do is briefly describe how we have organized our modeling effort and how we have recently used that modeling effort to evaluate three important energy policy questions.

In terms of what we have done, since 1974, I have directed a large computer-based modeling effort for the Energy Institute at the University of Houston. The resulting model represents a comprehensive economic framework to evalute the important economic consequences of major policy changes for the fossil energy sector of the United States economy. Extensions of the model are being made to evaluate how policy-induced modifications in the transaction values of the core industries in the fossil energy sector will ripple throughout all industries in the U.S. economy.

All important supplies of energy, industrial conversions of energy, and consumer demands for energy are accounted for in the model. The model shows how profit-conscious producers of crude oil and natural gas will increase exploratory drilling, reserve additions and domestic production in response to different government pricing and taxing policies.

The model shows how cost-conscious managers in the petroleum refining, electric power, and basic chemicals industries will produce the Nation's energy fuels, electricity, and petroleum derivatives in response to major changes in energy availabilities, fuel prices (including taxes), and effluent standards. The model shows how final consumers' expected responses to higher costs of petroleum fuels, natural gas, and electricity will feed back to industry managers and resource producers to give the final product costs paid by consumers, resource mix used by industry, and wellhead prices received by energy producers.

One important use of this economic framework is to show the public and its representatives the economic costs of increased government regulation versus the economic costs of decreased government regulation in the areas of energy policy. In the current debate on the consequences of a modified price regulation policy, as recommended by President Carter, versus the consequences of a deregulated energy pricing policy, as recommended by the Texas Governor's Energy Advisory Council, the University of Houston economic model measures the open sales and hidden economic costs of both policies.

Under the Carter case, everyone is rapidly understanding the sales costs of what will be produced at different regulated prices, but no one seems to know the hidden costs of what will not be

produced at regulated prices. For example, much new natural gas can be produced in the United States with U.S. workers and capital at a cost lower than the Btu equivalent of imported oil, but this new natural gas will not be produced at low regulated prices. Though many final consumers will be able to get cheap gas at the regulated price proposed by President Carter, millions of other consumers will have to substitute expensive imported crude oil (and liquefied natural gas) because they will not be able to get domestic natural gas at these regulated prices. Their inability to get domestic natural gas at low regulated prices increases energy costs, decreases employment opportunities, and increases the general cost of living throughout the U.S. economy.

Our University of Houston economic model was used to evalute the following important questions for the fossil energy sector of the U.S. economy in 1985:

One, how will a modified energy price regulation policy, which we will call Modified Price Regulation, affect U.S. energy costs, foreign exchange payments, domestic energy prices, fossil energy production, electric power generation, industry capital requirements, and sulfur dioxide discharges?

Two, how will the consequences of a modified energy price regulation policy as recommended by the President compare with the consequences of a deregulated energy pricing policy, which we will call Complete Price Deregulation?

Three, how will the consequences of Modified Price Regulation and Complete Price Deregulation policies compare with the consequences of a Business-As-Usual policy?

As modeled, Modified Price Regulation reflects the salient pricing, taxing, and environmental recommendations of President Carter's program; and Complete Price Deregulation reflects the fundamental pricing recommendations of the Texas Governor's Energy Advisory Council plus windfall profit taxes on old oil production.

In the Modified Price Regulation case, higher regulated prices are allowed for new natural gas; new crude oil prices are allowed to rise to the current import level; excise taxes are imposed on industry, electric utilities, and gasoline; and stack gas scrubbers are required on all new electric powerplants and industrial steam boilers. In the Complete Price Deregulation case, crude oil and new gas prices are allowed to rise to what the market will bear; windfall profit taxes are imposed on old oil; and water and air pollutant discharges must meet EPA's promulgated effluent standards. In the Business-As-Usual case, natural gas and crude oil prices are regulated as at present, no new taxes are imposed, and EPA's promulgated effluent standards are met. In all three cases, use of oil products and natural gas is prohibited in all new baseload fossil-fueled electric powerplants and new industrial steam boilers; and cogeneration of electricity is allowed by the process industries modeled for sale into the grid of electric utilities. All evaluations are made for 1985; and all monetary units are expressed in 1975 dollars.

The major points of the study show the following consequences for the Modified Price Regulation case in comparison to the Complete Price Deregulation and Business-As-Usual cases.

One, economic costs of fossil energy at the wholesale level, in contrast to the testimony of Treasury Secretary Blumenthal, are cheaper in the Complete Price Deregulation case ($2.42/mil Btu) than in the Modified Price Regulation case ($3.09/mil Btu). Deregulation of prices in the Complete Price Deregulation case gives a higher level of domestic industrial activity (9 percent) than continued regulation of prices in the Modified Price Regulation case. Both alternatives to current policy, which is the least costly of all—$2.01 per million Btu—reduce demand growth to less than 2 percent per year. However, this demand reduction is accomplished at a 54 percent increase in the price of energy in the Modified Price Regulation case and at a 20 percent increase in the price of energy in the Complete Price Deregulation case (from the base case of Business-As-Usual).

Two, the Carter program, as modeled, will impose $54.7 billion of new taxes at the conversion level, where the raw crude oil, natural gas, and coal are transformed from fuel and feedstocks into usable end products, and at the final consumer level, where end products are transformed into desired services. Summing the $54.7 billion of the new excise taxes and the $15.5 billion of the oil equalization tax gives a level of new taxes ($70.2 billion) slightly greater than the estimated revenues in 1985 of all domestic oil and gas producers in the Modified Price Regulations case; this $70 billion of new proposed taxes is 18 percent of all Federal outlays by the U.S. Government in 1976. At the proposed prices for oil and gas, the $19.7 billion of excise taxes at the conversion industry level are not needed to discourage the use of oil and gas to fire boilers in industry and electricity generation because oil and gas electric powerplants are retired at the maximum possible rate and all of the process industries modeled use coal to fire boilers in the model. However, full imposition of the gasoline excise tax, which amounts to $35 billion in 1985, is needed to make significant progress toward the President's oil import goal of 6 million barrels per day in 1985. However, without the gasoline excise tax, imports of foreign oil will be nearly at the level found in the Complete Price Deregulation case (6.85 million barrels per day), which is approximately the 1976 level.

Four, higher regulated prices of natural gas will give cheap gas to those final consumers who can obtain gas at the regulated prices but not to those final consumers who must substitute purchases of imported oil and gas products at high import prices. At the wellhead level, regulation of both gas and oil prices imposes a hidden cost on U.S. citizens of $33 billion in 1985. The Carter program, as modeled, decreases the magnitude of this hidden cost from $33 billion in the Business-As-Usual case to $23.6 in the Modified Price Regulation case. Regulating prices of new oil at the current import level will save the public $9.4 billion; however, deregulating new gas and new oil prices will save the public another $8.1 billion. Continuing current price regulation will cost the public around $18 billion in 1985 at the wellhead level.

Five, universal use of stack gas scrubbers, as recommended by President Carter, increases the national cost of electricity, discourages growth of coal production, and shifts the production of coal

from the West to the East. Because of the uneconomic use of sulfur control technology, consumer costs of electricity from new coal plants are 18 to 20 percent higher (4.0 to 4.6 mills per kWh) in the Modified Price Regulation case than in the Complete Price Deregulation case. Because higher electricity costs reduce electricity use, considerably less coal is required in the Modified Price Regulation case (809 million short tons) than in the Complete Price Deregulation case (940 billion short tons). The President's proposal increases the production of high-sulfur coal on the East Coast (61 million short tons) and in the Midwest (52 million short tons) and decreases the production of low-sulfur coal in the Far West (218 million short tons). High-sulfur coal producers reap a large price increase of $4.53 per ton in the Midwest and $3.25 per ton on the East Coast because of the government expanded demand for high-sulfur coal. Low-sulfur coal producers in the Far West suffer a significant price decrease of $1.60 per ton because the government increases the supply costs to users of low-sulfur coal with the required use of stack gas scrubbers.

In summary, two of President Carter's six national goals for 1985 (reduced demand growth and increased coal production) can be attained in a much cheaper way than the way proposed by the President. Use of market prices and windfall profit taxes will reduce demand growth to less than 2 percent per year. This market pricing alternative will come closer to attaining the President's 1985 goal of increased coal production (400 million tons per year) than the program he proposed. Full imposition of the gasoline excise tax is necessary in any program to make significant progress toward attaining the President's gasoline consumption goal (10 percent reduction from current level) and oil import goal (6 million barrels per day). Accomplishment of the two remaining goals (insulation of 90 percent of the buildings and use of solar energy in 2-1/2 million homes) can be added to any alternative program.

Thank you, Mr. Chairman.

[Testimony resumes on p. 477.]

[The technical reports referred to follows:]

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ENERGY SUPPLIES, DEMANDS, AND PRICES FOR THE U.S. ECONOMY IN 1985

by

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We now know who pays and how much,
we next need to find out who gets
and why.

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HIGHLIGHTS OF "ENERGY SUPPLIES,
DEMANDS, AND PRICES FOR THE U.S. ECONOMY IN 1985"

The University of Houston has developed a reliable, consistent computer model which provides an economic framework to show the effects of government policies on energy prices, production, use, and costs. This economic framework was used to evaluate three different alternatives for United States energy policy: (1) Modified Price Regulation, (2) Complete Price Deregulation, and (3) Business-As-Usual. As modeled, Modified Price Regulation reflects the salient pricing, taxing, and environmental recommendations of President Carter's Program; and Complete Price Deregulation reflects the fundamental pricing recommendations of the Texas Governor's Energy Advisory Council plus windfall profit taxes on old oil production.

In the Modified Price Regulation Case, higher regulated prices are allowed for new natural gas; new crude oil prices are allowed to rise to the current world price; excise taxes are imposed on industry, electric utilities, and gasoline; and stack gas scrubbers are required on all new electric power plants and industrial steam boilers. In the Complete Price Deregulation Case, crude oil and new gas prices are allowed to rise to what the market will bear, windfall profit taxes are imposed, and water and air pollutants must meet EPA's promulgated effluent standards. In the Business-As-Usual case, natural gas and crude oil prices are regulated as at present, no new taxes are imposed, and EPA's promulgated effluent standards are met. All evaluations are made for 1985; and all monetary units are expressed in 1975 dollars.

The major points of the study show the following consequences for the Modified Price Regulation Case in comparison to the Complete Price Deregulation Case:

1. Economic costs of fossil energy in 1985 are $212 higher per person in the Modified Price Regulation Case than in the Complete Price Deregulation Case largely because of hidden costs and taxes.
2. Consumer Costs of electricity from new coal plants are 18 to 20 percent higher (4.0 to 4.6 mills per kWh) in the Modified Price Regulation Case than in the Complete Price Deregulation because uneconomic sulfur control technology must be used.
3. Higher regulated prices of natural gas will give cheap gas to those final consumers who can obtain gas at the regulated prices but not to those final consumers who must substitute purchases of imported oil and gas products at high import prices.
4. Gasoline use and oil imports will only be decreased significantly by full imposition of the proposed gasoline excise taxes.
5. Universal use of stack gas scrubbers, as recommended by President Carter, increases the national cost of electricity, discourages growth of coal production, and shifts the production of coal from the West to the East.
6. Excise taxes on electric utility, petroleum refining, and basic chemical industry uses of oil products and natural gas are not needed at the prices proposed by President Carter to phase out the use of oil and gas products in the firing of boilers in these industries.

ENERGY SUPPLIES, DEMANDS, AND PRICES FOR THE U.S. ECONOMY IN 1985

1. Introduction

Since the Arab Oil Embargo in the fall of 1973, the Industry Studies Program of the University of Houston has developed a comprehensive economic modeling capability for the fossil energy sector of the United States economy. This modeling capability includes (1) detailed process economic models for the electric power, petroleum refining, and basic chemicals industries, (2) price responsive supply models for crude oil, natural gas, and coal, and (3) economic demands for gasoline, electricity, natural gas, fuel oils, kerosene, and coal. Interactive use of the industry models, the economic supplies, and the product demands gives an equilibrium solution in prices and quantities for the fossil energy sector of the national economy. This equilibrium solution shows how the raw energy resource and energy endproduct markets will adjust to a wide range of energy, environment and economic policies before policy is changed.

The primary purpose of developing this industry modeling capability is to show how cost-conscious managers in the nation's petroleum refining, electric power, and basic chemicals industries will respond to major changes in resource availabilities, effluent standards, and product requirements before these availabilities, standards, or requirements are regulated by government policy. Accomplishing this objective requires a synthesis of technical information into a mathematical economic framework to evaluate the engineering cost, resource use, and technical configuration consequences of policy decisions

and economic considerations. Evaluations are made by limiting or not limiting (1) the availability of any scarce energy, capital, water, or raw material input, and (2) the discharge of any major water, air, or solid waste pollutant. Also, evaluations are made by increasing or decreasing (a) the price of any resource input, (b) the price of any resource output, or (c) the possible effluent tax on any major pollutant; see Calloway and Thompson (1976) and Thompson et al. (1976a, 1977a) for descriptions of industry models.

One of the fundamental uses of this economic framework is to show how the responses of industry managers to different resource, environmental, and consumer policies will affect production costs, resource prices, energy use, and capital requirements. Attaining this use requires economic supply functions for natural resources to evaluate the increasing marginal product costs of restrictive discharge standards, reduced depletion allowances, decreased tax incentives, and wellhead price controls; see Kim and Thompson (1976) for a description of supply models for crude oil and natural gas, and see Appendix II for a description of the supply model for coal.

Another fundamental use of this economic framework is to show how the responses of final consumers to these higher supply costs will feed back to industry managers and resource producers to modify the product costs paid by consumers, the resource mix used by industry, and the wellhead prices received by resource producers. Attaining this use requires economic demand functions for important endproducts to evaluate the sensitivities of consumer market baskets to efforts by industry to pass through higher marginal costs of production; see Thompson et al. (1976b, 1977b) for a description of how the supply, industry and demand models are interfaced.

Users of this economic modeling capability are the Texas Governor's Energy Advisory Council, the Wharton Econometrics Forecasting Associates, Inc., the National Commission on Water Quality, the Federal Energy Administration (FEA), and the International Institute of Applied Systems Analysis (IIASA). The Advisory Council has continually used the models since 1974 to forecast (i) the production of crude oil, natural gas, and coal, (ii) the use of important energy endproducts (electricity, gasoline, kerosene, fuel oils, natural gas, and coal), and (iii) the prices of both raw energy resource inputs and finished energy endproducts; see Thompson et al. (1975b, 1976c). The Wharton Group has effectively built the electric power model into their long-run industry and economy forecasting model; see Griffin (1977). The National Commission on Water Quality used the models to evaluate the economic impact on the Houston/Galveston Region of federally promulgated wastewater effluent standards; see Thompson et al. (1975a). FEA plans to use the industry models as the fundamental petroleum refining/basic chemical industries components of the Project Independence Evaluation System. IIASA plans to use the models for economic evaluations in countries of its 17 national member organizations.

2. Purpose of the Study

The primary purpose of this study is to use the modeling capability of the Industry Studies Program to answer the following questions for the fossil energy sector of the United States economy in 1985:

- How will a modified energy price regulation policy (Modified Price Regulation) affect U. S. energy costs, foreign exchange payments, domestic energy prices, fossil energy production, electric power generation, industry capital requirements, and sulfur dioxide discharges?

- How will the consequences of a modified energy price regulation policy compare with the consequences of a deregulated energy pricing policy (Complete Price Deregulation)?
- How will the consequences of a Modified Price Regulation and Complete Price Deregulation policies compare with the consequences of a Business-As-Usual policy?

As modeled, the Modified Price Regulation option reflects the most salient pricing, taxing, and environmental recommendations in President Carter's Energy Program; see Appendix for delineation. The Complete Price Deregulation option reflects market-clearing prices for crude oil and natural gas, a windfall profits tax on old domestic oil production, and implementation of EPA's promulgated effluent standards. The Business-As-Usual option basically reflects continuation of present government energy pricing and environmental control policies.

3. Specifications and Assumptions

The following specifications and assumptions were made in the modeling to answer the three basic questions for 1985 (1975 dollars are used throughout):

- Estimates of domestic supplies of new crude oil and natural gas assume no depletion allowance, continued deductions of intangible and dryhole drilling costs, and a future finding rate reflecting the rate of change in cumulative finds vs. cumulative exploratory drilling since 1962.
- Capacities of old fossil steam electric power plants were based on National Electric Reliability Council estimates (1975).
- Ranges of retirement rates for old electric power plants between 1975 and 1985 were from 10 to 30 percent for coal, oil, and gas-fired

plants and from 0 to 5 percent for combined-cycle plants.

- Annual supplies of electricity from nuclear generation are 372.7 billion kilowatt hours for the East Coast Region and 368.3 billion kilowatt hours for the rest of the country.
- Imports of crude oil and residual fuel oil are available, as needed, at prices of $13 per barrel; limited imports (up to 3 trillion cubic feet) of liquified natural gas are available at $2.50 per 1000 cubic feet.
- Use of oil products and natural gas in all new base-load fossil-fueled electric power plants and new industrial steam boilers is prohibited in all three cases.
- Cogeneration of electricity by the process industries for sale into the grid of electric utilities is allowed in all three cases.
- Sulfur content of oil sold to residential/commercial sectors must meet new source air emission standards. Sulfur content of coal sold to these sectors must be equivalent to no more than 1.25 times the new source sulfur oxide standards. Use of best available technology is required for all major wastewater effluents. Air emissions from new plants must meet new source standards as promulgated by EPA in the Complete Price Deregulation (CPD) and Business As-Usual (BAU) Cases. In the Modified Price Regulation (MPR) Case, stack gas scrubbers are required on all new fossil-fueled electric power plants and new coal-fired industrial steam boilers. In all cases old plants must burn oil having 1% sulfur or less, and old coal-fired plants must not emit more than one and one-half times as much sulfur oxides as allowed by new source standards.
- The Implicit Gross National Product Price Deflator is used to make constant dollar adjustments.

- Domestic supplies of crude oil and natural gas are determined in response to the following price conditions:

	Modified Price Regulation MPR	Complete Price Deregulation CPD	Business-As-Usual BAU
	(1975 dollars)		
Old Natural Gas	$ .80/Mcf	$.80/Mcf	$ .80/Mcf
New Natural Gas	$1.61/Mcf	Market-Clearing	$1.42/Mcf
Crude Oil from pre '74 Reserves(L.Tier)	$4.84/bbl	Market-Clearing	$4.84/bbl
Crude Oil from '74-77 Reserves(U.Tier)	$10.40/bbl	Market-Clearing	$10.40/bbl
Crude Oil from New Reserves(after'77)	$13.78/bbl	Market-Clearing	$10.40/bbl

- Imposition of the following taxes are assumed for the MPR Case (1975$):

	Transportation	Industry	Electric Utilities
Oil products	-	$ .46/MMBtu's	$ .20/MMBtu's
Natural Gas	-	$1.54/MMBtu's	$1.24/MMBtu's
Gasoline	$14.70/bbl.	-	-

The taxes imposed on industry are applied only to petroleum hydrocarbons used as fuels. Chemical feedstocks are exempt from taxation, as are all synthetic fuels derived from coal.

- Real rate of growth in the economy from 1975 through 1985 will average 3 percent per year (1.2% for population and 1.8% for real per-capita income).

- FEA's demand model (1976) is used basically to reflect (1) the final consumer's response to prices of important energy products (gasoline, electricity, natural gas, fuel oils, kerosene, and coal) and (2) the improved efficiencies of energy use resulting from anticipated adoption of new end use technology.

4. Results of the Modeling Evaluations for 1985

Fossil Energy Supplies, Demands, Prices and Imports. Comparison of the modeling results in Table 1 shows deregulated prices of new natural gas in the CPD Case will increase domestic production 1.63 Tcf (9.2%) from the level in the MPR Case (17.75Tcf). Gas production is .35 Tcf higher in the MPR Case than in the BAU Case, where interstate prices are limited to $1.42 per 1,000 cubic feet. In the MPR Case, a small amount of liquefied natural gas (.01 Tcf) must be imported at a price of $2.50 per Mcf to supply needed feedstock and fuel uses; however, total gas supplies from domestic and foreign sources are 12 percent less in 1985 than they were from domestic sources in 1975.

Domestic production of oil liquids in 1985 is virtually the same, according to the model, in the MPR and CPD Cases (4.66vs. 4.67 billion barrels). This level of production is around 28 percent greater than the level of production in 1975. Imports of crude oil in the MPR Case are at the 1975 level (2.22 vs. 2.23 bil. bbls.). Crude oil imports are 13 to 18 percent higher in the CPD and BAU Cases than they were in 1975. Supplies of oil products used grow at the average rate of 1.7 percent per year in the MPR Case and at the average rate of 2.2 percent per year in the CPD Case.

Coal production in the CPD and BAU Cases is close to one billion short tons in 1985. This level of production is around 47 percent greater than the level in 1975 (640 mil. s. tons). Considerably less coal is produced in the MPR Case (809 mil. s. tons) than in the CPD and BAU Cases (940 and 950 mil. s. tons) because the uniform stack gas scrubber requirements increase electricity costs and decrease electricity use.

In terms of Btu's, less fossil energy is used in the MPR Case (74.70 quads) than in the CPD (79.42 quads) Case . Less oil products are used because of gasoline excise taxes; less natural gas is used because of low domestic production and high import prices; and less coal is used because of high electricity costs. Fossil energy use in the MPR Case grows at an average annual rate of only 1.2 percent from 1975 to 1985. This growth rate compares to the higher growth rate of 1.9 percent in the CPD Case. Both rates are below the President's 1985 goal of 2% growth in demand per year.

In the CPD Case, environmental standards for sulfur dioxide may be met by substituting low-sulfur coal use for high-sulfur coal use with stack-gas scrubbers. However, in the MPR Case, substitution of low-sulfur coal for high-sulfur coal is discouraged economically by the required use of stack-gas scrubbers on all new coal plants. The Carter Proposal increases the user costs of low-sulfur coal and expands the demand for high-sulfur coal. This policy would increase the production of high-sulfur coal on the East Coast (61 mil. s. tons) and in the Midwest (22 mil. s. tons) and decrease the production of low-sulfur coal in the Far West (218 mil. s. tons); see Table 2. High-sulfur coal producers reap a large price increase of $4.53 per ton in the Midwest and $3.25 per ton on the East Coast because of the government expanded demand for high-sulfur coal. Low-sulfur coal producers in the Far West suffer a significant price decrease of $1.60 per ton because of the government increased supply cost to users of low-sulfur coal; see Table 3.

In analyzing the price and use of low-sulfur coal versus the price and use of high-sulfur coal, two points must be kept in mind: (1) Btu content of the Eastern (and Midwestern) coal is greater per ton than the Btu content of Western low-sulfur coal; and (2) the costs of transporting low-sulfur coal from the Western mines to the East Coast is approximately $20 per ton. See Table 4 for Btu content of fossil energy.

The regulated price of natural gas at $ 1.61 per Mcf ($1.75 per Mcf in April 1977 dollars) in the MPR Case results in continued excess demand in the natural gas market. Unsatisfied users of natural gas are willing to pay $2.34 per Mcf (wellhead) for an additional 1,000 cubic feet of gas. This shadow price of $2.34 per Mcf in the MPR Case compares with a market-clearing price of $2.29 per Mcf in the CPD Case. The marginal price of domestic crude oil exceeds the marginal price of imported crude oil because of a premium for low sulfur oil.

Because of the excise taxes on oil products in addition to the higher regulated prices of new oil , the Carter Energy Proposal decreases the use and imports of oil products. Foreign exchange payments are $3.42 billion less in the MPR Case ($29.05 billion) than in the CPD Case ($32.47 billion). Deregulation of oil prices stablizes imports at approximately their current level; see Table 5.

A noticeable feature of the import bill is how its composition changes between the CPD and MPR Cases. In the CPD Case, deregulation of oil and gas prices gives self-sufficiency in natural gas production; a relatively modest level of residual fuel oil imports (8.5% of import bill); and a relatively high level of crude oil imports (91.5% of import bill). However, in the MPR Case imports of crude oil for refining in this country decrease to 86.9 percent of the foreign exchange payments for imports. Imports of residual fuel oil increase to 13 percent of the import bill because less domestic refining to produce gasoline produces less residual fuel oil.

Fossil-Fueled Electric Utilities. The Carter Energy Proposal has a significant impact on the fossil-fueled electric utilities in the nation. In comparison to the CPD Case , 139 billion kilowatt hours less electricity is generated and used in the MPR Case. This decrease in use results from the much

higher generation costs in the new coal burning base load plants, where stack-gas scrubbers are uniformly required on all new plants. Foregoing the alternative to achieve EPA's new source standards for sulfur dioxide by substituting low-sulfur, clean coal for high-sulfur, dirty coal and stack-gas scrubbers increases the marginal costs of generating electricity 4.0 mills per kWh on the East Coast and 4.6 mills per kWh in the rest of the country. Capital requirements are less in the MPR Case than in the CPD Case because of "belt-tightening" by electricity users; see Tables 6 and 7.

The composition of the investment in new electric power plants (fossil-fueled) is noteworthy. In the CPD Case, all of the new plants are steam-electric plants; however, in the MPR Case, 61 percent of the new plants are coal gasification/combined cycle plants. Required use of stack-gas scrubbers creates incentives for introduction of this new technology.

Fossil Energy Sales, Cost, Economic Value, and Regulation Costs at Wellhead and Minemouth Level.

Increasing the regulated price of new oil and increasing the regulated price of new natural gas (interstate) increases the revenues received by domestic producers of oil and gas from $56.8 billion in the BAU Case to $69.1 billion in the MPR Case. See Table 8. Deregulating the prices of crude oil and new natural gas increases the revenues received by domestic producers of oil and gas from $69.1 billion in the MPR Case to $79.8 billion in the CPD Case. Revenues of domestic gas producers, who employ U. S. workers and invest in the U. S. economy, increase around $10 billion. This modification in the regulation of new oil and gas prices does not affect very much the revenues received by all U. S. coal producers; but in combination with the universal stack-gas scrubber requirement for all new plants, it does affect significantly the regional composition of the revenues received by domestic coal producers. Revenues received by low-sulfur coal producers decrease from 83 percent of total coal revenues in the CPD and BAU Cases to 64 percent of these revenues in the MPR Case.

Revenues received by the domestic producers of raw fossil energy represent the sales costs, excluding taxes, of raw fossil energy at the wellhead and minemouth level. Sales costs represent the open transaction costs of producing fossil energy for those users who can buy fossil energy at the regulated prices; however, sales costs fail to take into account the hidden economic costs of those users who must substitute purchases of higher priced products. Two types of hidden costs are present in the BAU and MPR Cases. Both new oil and gas are regulated at prices below the market-clearing prices in the BAU Case. Clearly, new gas is regualted at a price below the market-clearing level in the MPR Case, while new oil is regulated at the current world price.

With price regulation, users must substitute imported oil products at

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high world oil prices for unavailable domestic production, which would be produced at prices above the regulated prices but is not because of the domestic price regulation. This price regulation imposes a cost on society; a measure of this regulation cost is the difference between the economic value of domestic raw fossil energy less the sales costs of the domestic raw fossil energy at the wellhead and minemouth level; see Table 9.

Regulation of both oil and gas prices at current levels imposes a hidden cost on U. S. citizens of $33.0 billion in 1985. The Carter Program, as modeled, decreases the magnitude of this hidden cost from $33 billion in the BAU Case to $23.6 in the MPR Case. Higher regulated prices of new oil and new gas will save the public at least $9.4 billion; however, deregulating new gas and new oil would save U. S. citizens another $8.1 billion in raw fossil energy costs. Continued regulation of oil and gas prices at current levels, which seems to take advantage of producers, will actually cost users of fossil energy $17.5 billion in 1985. Actually, costs to society will be several fold greater than the costs to the fossil energy sector alone because of the ripple effects through all sectors of the economy.

Because the economy will be operating at different levels of fossil energy production in the three cases, the economic cost of regulation per million Btu's is an improved measure of the hidden cost of price regulation; see Table 10. Higher regulated prices of new oil and new gas in contrast to continued regulation of oil and gas prices at current levels will save U. S. citizens at least 14.4 cents in hidden costs at the wellhead and minemouth level for every million Btu of fossil neergy used in 1985. Deregulation of prices (new oil and new gas) and clean fuel substitutions instead of continued regulation of prices and forced use of stack-gas scrubbers will save U. S. citizens another 14.6 cents in hidden costs at the wellhead and minemouth level for every million

Btu of fossil energy used in 1985.

With a 65 quad level of domestic fossil energy production and use, the nation will sacrifice $18.9 billion in hidden costs in 1985 at the wellhead and minemouth level if it continues to regulate the prices of oil and gas as at present. This $18.9 billion represents lost economic opportunity to the fossil energy sector of the U.S. economy because of the hidden costs being imposed on U.S. citizens by over zealous regulators in policy-making positions.

Proposed Petroleum Taxes and Economic Costs of Energy at Wholesale Level.

A striking feature of the Carter Program is the magnitude of the new taxes recommended at the conversion level, where the raw crude oil, natural gas, and coal are transformed from fuel and feedstocks into useable endproducts, and at the final consumer level, where endproducts are transformed into desired services; see Table 11. A total of $54.7 billion of new taxes in the Carter Program will be imposed on the conversion industries ($19.7 billion) and final consumers of gasoline ($35 billion). This tax will fall heavily on people living in the West South Central States (Texas, Oklahoma, Arkansas, and Louisana). In 1974, 62 percent of the natural gas used in electric power generation in the nation was used in the West South Central States; and 47 percent of the natural gas used in industry was used in the West South Central States. If this pattern of use continues in 1985, electric utilities in the West South Central States will pay $2.34 billion of the proposed excise tax on natural gas use in electricity generation; and process industries in the West South Central States will pay $5.57 billion of the proposed excise tax on natural gas use in industry. As is well-known, people living in Texas will pay a disproportionate share of the gasoline tax because of the state's geographical size.

The sum of the oil equalization tax at the producer level and the excise taxes at the conversion industry and final consumer levels is $70.11 billion in 1985. These new taxes virtually equal the sales costs received by domestic producers of oil and gas at the wellhead and minemouth levels in the MPR Case.

An alternative way to compare the economic costs of the MPR, CPD, and BAU Cases is to add the value of resources estimated by the model (at marginal prices), the costs of oil imports, and the new taxes of each case; see Table 12. This measure of economic costs shows that costs of fossil energy at the wholesale level, where distribution costs are ignored, would be the highest in the MPR Case ($231 billion) and the lowest in the BAU Case ($160 billion).

The deregulation of prices in the CPD Case gives a higher level of domestic industrial activity ($144 billion) than the higher regulated prices of new oil and new gas in the MPR Case ($132 billion). However, the higher regulated prices of the Carter Program give considerably more domestic industrial activity and less oil imports than a BAU Program, as at present.

Economic costs of fossil energy at the wholesale level are by far the highest in the MPR Case largely because of the excise taxes on gasoline, electric utilities, and industry. The excise taxes of the Carter Program are not needed to discourage the use of oil and gas to fire boilers in industry and electricity generation at the recommended prices for oil and gas. All of the process industries modeled use coal to fire boilers; and old oil and gas electric power plants are retired at the maximum possible rate. However, the gasoline excise taxes of the Carter Program are necessary in the model to reduce gasoline use (7 percent) below the 1976 consumption level of 2.56 billion barrels. Fossil energy costs at the wholesale level are $3.09 per million

Btu in the MPR Case and $2.42 per million Btu in the CPD Case. As modeled the per person cost of fossil energy at the wholesale level in 1985 is $212 greater in the MPR Case than in the CPD Case at 75 quads of use.

In summary, two of President Carter's six national goals for 1985 (reduced demand growth and increased coal production) can be attained in a much cheaper way than the way proposed by the President. Use of market prices and windfall profi taxes will reduce demand growth below 2 percent per year. This market forces alternative will come closer to attaining the President's coal production goal (increased production of 400 million tons per year from the current level) than the program he proposed. Full imposition of the proposed gasoline tax is necessary to make positive progress toward the gasoline consumption goal (10% reduction from the current level) and oil import goal (6 million barrels per day) of the President. Accomplishment of the two remaining goals (insulate 90% of the buildings and use solar energy in 2 1/2 million homes) can be added to any alternative program.

TABLE 1

-UNIVERSITY OF HOUSTON INDUSTRY STUDIES ANALYSIS-
FOSSIL ENERGY SUPPLIES AND DEMANDS FOR DIFFERENT
ENERGY POLICY PROPOSALS, 1985

Fossil Energy Source	1975 Statistics	Policy Cases		
		Modified Price Regulation (MPR)	Complete Price Deregulation (CPD)	Business As Usual (BAU)
Supplies				
Oil (billion barrels)				
Domestic[1]	3.65	4.66	4.67	4.52
Imported[2]	2.22	2.23	2.50	2.62
Total oil	5.87	6.89	7.17	7.14
Natural Gas[3] (tril.cu.ft.)				
Domestic	20.1	17.75	19.38	17.40
Imported	-	0.01	-	1.84
Total gas	20.1	17.76	19.38	19.24
Coal (million short tons)	640	809	940	950
Demands (quadrillion Btu's)				
Oil		38.36	39.78	39.70
Natural Gas		18.33	20.00	19.85
Coal		18.01	19.64	19.94
Total Use	66.83	74.70	79.42	79.49

1. Includes natural gas liquids
2. Includes residual fuel oil
3. Includes associated gas

TABLE 2

-UNIVERSITY OF HOUSTON INDUSTRY STUDIES ANALYSIS-

DOMESTIC ENERGY SUPPLIES FOR DIFFERENT ENERGY POLICY PROPOSALS, 1985

Fuel Type and Supply	Policy Cases		
	Modified Price Regulation (MPR)	Complete Price Deregulation (CPD)	Business As Usual (BAU)
Crude Oil (billion barrels)			
New Wells	2.67	2.61	2.54
Old Wells	1.43	1.43	1.43
Total	4.10	4.04	3.97
Natural Gas Liquids (billion barrels)			
New Wells	.34	.41	.33
Old Wells	.22	.22	.22
Total	.56	.63	.55
Natural Gas (trillion cubic feet)			
New Wells	10.66	12.29	10.31
Old Wells	7.09	7.09	7.09
Total	17.75	19.38	17.40
Coal (million short tons)			
Eastern High Sulfur	115	54	54
Eastern Low Sulfur	309	306	310
Midwestern High Sulfur	155	133	133
Western Low Sulfur	230	448	452
Total	809	941	950

TABLE 3

-UNIVERSITY OF HOUSTON INDUSTRY STUDIES ANALYSIS-

FOSSIL FUEL PRICES AT FINAL ITERATION OF MODEL

FOR DIFFERENT ENERGY POLICY PROPOSALS, 1985

Fossil Fuel Type and Price	Policy Cases		
	Modified Price Regulation (MPR)	Complete Price Deregulation (CPD)	Business As Usual (BAU)
	(1975 dollars)		
New Oil Price ($/bbl)			
Input			
Domestic	13.78	13.78	10.40
Imported	13.00	13.00	13.00
Marginal			
Domestic	13.84	13.79	13.75
Imported	13.00	13.00	13.00
New Gas Price ($/s mcf)			
Input	1.61	2.29	1.42
Marginal	2.34	2.29	2.35
Coal Prices ($/short ton)			
Eastern High Sulfur	14.05	10.80	10.80
Eastern Low Sulfur	17.50	17.50	17.50
Midwestern High Sulfur	14.91	10.38	10.38
Western Low Sulfur	7.30	8.90	8.90

TABLE 4

-UNIVERSITY OF HOUSTON INDUSTRY STUDIES ANALYSIS-
BTU CONTENT OF DOMESTIC AND FOREIGN FOSSIL ENERGY
FOR DIFFERENT POLICY ALTERNATIVES, 1985

	Policy Cases		
	Modified Price Regulation (MPR)	Complete Price Deregulation (CPD)	Business As Usual (BAU)
	(quadrillion Btu)		
Domestic Production			
Oil Liquids	25.464	25.435	24.718
Natural Gas	18.318	19.996	17.957
Total Oil and Gas	43.782	45.431	42.675
Eastern High Sulfur	2.767	1.291	1.308
Eastern Low Sulfur	8.039	7.956	8.070
Midwest High Sulfur	3.346	2.866	2.866
Western Low Sulfur	3.862	7.523	7.594
Total Coal	18.014	19.636	19.838
Total Domestic Fossil	61.796	65.067	62.513
Imports			
Oil Products	12.898	14.340	14.983
Natural Gas	.011	-	1.896
Total Fossil Imports	12.909	14.340	16.879
Total Domestic and Foreign	74.705	79.407	79.392

TABLE 5

-UNIVERSITY OF HOUSTON INDUSTRY STUDIES ANALYSIS-
FOREIGN EXCHANGE PAYMENTS FOR DIFFERENT ENERGY
POLICY PROPOSALS, 1985

	Policy Cases		
	Modified Price Regulation (MPR)	Complete Price Deregulation (CPD)	Business As Usual (BAU)
	(billion 1975 dollars)		
Crude Oil	25.25	29.71	31.51
Residual Fuel Oil	3.77	2.76	2.48
Natural Gas	0.03	-	4.59
	29.05	32.47	38.58

TABLE

-UNIVERSITY OF HOUSTON INDUSTRY STUDIES ANALYSIS-
ELECTRICITY GENERATED, GENERATION COSTS, CAPITAL REQUIREMENTS, AND SULFUR DISCHARGES FOR DIFFERENT ENERGY POLICY PROPOSALS, 1985

	Policy Cases[1]		
	Modified Price Regulation (MPR)	Complete Price Deregulation (CPD)	Business As Usual (BAU)
Electricity Generated (billion kWh)			
East Coast Region	1240	1293	1298
Rest of Country	2014	2100	2107
	3254	3393	3405
Electricity Generation Costs in Fossil Fueled Plants (billion 1975 dollars)			
East Coast Region	12.10	12.02	12.08
Rest of Country	16.86	16.42	16.51
	28.96	28.44	28.59
Capital Requirements for Fossil-Fueled Electric Power Plants, 1975-1985 (billion 1975 dollars)			
East Coast Region	17.12	18.42	18.77
Rest of Country	25.33	26.79	27.24
	42.45	44.61	46.01
Sulfur Dioxide Discharges of Electric Power Plants (billion pounds)			
East Coast Region	8.56	10.08	10.13
Rest of Country	12.62	16.33	16.41
	21.18	26.41	26.54
Marginal Costs of Generating Electricity in Fossil Fueled Plants (Cents per kWh in 1975 dollars)			
East Coast Region	2.65	2.25	2.25
Rest of Country	2.73	2.27	2.27

1. East Coast Region is states east of Applachian Mountains, and Rest of Country Region is states west of Appalachian Mountains.

TABLE 7

-UNIVERSITY OF HOUSTON INDUSTRY STUDIES ANALYSIS-

ELECTRIC POWER GENERATION FOR NEW AND OLD PLANTS BY FUEL TYPE FOR DIFFERENT ENERGY POLICY PROPOSALS, 1985

	Policy Cases		
	Modified Price Regulation (MPR)	Complete Price Deregulation (CPD)	Business As Usual (BAU)
	(billion kWh)		
Old			
Gas-Fired Steam Electric	358	358	358
Oil-Fired Steam Electric	331	331	331
Coal-Fired Steam Electric	858	858	858
Combined Cycle	15	15	15
Total Old	1562	1562	1562
New			
Coal-Fired Steam Electric	192	630	642
Coal Gasification/Combined Cycle	300	-	-
Total New	492	630	642
Nuclear	741	741	741
Hydro	460	460	460
Total	3254	3393	3405

TABLE 8

-UNIVERSITY OF HOUSTON INDUSTRY STUDIES ANALYSIS-
REVENUES RECEIVED BY DOMESTIC PRODUCERS OF OIL LIQUIDS, NATURAL GAS, AND FOUR TYPES OF COAL AT WELLHEAD AND MINEMOUTH PRICES, 1985

	Policy Cases[1]		
	Modified Price Regulation (MPR)	Complete Price Deregulation (CPD)	Business As Usual (BAU)
	(billions 1975 dollars)		
Oil and Gas			
Oil Liquids	46.3	46.1	36.5
Natural Gas	22.8	33.7	20.3
Total Oil and Gas	69.1	79.8	56.8
Coal			
Eastern High Sulfur	1.62	0.58	0.59
Eastern Low Sulfur	5.41	5.36	5.43
Midwest High Sulfur	2.31	1.38	1.38
Western Low Sulfur	1.68	3.99	4.02
Total Coal	11.02	11.30	11.42
Total Oil, Gas & Coal	80.1	91.1	68.2

1. Revenues are calculated as follows: (1) In MPR Case, revenues reflect regulated prices for new gas, lower tier oil, and upper tier oil; and revenues reflect current world prices for new oil, as specified; (2) In CPD Case, revenues reflect market prices for new gas and new oil; revenues reflect market prices less windfall profit taxes for lower tier and upper tier oil; and (3) In BAU Case, revenues reflect regulated prices for oil and new gas.

TABLE 9

-UNIVERSITY OF HOUSTON INDUSTRY STUDIES ANALYSIS-
SALES COSTS, ECONOMIC VALUE, AND REGULATION COSTS
OF DOMESTIC RAW FOSSIL ENERGY PRODUCTION AT
WELLHEAD AND MINEMOUTH LEVEL, 1985.

	Policy Cases		
	Modified Price Regulation (MPR)	Complete Price Deregulation (CPD)	Business As Usual (BAU)
	(billion 1975 dollars)		
Sales Cost of Domestic Raw Fossil Energy Production, as Received by Producers[1]			
Oil Liquids	46.3	46.1	36.5
Natural Gas	22.8	33.7	20.3
Coal	11.0	11.3	11.4
Total Sales Costs	80.1	91.1	68.2
Economic Value of Domestic Raw Fossil Energy Production[2]			
Oil Liquids	62.1	61.6	59.9
Natural Gas	30.6	33.7	29.9
Coal	11.0	11.3	11.4
Total Economic Value	103.7	106.6	101.2
Economic Cost of Regulation [3]	23.6	15.5	33.0

1. Excludes oil equalization tax in MPR Case and Windfall profit tax in CPD Case; note, oil equalization tax equals windfall profit tax.

2. Economic value calculated at marginal prices of oil, new gas, and coal.

3. Total economic value of domestic raw fossil energy at wellhead and minemouth level less sales costs of domestic raw fossil energy at wellhead and minemouth level; note, regulation cost equals windfall profit tax in CPD Case.

TABLE 10

-UNIVERSITY OF HOUSTON INDUSTRY STUDIES ANALYSIS-
ECONOMIC COSTS OF REGULATION PER MILLION BTU OF RAW FOSSIL ENERGY AT THE WELLHEAD AND MINEMOUTH LEVEL, 1985

Policy Case	Raw Fossil Energy Cost per Million Btu [1] (1975 dollars)
MPR	38.2 cents
CPD	23.8 cents
BAU	52.8 cents

1. Economic cost of regulation in Table 9 divided by Btu of domestic fossil energy production in Table 4.

TABLE 11

-UNIVERSITY OF HOUSTON INDUSTRY STUDIES ANALYSIS-
NEW TAXES FOR MODIFIED PRICE REGULATION CASE,1985

Source of New Taxes	Tax Computations		
Taxes Exogenous to Industry Model	Tax Rate (1975$)	Use (billion)	Tax (billion 1975 $)
Gasoline	14.70/bbl	2.381 bbls	35.00
Industrial Distillate	2.760/bbl	0.196 bbls	0.54
Industrial Residual	2.944/bbl	0.181 bbls	0.53
Industrial LPC	2.024/bbl	0.076 bbls	0.15
Industrial Kerosene	2.714/bbl	0.018 bbls	0.05
Industrial Natural Gas	1.586/smcf	7.482 smcf	11.87
Total Exogenous Taxes			$48.14
Taxes Endogenous to Industry Model			
Natural Gas in Electricity Generation			
East Coast Region		0.953 quads	1.18
Rest of Country		3.049 quads	3.78
Oil Products in Electricity Generation			
East Coast Region		2.150 quads	0.43
Rest of Country		1.467 quads	0.29
Natural Gas in Process Industries		neg.	neg.
Oil Products in Process Industries		1.921 quads	0.88
Oil Equalization Tax (Windfall Profits Tax)			
Lower Tier Oil (pre'74)		1.43 bbls.	12.78
Upper Tier Oil ('74-'77)		0.38 bbls.	1.28
Lower Tier NGL (pre '74)		0.22 bbls.	1.38
Upper Tier NGL ('74-'77)		0.04 bbls.	0.09
Total Endogenous Taxes			$21.97
Total New Taxes of MPR Case			$70.11

TABLE 12

-UNIVERSITY OF HOUSTON INDUSTRY STUDIES ANALYSIS-
ECONOMIC COSTS OF SATISFYING FINAL ENDPRODUCT REQUIREMENTS IN THE FOSSIL ENERGY SECTOR AT THE WHOLESALE LEVEL, 1985

	Policy Cases		
	Modified Price Regulation (MPR)	Complete Price Deregulation (CPD)	Business As Usual (BAU)
Oil Imports (Bil '75 $)	29	32.5	39
Domestic Industry (Bil '75 $)	132	144.0	121
New Taxes (Bil '75 $)	70	15.5	0
Total	231	192	160
Fossil Energy Use (quadrillion Btu)	74.7	79.4	79.5
Economic Cost per Million Btu at Wholesale Level (1975 dollars)	$3.09	$2.42	$2.01

REFERENCES

1. Calloway, James A. and Russell G. Thompson. "An Integrated Industry Model of Petroleum Refining, Electric Power and Chemicals Industries for Costing Pollution Control and Estimating Energy Prices." Engineering and Process Economics, I, pp. 199-216, 1976.

2. Griffin, James. "Long-Run Production Modeling with Pseudo Data: Electric Power Generation," Bell Journal, (Spring, 1977).

3. Federal Energy Administration, National Energy Situation, Washington, D. C., 1976.

4. Kim, Y. Y. and R. G. Thompson, An Economic Model of New Crude Oil and Natural Gas Supplies in the Lower 48 States. Technical Report to the Texas Governor's Energy Advisory Council, Austin, Texas, December 1976.

5. National Electric Reliability Council, "Review of Overall Reliability and Adequacy of the North American Bulk Power Systems (Fifth Annual Review)," July 1975, NERC, Princeton, New Jersey.

6. Thompson, R. G., Robert R. Hill, David Gottlieb, Erick Furubotn, and A. Rufus Waters. "Economic Analysis" in Regional Assessment Study: Houston Ship Channel-Galveston Bay prepared by Bernard Johnson, Inc. Houston, for the National Commission on Water Quality. Volume II, pp. IV-A-1 to IV-A-79, August 1975 (1975a).

7. Thompson, Russell G., R. J. Lievano, Robert R. Hill, James A. Calloway, and John C. Stone. Relationship Between Supply/Demand and Pricing for Alternate Fuels in Texas: A Study in Elasticities." Technical Report to the Texas Governor's Energy Advisory Council, December 31, 1974. Republished in the Hearings Before the Committee on Interior and Insular Affairs, United States Senate, 94th Congress, 1st Session, pp. 337-363, January 1975 (1975b).

8. Thompson, R. G., J. A. Calloway, and L. A. Nawalanic, eds. The Cost of Clean Water in Ammonia, Chlor Alkali, and Ethylene Production. Houston: Gulf Publishing Company, 1976 (1976a)

9. Thompson, R. G., R. J. Lievano, and J. A. Calloway, "Forecasting Change in Industry and the Economy with Restricted Resources," Interdisciplinary Science Reviews, Vol.1, No. 4, 1976, pp. 311-321 (1976b).

10. Thompson, R. G., J. C. Stone, and F. D. Singleton, Jr., Summary of Energy Supply, Demand, and Pricing Evaluations for Texas Governor's Energy Advisory Council, technical report to Advisory Council, Austin, Texas, December, 1976 (1976c).

11. Thompson, R. G., J. A. Calloway, and L. A. Nawalanic, eds. The Cost of Electricity: Cheap Power Vs. a Clean Environment, Houston: Gulf Publishing Company, 1977 (1977a).

12. Thompson, R. G., J. A. Calloway, and L. A. Nawalanic, eds. The Cost of Energy: A Linear Economic Model of the Petroleum Refining, Electric Power, and Chemicals Industries. Houston: Gulf Publishing Company. To appear in November 1977 (1977b).

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-APPENDIX I

CARTER'S NATIONAL ENERGY PROGRAM ELEMENTS: A SUMMARY

The following is a summary of a 28-page fact sheet distributed to the press a few hours before the President unveiled his energy plan to Congress on the night of April 20. The fact sheet itself is a summary of legislation which may total 1,500 pages and administrative actions required by the program. Statements in parentheses have been added by the GEAC staff for clarification or emphasis.

CONSERVATION

Evaluated in Modeling	
	Transportation
no	--Gas guzzler tax and rebate. Graduated tax and rebates on new cars and light trucks linked to fuel efficiency; begins in 1978 and increases through 1985; the break point between tax and rebate increases from 18 mpg in 1978 to 27.5 mpg in 1985; highest tax in 1978 (for 12.5 mpg or less) is $449 increasing to $7,488 in 1985; highest rebate over the period is $499 (for 39 mpg or better); rebates for foreign cars are subject to negotiation.
no	--May withhold federal highway funds from states not enforcing 55 mph speed limit (Texas legislature is considering bills easing penalties for 55 mph violators).
yes	--Standby gasoline taxes to go into effect if consumption targets are not met; tax amounts to 5 cents per gallon per year not to exceed 50 cents per gallon; earliest possible tax is January, 1979; tax may be reduced when targets are met; all taxes collected will be rebated through income tax system.
no	--Removal of 10% excise tax on intercity buses; increase aviation gas tax by 4 cents and motorboat gas tax by 2 cents.
no	--New federal government vehicles to exceed fuel efficiency standards by 2 mpg in 1978 and 4 mpg in 1980.
	Buildings
no	--Tax credit to homeowners of 25% of first $[illegible]00 and 15% of next $1,400 spent on approved conservation measures undertaken before 1985.
no	--State utility commissions "required" to direct utilities to offer customers a residential energy conservation service to be repaid through monthly utility bills.
no	--Government-backed home improvement conservation loans.
no	--Low-income weatherization funding increased to $130 million in FY 78 and $200 million in FY 79 and FY 80.
no	--Rural home weatherization through electric cooperatives.
no	--Businesses given additional 10% tax credit for conservation investments.
no	--Federal grants to non-profit schools and hospitals, $300 million per year for three years.
no	--HUD will advance by one year (from 1981 to 1980) the effective date for mandatory standards required for new residential and commercial buildings under the Energy Conservation and Production Act. Funds to states to help in this effort.
	Appliances
no	--Present voluntary standards to be made mandatory for certain appliances. Ongoing labeling program to continue.
	Industry
no	--Five year 10% investment tax credit for energy-saving capital improvements.
Co-generation modeled	--To encourage cogeneration (the production of industrial steam and electricity from the same facility) industrial cogenerators will be exempt from utility regulations; [illegible] assurance of fair rates for back-up power; 10% tax

credit to purchase cogeneration equipment; possible exemption from conversion orders.

Rate Reform

no --State utility commissions must eliminate promotional rates which do not reflect cost-of-service.
no --Utilities must offer customers daily off-peak rates (customer pays for metering) and interruptible rates.
no --Prohibition of master metering for new buildings.
no --Gas utilities would have to discontinue declining block rates.
no --Required interconnection and power pooling among intrastate electric utilities (aimed at the Texas Interconnected System and its current problems).
yes --Taxes on oil and gas to encourage conservation (details below).

OIL & GAS PRICING

Oil Pricing

yes --Continue indefinitely the $5.25 lower tier and $11.28 upper tier prices to be adjusted for inflation.
yes --Allow newly discovered oil to rise over three year period to current world price (about $14) with inflation adjustments.
no --Define new oil as oil from wells drilled more than 2 1/2 miles from an existing well or 1,000 feet deeper than other wells in a 2 1/2 mile radius. All new OCS leases will be defined as new oil.
yes --Stripper oil and incremental tertiary recovery oil will be unregulated.
yes --Alaskan crude will be considered upper tier oil ($11.28 adjusted) and treated as foreign oil for purposes of entitlements. New Alaskan finds will be "new" oil. Elk Hills NPR production will be limited until west-to-east transportation system is in place.
no --Shale oil to receive world market prices.
yes --All domestic production will be subject to an equalization tax to be imposed in stages such that by 1980 all domestic crude will be taxed at a per-barrel rate sufficient to equal the world market prices. Taxes to be rebated through income tax (would end entitlements program).

Gas Pricing

yes --All new gas sold in U.S. (including intrastate gas) cannot exceed the Btu equivalent of the average refiner acquisition cost of domestic crude before tax (or about $1.75 per mcf).
no --Define "new gas" using same standards as "new oil" (2 1/2 miles, 1,000 feet and new OCS leases).
no --Certain high cost gas may have higher price ceilings.
no --Gas from expiring interstate contracts may sell for up to $1.42 per mcf. Expiring intrastate gas may sell at $1.75 ceiling.
no --Allocates the cost of more expensive new gas to industrial users (incremental pricing).
no --Extends federal controls to SNG plants.

CONVERSION (away from oil and gas)

Oil and Gas Users Tax

yes --Beginning in 1979 industrial gas users (excepting agricultural) will be taxed such that their gas costs equal a "target" keyed to fuel oil prices. The target price will rise to equal fuel oil prices by 1995. The target for 1979 will be $1.05 below the Btu equivalent cost of fuel oil.
yes --Electric utilities will bear a similar tax beginning in 1983 (with fuel oil

price parity achieved in 1988).

yes --Petroleum used by industry will be taxed at 50 cents per bbl in 1979 rising to $3 per bbl in 1985. A similar tax on utility use of petroleum will begin in 1983 at a rate of $1.50 per bbl (and remain constant).

no --Industry to receive either a 10% investment tax credit for conversion expenditures or a rebate of oil and gas taxes paid equal to conversion costs.

Mandatory Conversion Regulations

yes --Ban on new oil and gas-fired boilers.

yes --Prohibits any utility from burning gas after 1990.

Environmental Policy for Coal

yes --Requires best available technology (scrubbers) in all new coal-fired plants.

uncertain --Continues "significant deterioration" policy.

no --Tough federal strip mining law.

Coal Research and Development

no --Extensive R&D into clean coal burning technologies, pollution control and coal gasification and liquefaction.

Nuclear Power

no --Reiteration of previously announced policies on nuclear proliferation, plutonium recycle and deemphasis of breeder technology.

no --Expansion of enrichment capacity.

no --Stepped-up safety monitoring of existing light water reactors.

no --Streamline licensing process for standardized plant designs.

Solar Power

no --Tax credits of 40% of the first $1,000 and 25% of the next $6,400 for approved solar installations; credits gradually diminish through 1984 then expire.

no --$100 million three year program for solar additions to federal buildings.

no --Increased funding for solar, wind, biomass and other alternate source research, development and demonstration.

no --Business tax credits for solar investments for industrial and commercial use (eligible for 10% conservation tax credits).

no --State utility commissions required to develop guidelines to prevent discriminatory rates against solar users.

Geothermal Energy

no --Tax deductions for geothermal drilling operations.

no --Streamline leasing and environmental review procedures to develop geothermal resources on federal lands.

no --Extensive funding of development of gas resources from geopressured zones (Texas and Louisiana, primarily).

OTHER ELEMENTS

Energy Research, Development and Financial Incentives

no --Government assumption of audit and verification roles now performed by AGA and API in determining reserve and production statistics.

no --Elimination of redundant reporting requirements by federal agencies.

no --Extensive financial reporting by major oil and gas companies based on functional areas of production, refining, transportation and marketing and geographic regions (viewed by some as a substitute for divestiture and by others as a first step to divestiture).

no --Rejection (for the moment) of either horizontal or vertical divestiture with close monitoring of anti-competitive actions.

no --State energy offices, assisted by the federal government, to collect data on

energy availability and reliability.

Low-Income Assistance

no --In addition to weatherization program and tax rebates, there will be rebates to users of home heating oil (mostly in the East and North).

Strategic Petroleum Reserve

no --Expand SPR program from 500 million bbl storage to 1 billion bbl, enough to withstand serious supply interruptions for 10 months.

Liquefied Natural Gas

Limited LNG imports allowed --Removal of current import limitation on LNG coupled with strict siting criteria.

Outer Continental Shelf

no --Support of current OCS bill before Congress (which industry says will hamper rather than expedite OCS production).

Gasoline Decontrol

yes --Removal of gasoline price control and allocation regulations by next fall (would likely eliminate the question of "passthrough" of a potential Texas refinery tax).

Industry Taxation

no --Give independents same tax relief as majors in the treatment of intangible drilling costs.

Studies, Inquiries, Investigations, Etc.

no --In addition to the administrative actions and proposed legislation, the plan calls for a variety of inquiries into such areas as the adequacy of the energy transportation system, energy development and price impacts, industry competition, environmental considerations of coal conversion, uranium and thorium resource evaluation, and a search for additional hydroelectric sites.

If all the above is carried out, the President hopes the following goals will be reached.

GOALS (for U.S. by 1985)

Reduce annual growth of demand to less than 2% (historic growth is about 3 1/2%); reduce oil imports from forecasted 16 million b/d to 6 million; reduce gasoline consumption by 10% (presumably over current levels); insulate 90% of buildings; increase coal production by 400 million tons per year (from current level of about 650 million); and use solar energy in 2 1/2 million homes.

APPENDIX II

COAL SUPPLY, BENEFICIATION, AND TRANSPORTATION

Briefly, economic supplies of coal produced in the Eastern, Midwestern, and Western Regions of the nation were developed as follows: price-quantity data were extracted from FEA's Coal Report (1976) with key states being selected for each major producing region; each supply point was categorized according to Btu content and sulfur content; FEA's regions were aggregated into Eastern, Midwestern, and Western Regions; and FEA's many coal type classifications were aggregated to give four coal types: Eastern High Sulfur (EHC), Eastern Low Sulfur (ELC), Midwestern High Sulfur (MHC), and Western Low Sulfur (WLC); FEA data within the four coal types were summed to give four step-function supply curves for coal; and piecewise linear approximations of each step-function were used to derive a price-quantity pairing for each coal type.

Central and Eastern coal consuming regions are used in the model to prevent large quantities of western low sulfur coal from being shipped to the electric power industry on the East Coast at an unrealistically low price. The Central coal consuming region is assumed to consist of the states west of the Appalachian Mountains; and the Eastern coal consuming region is assumed to consist of the states east of the Appalachians. Areas served by barge transport on the Mississippi and Ohio Rivers are included in the Central Region.

All of the petroleum refining and chemicals industries are assumed to be in the Central Consumption Region to minimize computational time. No provisions are made for other special regions like the West Coast of the United States.

Coal Supply for the Model

Coal supply curves were developed for the model based on the data and methodology used during 1975-76 in the Project Independence Evaluation System (PIES) of the Federal Energy Administration (FEA). The PIES coal supply methodology is based on Bureau of Mines reserve base estimates of coal tonnage and quality characteristics by seam and county (FEA, 1976). The PIES methodology assigns Bureau of Mines coal reserves to 32 product quality categories (8 sulfur content ranges x 4 Btu content ranges), and to a large number of mine type categories. Mine type categories are differentiated by surface or deep mine technology, size of mine, and depth and thickness of coal seam. For surface mines the depth below ground and thickness of a coal seam are combined to give the parameter "overburden ratio," the ratio of cubic yards of overburden material removed per ton of coal mined. In the PIES analysis a mining cost model was used to develop capital and operating costs for each mine type. The PIES methodology thus defines a set of hypothetical coal mines that exploit the entire U.S. coal reserves as defined by the Bureau of Mines.

In the PIES methodology a fraction of the entire set of hypothetical coal mines is identified as corresponding to existing U.S. capacity. Coal is assumed to be produced by these mines provided the market price covers variable costs of production. The remaining mines are mines built after 1976 and are only brought into production when the market price covers all costs plus 8% per year return on investment.

In the PIES model supply curves are generated by aggregation of

the hypothetical coal mines over 12 geographical regions and three product types: metallurgical coal, low sulfur coal, and high sulfur coal. Metallurgical coal is defined as coal in the highest PIES Btu content range (greater than 26 million Btu per ton) and the two lowest sulfur content categories (less than 0.6 lb sulfur per million Btu). PIES low sulfur coal is defined as coal which does not meet metallurgical specifications but has a sulfur content of less than 0.72 lb sulfur per million Btu. PIES low sulfur coal is defined such that it meets EPA new source SO_x performance standards (1.2 lb SO_2/MMBtu coal) either as is or after beneficiation. PIES high sulfur coal is defined as all coal which contains more than 0.72 lb sulfur per million Btu.

For the work reported here, the 12 PIES geographical regions were aggregated into three regions: the three PIES Appalachian regions were combined into one Eastern region; the PIES Midwest and Central-West regions were combined and designated Midwestern; and the PIES Western Northern Great Plains region (western Montana, Wyoming, and northern Colorado) was taken to represent the Western region for the model. Further, coal was allocated into four representative types: eastern low sulfur coal type (code ELC), eastern high sulfur (EHC), midwestern high sulfur (MHC), and western low sulfur (WLC) coals. Coals MHC and WLC were defined as all coal in the midwestern and western regions, respectively, with the exception of metallurgical grades. The eastern region has coal with a very wide range of sulfur contents, and coal types ELC and EHC are defined such that roughly half of the eastern non-metallurgical coal reserves are in each representative type. Type

Table 1

POINTS DEFINING STRAIGHT-LINE-SEGMENT COAL SUPPLY CURVES

Coal Type	Price - $/ton	Quantity - 10^6 tons/yr.
ELC	10.00	0
	16.20	230
	21.60	660
	33.10	1100
	107.00	1155
EIIC	7.70	0
	16.60	150
	20.40	460
	33.10	810
	107.00	857
MHC	6.50	0
	8.90	125
	15.00	160
	19.60	960
	31.00	1450
	94.70	1483
WLC	5.50	0
	9.20	450
	19.30	2700
	28.50	3850

ELC is defined as coal with a sulfur content of less than 1.68 lb/million Btu but not meeting metallurgical quality standards. Type EHC is defined as coal exceeding 1.68 lb/million Btu in sulfur content.

A supply curve was generated from the PIES mine cost data for each of the four representative coal types. This was done by assigning each PIES hypothetical coal mine to the appropriate representative coal type. The mine data for each type were then arranged in order of increasing coal selling price, and selling price was plotted versus cumulative mine capacity to give a supply curve consisting of a large number of small discrete stair-steps, with each step representing the addition of one or more mines to the production base. It was found that these supply curves could be well represented by sets of 3 to 6 straight-line segments fitted to the stair-steps. Table 1 presents the supply curves for the four representative coal types. If the price-quantity data in Table 1 are plotted and the points connected by straight lines, the supply curves are obtained.

Representative ash, sulfur, and Btu contents were assigned to each of the four coal types. Ash content of the coal was not specified in the PIES data. Ash content of coal varies widely, but it does not show any pronounced trends from region to region (Deurbrouck, 1972). Accordingly, all types of coal were assumed to have the same ash content, 17% by weight. As the cumulative production quantities were computed for the supply curves, cumulative average sulfur and Btu contents were also computed. As individual mines with differing coal qualities are added to the production base, the cumulative average sulfur and Btu contents vary slightly. The

Table 2

RAW COAL PROPERTIES

Coal Type	% Sulfur	% Ash	Btu/lb.
ELC	1.4	17.	13000
EHC	3.0	17.	12000
MHC	3.0	17.	10800
WLC	0.4	17.	8400

Table 3

BENEFICIATED COAL PROPERTIES

Coal Type	% Sulfur	% Ash	Btu/lb.
ELB	1.19	6.8	14690
EHB	2.11	6.8	13560
MHB	2.11	6.8	12200
WLB	0.38	6.8	9490

Table 4

COAL TRANSPORTATION COSTS PER TON

Coal Type	To Central Region	To Eastern Region
Eastern (ELC, EHC, ELB, EHB)	$8	$5
Midwestern (MHC, MHB)	$4	$8
Western (WLC, WLB)	$10	$20

sulfur and Btu contents given in Table 2 were selected as being typical values for the four coal types.

Coal Beneficiation

Beneficiation, or "washing," is carried out at the mine mouth to improve coal quality by separating heavy sulfur-bearing and ash-producing inorganic minerals from the lighter, burnable, organic portion of the coal. Raw coal is crushed and slurried in water, and the separation is carried out on jigs, tables, "spirals," air flotation units, or other apparatus. The final product is dried in a rotary drier and the discarded material is reburied in the mine. (U. S. Dept. of Commerce, 1975; Cavallaro et al, 1974; Deurbrouck, 1972.)

Different levels of treatment are possible with coal beneficiation. The coal may be crushed to a fine mesh size and passed through a multi-stage separation device to achieve a high level of cleaning, or it may be coarse-crushed and separated in a simple apparatus to obtain a low level of cleaning. The process assumed for the model is described in the literature as "Level 3," a medium level process (U. S. Dept. of Commerce, 1975). We assume that this process reduces the ash content to 40% of its original value (i.e., from 17% to 6.8%). Also, the Btu content per lb is increased by 13%. We assume that 1.25 tons of raw coal are required to produce one ton of beneficiated coal. Some fuel value is lost in the discarded material, and approximately 40 lb of coal and 0.4 gallons of fuel oil are burned as drier fuel per ton of product (Lyons, 1950). Capital cost for beneficiation is assumed to be $4.22 per ton

per year capacity, and operating cost excluding energy costs is assumed to be $0.52 per ton. A 20% per year capital charge is applied. (U. S. Dept. of Commerce, 1975.)

Coal contains the inorganic sulfur mineral pyrite (FeS), which can be mechanically separated and removed by beneficiation. It also contains organic sulfur compounds which cannot be removed by beneficiation. As a general rule, high sulfur coals contain pyrite and organic sulfurs in roughly equal proportions. In low sulfur coals nearly all sulfur is organically combined. For the model, sulfur removal percent was assumed to be a function of raw coal sulfur content:

$$(\text{Percent S removal}) = 11\ (\%S)^{0.9}$$

Thus for 3% sulfur coal 30% removal is expected, but for 0.4% coal only 5% removal is expected by beneficiation. Tables 2 and 3 give the properties of the four representative coal types before and after beneficiation, respectively.

The economic justification for beneficiation of steam boiler coals may stem from different factors. For all coals in the model, ash disposal costs at the boiler are reduced by 60%. For high sulfur coals, sulfur removal is an important benefit. For low sulfur western coals which must be transported long distances, the reduction in weight per Btu is significant in the model.

Coal Transportation Costs

In the model coal is assumed to be mined and beneficiated in the three regions, Eastern, Midwestern, and Western, as described above.

Two coal consuming regions, Central and Eastern, are used in the model to prevent large quantities of western low sulfur coal from being shipped to the eastern electric power industry at an unrealistically low price. To avoid further addition of rows and increased computation times, the petroleum refining, chemical, and plastics industries are assumed to be located in the Central consuming region. Also, no provision is made for other special regions, such as the U. S. West coast.

The Central coal consuming region is assumed to consist of the portion of the country west of the Appalachian Mountains, including areas served by barge transport on the Mississippi and Ohio Rivers. The Eastern region consists of the easternmost tier of states.

Table 4 gives the coal transportation costs assumed for the model. These costs were estimated based on PIES cost data (Childress, 1976).

APPENDIX III

REVISIONS TO OTHER COMPONENTS OF MODELLING SYSTEM

In the interim between the analyses reported in The Costs of Energy (Thompson et al, eds., 1977) and the analyses for GEAC reported here, a number of revisions and improvements have been made to the various components of the overall system. A wholly new supply model was developed for oil and gas and has been documented separately (Kim and Thompson, 1977). A price-sensitive coal supply model was adapted from the work of FEA as described in Appendix III. Additional changes to and substitutions in the linear programming industry model, the end product demand model, and the supply-demand-industry interface will be briefly outlined here.

Revisions to Industry Model

(1) Process vectors designed to represent the production of nylon (and its precursors) and low density polyethylene were added to the model. New vectors for polyvinyl chloride were developed from more recent data.

(2) Extensive revisions were made to the electric power industry component of the model, both in terms of structure and estimates of process parameters. Major revisions were made in the method of accounting for air emissions and the control thereof. New cost and energy requirement parameters were developed for air emissions control processes and many of the production processes. However, the electricity generating unit types and utilization factors were retained from the previous version of the model.

As mentioned previously, the electric power component was also separated into two regions so as to account properly for the generation cost impact of the differences in coal transportation costs.

(3) Coincident to the revisions to the electric power sector a new system of vectors was designed to more accurately represent the burning of coal and fuel oil, both in large power plant boilers and in the kind of smaller boilers likely to be used by the process industries. FORTRAN programs were developed to estimate air and water emissions, and pollution control costs (precipitators and wet scrubbers) for the various types of boiler fuel. In the model, it is possible to burn eight types of coal, three grades of residual fuel oil, and two grades of distillate fuel oil.

Fuel burning in each industry was required to comply with a specified standard of allowable air emissions. Particulate control was required for any fuel with a non-trivial ash content. Additionally, each industry was required to mix fuels or employ stack scrubbers as necessary to achieve an average sulfur oxide emission standard. New source performance standards were specified as 1.2 lbs SO_2/MMBtu for coal and 0.8 lbs SO_2/MMBtu for oil. Because of the variance in old source emission standards, a standard 1.5 items that of the new source standard for coal was imposed. For old oil plants the emission standard was set at 1.05 lb SO_2 per million Btu, which is equivalent to burning 1% sulfur oil without scrubbers. The distinction between old and new sources for electric power was clear-cut since the industry model explicitly deals with old and new plants in that industry. Such detail is generally not modelled for the process industries, however, and a further approximation was required.

All coal-fired boilers were assumed to be new sources since the industries modelled do not currently use a great amount of coal as boiler fuel. All existing plant (pre 1975) boilers were assumed to be oil-fired. The capacity of pre-1975 boilers in 1985 plants was assumed to be approximately one-half of that required in a typical 1985 solution of the model (e.g. the CPR case described above). However, the model chooses in all cases to discard its existing oil-fired industrial steam boilers and retrofit coal-fired ones, even when stack-gas scrubbers are required.

As in previous versions of the model process heaters are assumed not able, for technical reasons, to burn coal or residual fuel oil.

Finally, the end product demands for coal and fuel oils supplied by the industry model (as opposed to consumed by it) were required on the average to meet the new source standard without sulfur control (fuel oils) or meet a standard 1.25 times the new source standard (coal). This is appropriate for residential and commercial demands since those establishments are generally of insufficient scale to install stack gas scrubbers. It is not completely appropriate for exogenous industrial demand, but the technique does indirectly account for the costs of sulfur control in non-modelled industries as the premium on the price of clean fuel supplied to those industries is determined by the cost of emission control on dirtier fuels as explicitly and accountably included in the industry model. By a similar logic, the costs of particulate control on these "sold" fuels is included in the objective function in order to prevent the occurrence of a cheap "out" for fuels with a high ash content.

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(4) New estimates were made of the existing capacities of the different kinds of fossil-fueled electric power plants. Data published by the National Electric Reliability Council (1975) were employed, as that provided by the Federal Power Commission does not disaggregate steam generation among the various fossil fuel types. Unfortunately, the NERC regional disaggregation did not completely correspond to the regionalization used in the model (which is based on FEA regions which are based on FPC regions). Accordingly, adjustments based on our experience were made for two NERC regions which overlap FPC regions.

(5) Production levels specified for the numerous products included in the industry model were all re-estimated on the basis of the most current data available. Such a re-estimate was believed important in order to account for the rather abrupt decline in refinery and chemical production following late 1973. The primary source for these estimates was the Chemical Economics Handbook which had largely complete data for 1974 and partial or projected data for 1975. The estimated 1975 production levels were then extrapolated to 1985 on the basis of assumed trends in population and income growth.

(6) Cost coefficients in the industry model were inflated to a 1975 price level on the basis of industry-specific components of the Chemical Engineering Plant Cost Index and the Marshall and Stevens Equipment Cost Index.

(7) To reduce the size of the model, and hence the solution time, the explicitly modelled wastewater treatment systems in each industry were removed from the model. These were replaced by cost rows to sum wastewater treatment costs for each industry. Process activities in the model previously contributed gallons of wastewater and lbs of BOD, COD, etc. , to a wastewater treatment system. In the current model a process activity has a single coefficient in a wastewater cost row.

The value of the cost coefficient in each process vector was estimated using the U. H. Industry Studies Wastewater Treatment Simulation Model (UHTMOD). First, representative treatment plant raw waste loads were chosen as shown in Table 1. Parameters in UHTMOD were adjusted to give reasonable wastewater treatment plant designs for each row waste load. Each design contained primary, secondary, and tertiary treatment capacity sufficient to meet EPA 1983 (BAT) effluent standards. For the petroleum refining and organic chemical industries three additional UHTMOD simulations were run with 20% increases in water flow, COD raw waste load, and oil raw waste load. Three simultaneous linear equations were set up containing the water, oil, and COD raw wasteloads as coefficients and the treatment costs as right hand sides. Solution of the three equations gives

$Treatment Cost = 1.126 (flow, Kgal) +0.104 (COD, lb) -0.132 (oil, lb)

The treatment cost coefficients for each activity in the organic chemicals and petroleum refining industries were then computed from the above equation.

For the plastics and synthetic rubber industries the same procedure was followed except that total suspended solids were included to give four simultaneous linear equations. Raw waste loads were re-estimated based

Table 1 Representative Treatment Plant Raw Waste Loads for UHTMOD

Organic Chemicals and Petroleum Refining:

Flow:	1.08 Mgal/day
COD:	2523 mg/l
TSS:	100 mg/l
Oil:	567 mg/l

Plastics and Synthetic Rubber Industries - high COD:

Flow:	0.8 M gal/day
COD:	3000 mg/l
TSS:	200 mg/l
Oil:	50 mg/l

- low COD:

Flow:	0.8 M gal/day
COD:	800 mg/l
TSS;	167 mg/l
Oil:	42 mg/l

on EPA data (EPA, 1973) because in the earlier model suspended solids were neglected. Wastewaters from many processes involving polymers contain fine suspended polymer solids which exert COD. Also, two different treatment cost equations were estimated because COD concentration varies widely in these industries:

$Treatment Cost = 1.190 (flow,Kgal) + 0.090 (COD, lb)
+ 0.303 (TSS, lb) + 0.600 (oil, lb)
for COD > 1550 mg/l

$Treatment Cost = 1.030 (flow, Kgal) + 0.145 (COD, lb)
+ 0.287 (TSS,lb) + 0.444 (oil, lb)
for COD < 1550 mg/l.

New End Product Demand Model

Price-sensitive demands for coal, electricity, distillate and residual fuel oils, natural gas, LPG, gasoline, kerosene, and jet-grade naphtha were determined for the model by an adaptation of the energy demand model employed by FEA in the PIES methodology (FEA, 1976). The model is a constant elasticity approximation of the larger, dynamic FEA energy model. According to FEA, any such approximation corresponds to (is calculated at) a particular solution to the PIES model; the only elasticity matrix for which complete documentation was available was that for the $13 Reference Scenario in the 1976 Energy Outlook. It is recognized that the elasticities and base demands drawn from this scenario involve judgmental considerations, but these judements were unavoidable in light of the available

FEA documentation. The base demands corresponding to the elasticity matrix are disaggregated regionally by FEA. The product demands for these regions were grouped to provide base demands for the two gross regions used in the analysis reported here. That portion of demand expected to be accounted for by industries in the LP model was subtracted to avoid double counting. The elasticities are appropriately weighted averages of regional elasticities. The same elasticity matrix is used for the two regions. Region-specific base prices are documented, and region-specific demands were used to derive average weighted base prices for each of the two regions. Given these base prices and demands and the matrix of own- and cross-price elasticities, "new" demands could be calculated corresponding to prices implicit in the scenarios modelled here. For coal and electricity, demands for the east and central regions were specified separately to the model. For all other products, demands for the two regions were added together to yield a single national demand.

Interfacing the Industry Model Linear Program with the Demand and Supply Models

At market equilibrium, the prices input to the demand model should be the final product shadow prices from the industry model. Also, the prices input to the supply models should be the shadow prices of the raw materials supplied to the industry model (Lievano et al, 1977).

We denote the set of prices input to the supply and demand models by the vector $\underline{z}$ and the set of supply and demand product quantities computed by the supply and demand models as

$$\underline{q} = \underline{q}\ (\underline{z})$$

Given a set of supply and demand quantities entered into the Industry Model, the model computes a set of shadow prices

$$\underline{r} = \underline{r}\ (\underline{q}\ (\underline{z})) = \underline{r}\ (\underline{z})$$

for the supply and demand products.

To achieve market equilibrium the modeller needs to find the root $\underline{z}^*$ of the nonlinear vector equation

$$\underline{f}\ (\underline{z}) = \underline{r}\ (\underline{z}) - \underline{z} = 0$$

This is always done in practice by some iterative technique. The modeller assumes some starting estimate of $\underline{z}^*$, designated $\underline{z}_1$. He then computes $\underline{r}\ (\underline{z}_1)$ and estimates some new $\underline{z}$, $\underline{z}_2$, such that $\underline{z}_2$ is better estimate of $\underline{z}^*$ than $\underline{z}_1$. He then computes $\underline{r}\ (\underline{z}_2)$, etc., and iterates until the problem converges, i.e. the input prices equal the shadow prices $\underline{z} = \underline{r} = \underline{z}^*$

In early analyses with the model there were seven varying demands in the demand model which were calculated directly from the shadow prices of crude oil and natural gas by a formula external to the industry model. Also, the supply models used for oil, gas, and coal were virtually insensitive

to price so that they did not enter into the equilibrium (Thompson, et al, 1977). Thus, in the early analyses the equilibration of the vector $\underline{r}$ of shadow prices with the vector $\underline{z}$ of input prices was not actually done. In later analyses done for Texas GEAC, the current demand model and similar-to-current coal and petroleum supply functions were used. The vector $\underline{z}$ of input prices to the demand model, 4 input prices to a coal supply model external to the industry model, and, for deregulated gas price, the natural gas price input to the external petroleum supply model. The vector $\underline{r}$ consisted of the shadow prices of the corresponding products and raw materials. The domestic crude oil and natural gas liquid shadow prices are always fixed within a narrow range of variation of less than 13% because imported oil price sets the petroleum price levels. Therefore fixed domestic crude oil and natural gas liquid input prices were used in the petroleum supply model.

With both demand prices and supply prices included in the equilibration prices, there is a large amount of interaction between prices. If the $\underline{z}$-vector component for supply of one type of coal is increased, the $\underline{r}$-vector components for electricity demand, coal demand, and coal supply will be affected, and the components for gas supply and demand are usually also affected. The vector of shadow prices, $\underline{r}$, is usually extremely sensitive to small changes in the supply price components of $\underline{z}$. In an effort to obtain faster convergence, Broyden's root finding method was used:

$$\underline{z}_{i+1} = \underline{z}_i + t_i \underline{p}_i$$

where $\underline{p}_i = \underline{\underline{H}}_i (\underline{r}_i - \underline{z}_i)$,

t_i is an acceleration parameter between 0 and 1 adjusted by the user at each iteration, and $\underline{\underline{H}}$ is a matrix which depends on the convergence history of the problem

(Broyden, 1965). $\underline{\underline{H}}$ is initially an identity matrix, and is then updated at each iteration by

$$\underline{\underline{H}}_i = \underline{\underline{H}}_{i-1} - \frac{[t_{i-1}\ \underline{p}_{i-1} + \underline{\underline{H}}_{i-1}(\underline{f}_i - \underline{f}_{i-1})]\ \underline{p}^T_{i-1}\underline{\underline{H}}_{i-1}}{\underline{p}^T_{i-1}\ \underline{\underline{H}}_{i-1}(\underline{f}_i - \underline{f}_{i-1})}$$

where $\underline{f}_i = \underline{r}_i - \underline{z}_i$

In an effort to reduce the high sensitivity and large number of interactions in the convergence procedure, the current version of the model was developed. In this version the petroleum and coal supply models are internal to the industry model as a set of stair-step functions. Development of the stair-step functions for coal is described in Appendix II above. Ability to express the petroleum supply model internal to the industry model depends on the assumption , also used in the previous versions of the model, that the crude oil and natural gas liquid supply prices are fixed, even in a free market situation. Kim's petroleum supply model was used to generate curves of natural gas, crude oil, and natural gas liquids as a function of gas price. These curves were interpolated at $0.01/KSCF intervals to give a stair-step supply function with $0.01/KSCF price steps.

A column vector in the industry model was defined for each stair step. As in the coal supply vectors each gas supply vector has a unit entry for gas production and an entry in the cost row equal to the gas price. However, each gas supply vector also has the two additional entries specifying the amount of crude oil and natural gas liquids produced per unit of gas produced in the given stair step. The bounds section of the model specifies the amount of gas produced in each stair step. The crude oil and natural gas liquid supplies from each stair step are summed and passed

through transfer column vectors which apply their costs (via fixed input prices) to the objective function.

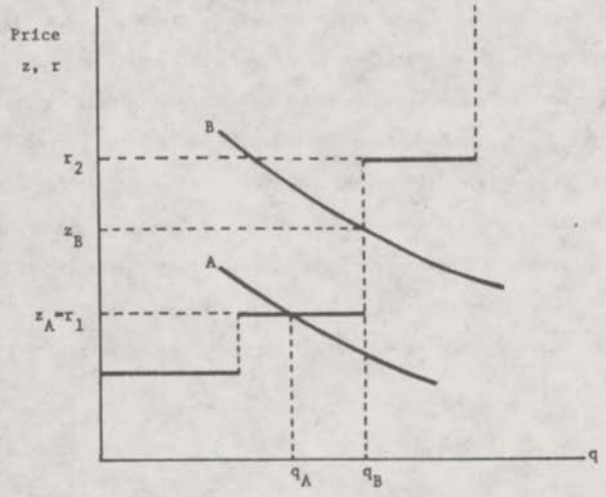
With the supply functions internalized in the industry model the $\underline{z}$ and $\underline{r}$ price vectors contain the 11 demand model prices only. Convergence problems due to the extreme sensitivity of the shadow prices to coal supply model input prices have been eliminated.

One problem which frequently exists in the interfacing the industry model with supply or demand models to obtain market equilibrium is the so-called "corner point" problem. This problem is illustrated in Figure III-1, which represents the interfacing a linear programming (LP) model of production of one product with an econometric model for the demand of the product. The corner point problem comes about because the supply curve generated by the LP is a stair step. The product shadow price r only takes on a limited number of discrete values over a given range of production. If the demand model gives demand curve A, an equilibration procedure results in an equilibrium market price z_A equal to the shadow price r_1 with equilibrium production of product at q_A. However, if the demand model gives curve B all attempts to obtain exact equilibration fail because z as a function of q passes through the vertical portion of the stair step. As the modeller increases the trial z, hoping to obtain z=r, the value of r suddenly drops from $r_2 > z$ to $r_1 < z$.

Error due to the corner point problem is diminished if the shadow price r changes by only small percentages in each step. An LP model which is flexible i.e. represents a large number of closely spaced alternatives, frequently gives this behavior. The Modified Price Regulation (MPR) case described above has fixed petroleum supplies, and has a corner point problem in the gas demand price, whereas no problems were observed during convergence

Figure III-1

Intersection of Supply and Demand Curves Giving the "Corner Point" Problem



of Complete Price Deregulation case, which has flexible petroleum supplies from a large number of clcsely spaced supply vectors. Fortunately, the MPR gas demand curve intersected the stair step supply curve very close to upper end of a vertical section, and the unavoidable convergence error was only 1%.

Broyden's algorithm, described above, was derived for continuous functions, and implicitly involves partial derivatives of the function $\underline{r}(\underline{z})$. If,due to the corner point problem, the function $\underline{r}(\underline{z})$ is highly discontinuous, the method breaks down. With the highly sensitive 16-component convergence problem, Broyden's algorithm seemed to perform properly during the first four or five iterations. However, as convergence was more closely approached, corner point problems would tend to destroy the usefulness of the $\underline{\underline{H}}$ matrix. Therefore the $\underline{\underline{H}}$ matrix was usually "frozen" after the first four or five iterations, i.e. the matrix updating formula was not used thereafter. With the current version 11-component convergence problem, initial approach to convergence is obtained in only one or two iterations, and Broyden's algorithm is frequently not useful at all. The $\underline{\underline{H}}$ matrix is usually taken as a diagonal matrix with heuristically chosen component values.

BIBLIOGRAPHY
for Appendix II and Appendix III

Broyden, C. G., "A Class of Methods for Solving Nonlinear Simultaneous Equations," Math. Comp., 19, 577 (1965).

Cavallaro, J. A., A. W. Deurbrouck, and A. F. Baker, "Physical Desulfurization of Coal," A. I Ch E. Symposium Series 70 (137), 1974, pp. 114-122

Childress, Phillip, personal communication to the author, July 1976

Deurbrouck, A. W., "Sulfur Reduction Potential of the Coals of the United States," Report of Investigation 7633, U.S. Bureau of Mines, 1972

EPA (U. S. Environmental Protection Agency), Development Document for Proposed Effluent Limitations Guidelines and New Source Performance Standards for the Tire and Synthetic Segment of the Rubber Processing Point Source Category, EPA 440/1-73/013, (1973); also .. for the Synthetic Resins Segment of the Plastics and Synthetic Materials Manufacturing Point Source Category EPA 440/1-73/010, (1973).

Federal Energy Administration, 1976 National Energy Outlook, FEA-A-75/713, (Feb. 1976).

Federal Energy Administration, Office of Coal, Nuclear, and Electric Power Analysis, Washington, D.C., Coal Supply Analysis, May 1976

Federal Energy Administration, National Energy Situation, Washington, D.C., 1976.

Finch, R. D., H. Hahn, M. L. Holloway, and J. S. Kelley, Texas Energy Scenario, Texas Governor's Energy Advisory Council, Special Project, Austin, Texas, January 1975.

Holloway, M. L., H. W. Grubb, and W. W. Grossman, An Economic Analysis of Declining Petroleum Supplies in Texas: Income, Employment, Tax, and Production Effects as Measured by Input-Output and Supply-Demand Simulation Models, Texas Governor's Energy Advisory Council Project S/D-2 and S/D-3, Austin, Texas, February 18, 1975.

Lievano, R. J., J. C. Stone, J. R. Becker, and Russell G. Thompson, "Economic Model for Environmental Policy and Energy Price Analysis", in The Cost of Energy, Russell G. Thompson, James A. Calloway, and Lillian A. Nawalanic, Eds., Gulf Publishing Co., 1977.

National Electric Reliability Council, "Review of Overall Reliability and Adequacy of the North American Bulk Power Systems (Fifth Annual Review)," July 1975, NERC, Princeton, New Jersey.

Schneider, Gilbert G., T. I. Horzella, J. Cooper, and F. J. Striegl, "Selecting and Specifying Electrostatic Precipitators," Chemical Engineering, May 26, 1975, p. 98.

SRI (Stanford Research Institute) Menlo Park, California, Chemical Economics Handbook, Updated periodically.

Thompson, R. G., R. J. Lievano, and J. A. Calloway, "Limits to Survival," Hydrocarbon Processing, Vol. 55, No. 7, June 1976, pp. 71-77.

Thompson, R. G., R. J. Lievano, R. R. Hill, J. A. Calloway, and J. C. Stone, Relationship Between Supply/Demand and Pricing for Alternate Fuels in Texas: A Study in Elasticities, Technical Report to the Texas Governor's Energy Advisory Council, December 31, 1974. Republished in the Hearings Before the Committee on Interior and Insular Affairs, United States Congress, 1st Session, pp. 337-363, January 1975.

Thompson, Russell G., R. J. Lievano, J. C. Stone, and J. A. Calloway, "Economic and Resource Effects of Waste Discharge Standards for the Energy Sector of the United States Economy", in The Cost of Energy, ibid.

United States Department of Commerce, Report on Sulfur Oxide Control Technology, September 1975, pp. 33-39.

POLICY, ECONOMICS, AND FORECASTS OF OIL AND GAS RESERVES IN THE LOWER 48 STATES

by

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Since the Arab Oil Embargo in the fall of 1973, uncertainty regarding future additions to crude oil and natural gas reserves and future production from these reserves at different government pricing and taxing policies has greatly slowed the development of a viable energy policy in the United States. Participants in the debate over uncertain oil and gas reserves have taken either the position of the consuming interests, who refuse to believe the cheap stuff is gone, or the position of the producing interests, who refuse to make investments to expand oil and gas supplies at low regulated prices.

The polarity of these positions is illustrated by the dialogue between Dr. M. King Hubbert of the U. S. Geological Survey and Dr. Barry Commoner of Washington University. Dr. Hubbert's forecasts of oil and gas reserves (Hubbert, 1974) are regarded as gross underestimates by Dr. Commoner, because Hubbert uses declining historical trends in the finding rates for new oil and gas discoveries. Commoner claims that our present shortage of oil is not due to a scarcity of domestic oil resources but rather due to the declining efforts of United States oil companies to find oil (Commoner, 1976).

Both Hubbert and Commoner possess partial truth. Hubbert's diminishing finding rate reflects the principle of diminishing marginal returns in exploiting a fixed resource. However, as long recognized by economists,

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Any findings, conclusions, or recommendations are those of the authors and do not necessarily reflect the views of the University of Houston.

diminishing marginal returns are not sufficient to forecast the economic development of a resource and its resulting use. This physical description of marginal productivity must be augmented with appropriate market prices and economic costs to find the profit-maximizing levels of resource development and production. Economically, the ultimate reserves developed are functions of the prices received for crude oil and natural gas; prices paid for inputs used in exploration, development, and production; and tax provisions of state and national government.

The primary purpose of this study is to show how forecasts of economically recoverable reserves will be affected by different wellhead prices, depletion allowances, and tax deductions. These forecasts are made by use of a comprehensive economic model for crude oil and natural gas exploration, development, and productio in the lower 48 states; see Kim and Thompson (1976) for model documentation.

The forecasts of this study differ fundamentally from those of the U. S. Geological Survey where primary emphasis has been directed to statistically estimating the distribution of reserve additions. Estimates of the Survey assume continuation of certain price relationships and tax provisions. Unfortunately, the Survey never reports explicitly what these assumptions are and never documents mathematically how the consequences of these assumptions are mapped into the forecasts of reserves. Thus, the policy-maker is left completely in the dark as to how his actions in regulating the prices and determining the taxes are affecting the future estimates of oil and gas reserves.

Reserve Estimates

Additions to reserves are estimated for three different sets of pricing policies and for three different sets of taxing policies to show how variations in price relationships and tax provisions will affect reserve additions developed by profit-seeking oil and gas producers.

Wellhead prices of natural gas ($/Mcf) relative to wellhead prices of crude oil ($/bbl) are fixed at a price ratio of 1 to 10 in Cases 1, 2 and 3. Tax provisions in these three cases are as follows:

Case 1 -- Current deductions of intangible and dryhole drilling expenses; no depletion allowance.

Case 2 -- Amortized deductions of intangible and dryhole drilling expenses; no depletion allowance.

Case 3 -- Current deductions of intangible and dryhole drilling expenses plus 22 percent depletion allowance.

The mid-1976 order of the Federal Power Commission established the price of new natural gas in interstate commerce at $1.42/Mcf. This action resulted in a natural gas price relative to an imported crude oil price of around 1 to 10. In the spring of 1977, the Carter Administration in its Emergency Energy Legislation allowed the interstate price of natural gas to rise to approximately the Btu equivalent of imported crude oil. This legislation resulted in a natural gas price relative to an imported crude oil price ($2.25/Mcf vs $14/bbl) of nearly 1 to 6. However, President Carter's Energy Program proposes a regulated natural gas price of $1.75

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per Mcf and a world oil price for new crude oil. The President's Proposal, if enacted, will result in a natural gas price relative to an imported crude oil price of about 1 to 8 ($1.75/Mcf vs. $14/bbl.)

Two additional cases are analyzed below to show the consequences of these different pricing policies. Case 4 represents a price ratio of 1 to 6, and Case 5 represents a price ratio of 1 to 8 . Tax provisions of Case 1 are assumed in both cases.

Additional assumptions and specifications made in evaluating the reserve effects of different tax and price policies.

* The projected finding rate reflects the average rate of change in cumulative finds versus cumulative exploratory drilling footage since 1962.
* The price of natural gas liquids is 69.7% of the price of crude oil.
* The discount rate is 10% per year.
* All prices and costs are expressed in constant 1974 dollars.

With increased exploratory drilling, diminishing marginal returns from each additional foot drilled will result in falling finding rates for crude oil and natural gas; see Figures 1 and 2. The finding rates for oil and gas will fall from the respective 1974 levels of 29 barrels and 310 Mcf per foot drilled to the levels where the marginal value of the production from the reserves found by an additional foot of exploratory drilling is equal to the marginal costs of drilling that foot. Figures 3 and 4 show how far profit-maximizing producers of oil and gas will push the extensive margins of exploration in each of the five cases. For

example in Case 1, the industry will quit exploratory drilling for crude oil at a finding rate of 20 barrels per foot drilled if the price is $9.92 per barrel ($11.28/bbl in 1977). However, if the price of crude oil is allowed to rise to $12.31 per barrel ($14/bbl in 1977 dollars), the industry will continue exploration until the finding rate falls to 15.5 barrels per foot drilled. Summing the area under the finding rate curve in Figure 1 from the 20 to the 15.5 barrel ordinate gives an 18 billion barrel addition to oil reserves because of the $1.38 increase in the crude oil price. Similarly, increasing the per Mcf natural gas price from $1.25 ($1.42/Mcf in 1977 dollars) to $1.98 ($2.25/Mcf in 1977 dollars) in Case 1 decreases the terminal finding rate in Figure 4 from 165 to 117 Mcf per foot drilled. Summing the area under the finding rate curve in Figure 2 from the 165 to the 117 Mcf ordinate gives a 280 trillion cubic feet addition to gas reserves because of the $0.73 increase in the gas price. For each price, current deductions of intangible and dryhole drilling costs (Case 1) permit a lower terminal finding rate than amortized deductions of intangible and dryhole drilling costs (Case 2). Alternatively, attainment of a desired level of oil reserves (as identified by a terminal finding rate) requires a higher oil price with amortized deductions of intangible and dryhole drilling costs (Case 2) than with current deductions of intangible and dryhole drilling costs (Case 1).

For the same tax policy, a higher relative price of gas to oil lowers the terminal finding rate for crude oil at each oil price; see, for example, Case 1 vs. Case 4. This is a result of the increased value of the associated gas produced jointly with the crude oil However, for the same tax policy the

terminal finding rate for non-associated gas rises as the relative price of oil to gas decreases because of the decreased value of the natural gas liquids produced jointly with the natural gas.

Estimates of additions to crude oil and natural gas reserves are functions of the tax provisions and price relationships assumed; see Figures 5 and 6. Higher prices of crude oil will result in larger additions to crude oil reserves; and for each crude oil price, additions to crude oil reserves will be less for unfavorable than for favorable tax provisions. For example at a price of $14 per barrel, additions to oil reserves are 36, 53, and 80 billion barrels in Cases 2, 1, and 3, respectively. This 44 billion barrel range of reserve additions encompasses the total range of reserve additions estimated by the U. S. Geological Survey in 1975. It also encompasses the 1973 estimate of the National Petroleum Council (45 billion barrels); see Miller et al. (1975) for NPC estimate. However, the uppermost value of this range is not even close to the estimates quoted by Commor (325 billion barrles) in 1976.

Similar results are shown in Figure 6 for additions to non-associated natural gas reserves. For example at a price of $1.40 per Mcf, additions to gas reserves are 320 trillion cubic feet in Case 1, 235 trillion cubic feet in Case 2, and 480 trillion cubic feet in Case 3. This range of reserve additions also encompasses the range of reserve additions estimated by U.S. G. S. in 1975 (261 to 406 trillion cubic feet), with Case 3 conditions. Attainment of the 1973 National Petroleum Council estimate (600 trillion cubic feet) requires a natural gas price of $1.62 per Mcf.

In conclusion, the range of reserve additions estimated in this study, where government pricing and taxing policies are varied, is much greater than the range of reserve additions estimated by the United States Geological Survey, where government pricing and taxing policies are not varied. Oil and gas policies of the federal government will be the fundamental determinant of the brightness or bleakness of the future energy situation in the United States.

REFERENCES

American Petroleum Institute, American Gas Association, and the Canadian Petroleum Association. Crude Oil, Natural Gas Liquids, and Natural Gas in the United States and Canada and United States Productive Capacity as of December 31, 1974. Vol. 29, May 1975.

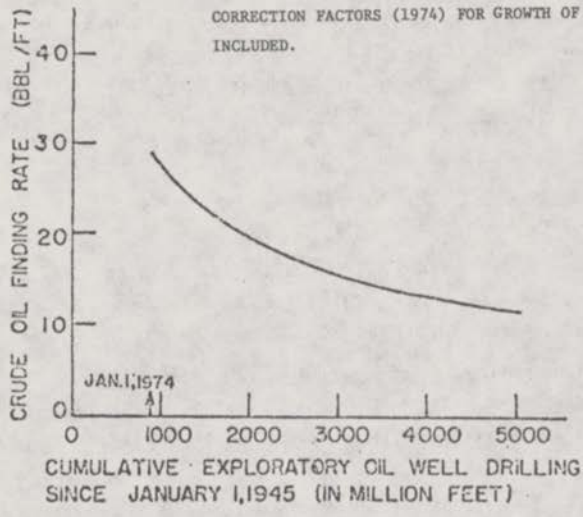
Commoner, Barry. "A Reporter at Large, Energy-I" The New Yorker, February 2, 1976.

Hubbert, M. K. "U.S. Energy Resources: A Review as of 1972." U.S. 93rd Congress, 2nd Session, Senate Committee on Interior and Insular Affairs, Serial No. 93-40 (92-75), 1974.

Kim Young Y. and R. G. Thompson, An Economic Model of New Crude Oil and Natural Gas Supplies in the Lower 48 States; Technical report to Texas Governor's Energy Advisory Council, Austin, Texas, 1976.

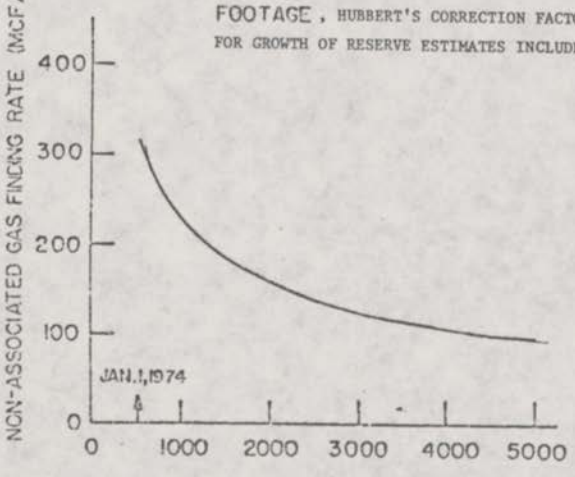
Miller, Betty M. et. al. "Ceological Estimates of Undiscovered Recoverable Oil and Gas Resources in the United States." Geological Survey Circular No. 725, March 1975.

FIGURE 1 CRUDE OIL FINDING RATES VS. CUMULATIVE OIL EXPLORATORY DRILLING FOOTAGE, HUBBERT'S CORRECTION FACTORS (1974) FOR GROWTH OF RESERVE ESTIMATES INCLUDED.



Source of Data: American Petroleum Institute (1975)

FIGURE 2 NON-ASSOCIATED GAS FINDING RATES VS. CUMULATIVE GAS EXPLORATORY DRILLNG FOOTAGE, HUBBERT'S CORRECTION FACTORS (1974) FOR GROWTH OF RESERVE ESTIMATES INCLUDED



Source of Data: American Petroleum Institute (1975)

FIGURE 3 TERMINAL FINDING RATES FOR CRUDE OIL

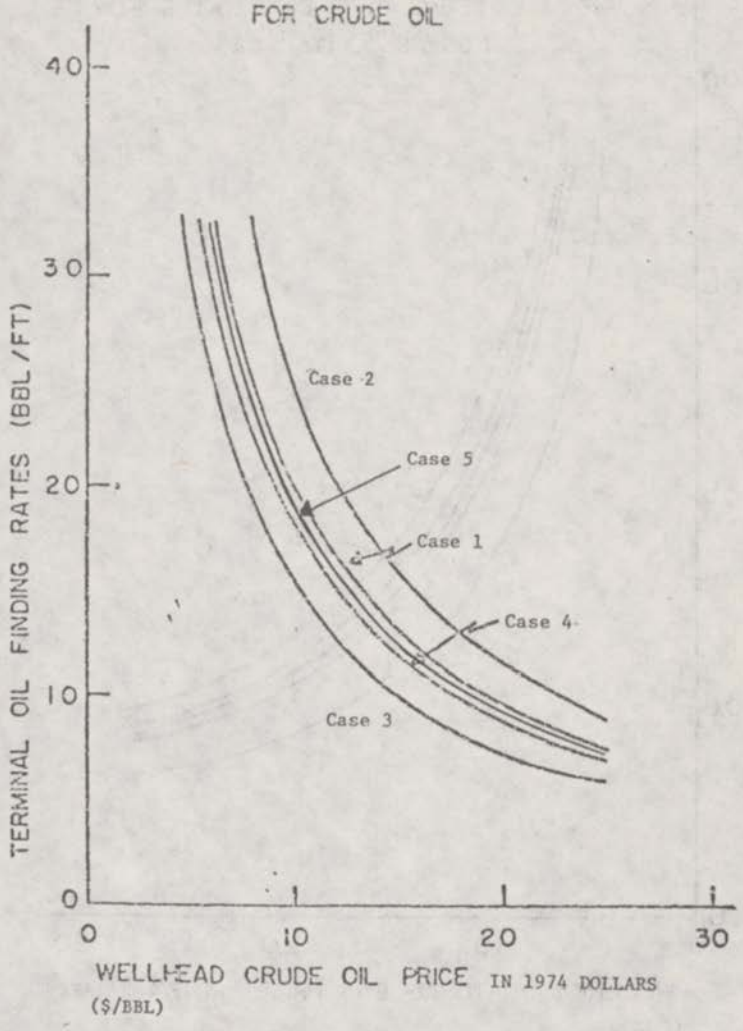


FIGURE 4 TERMINAL FINDING RATES FOR NON-ASSOCIATED GAS

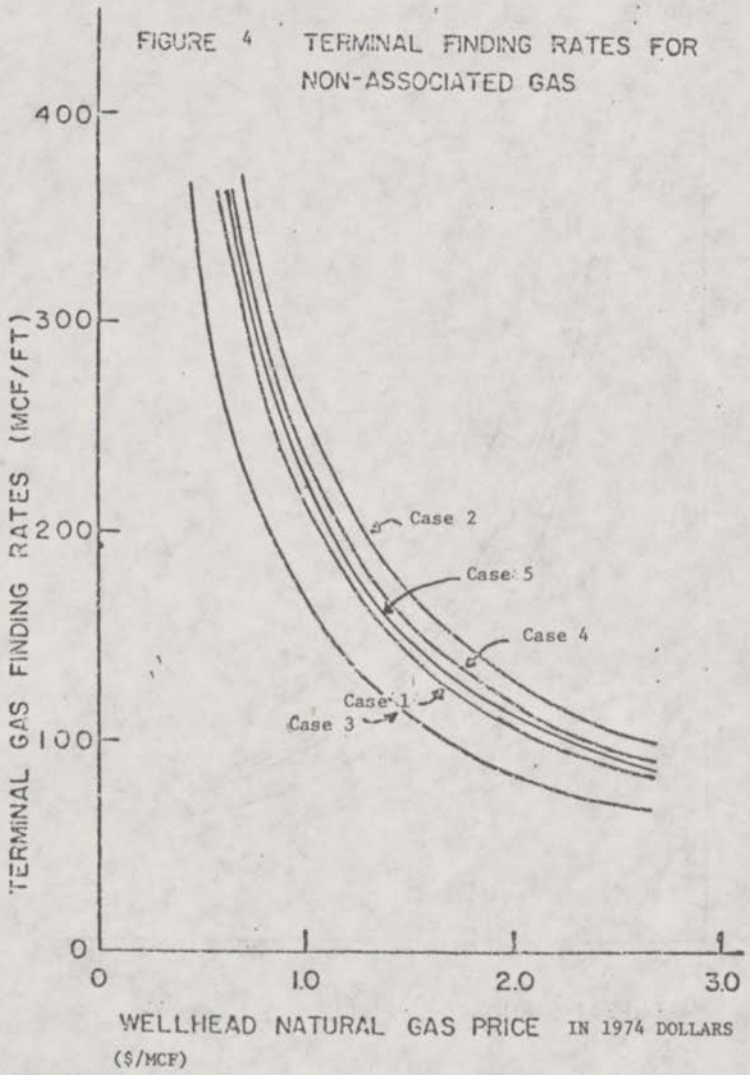
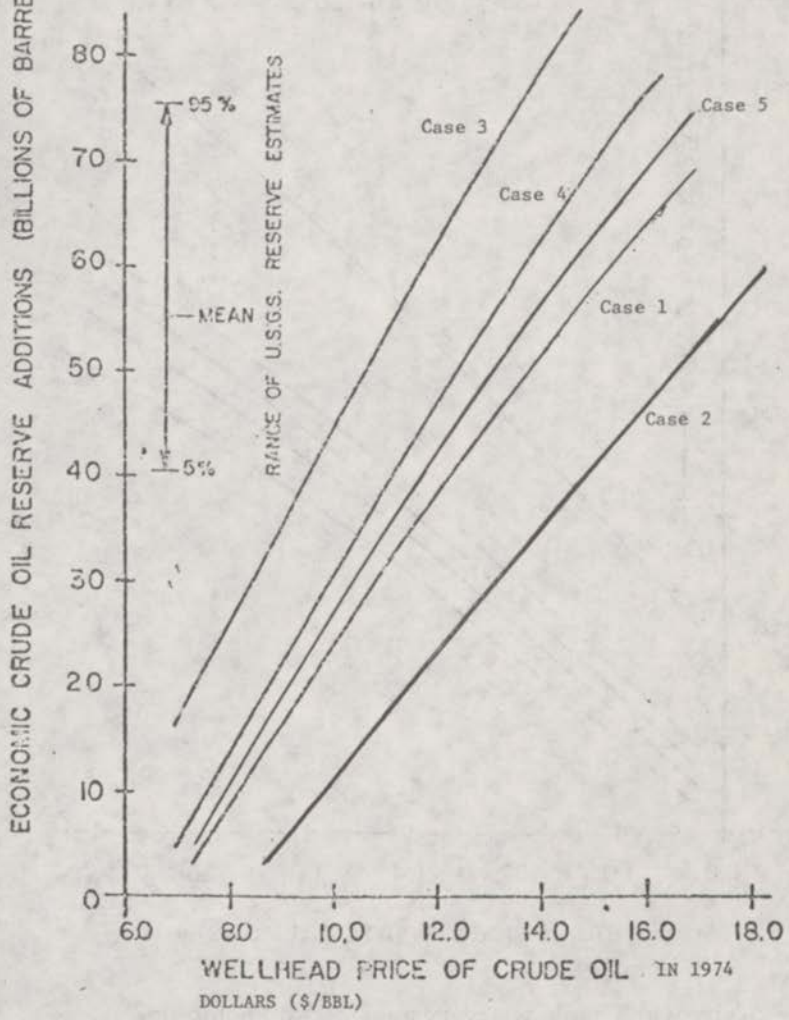
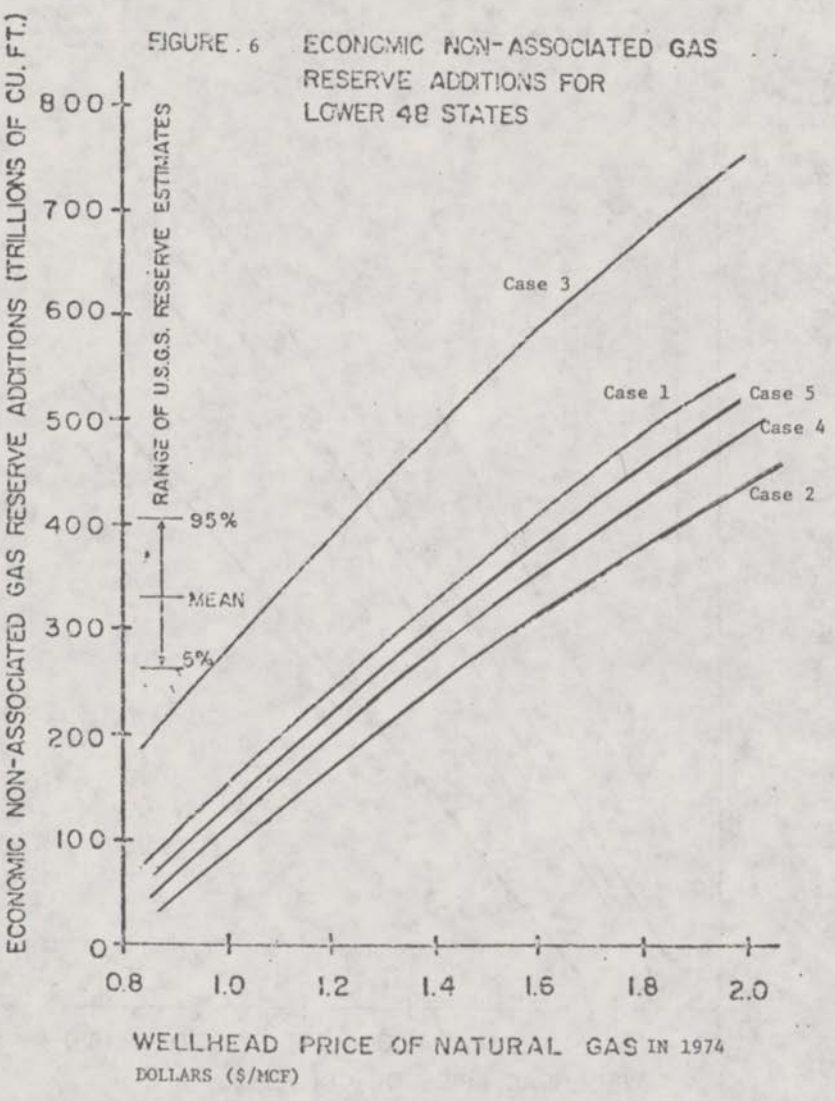


FIGURE 5 ECONOMIC CRUDE OIL RESERVE ADDITIONS FOR LOWER 48 STATES





Mr. KRUEGER. Thank you very much, Dr. Thompson.

There is a vote that has just begun, and I think what I shall do is to return to the floor for that vote and then come back for some brief questioning at that time. But I think rather than begin now and interrupt my own questioning, I would rather go to the floor and be back in 10 to 15 minutes.

The committee will stand in recess for 15 minutes.

[Brief recess.]

Mr. KRUEGER. The committee will resume its hearing. We have just received the testimony of Dr. Russell Thompson, and, at this time, the Chair recognizes itself for questioning.

First, Dr. Thompson, with regard to some of the assumptions in your model. In your testimony you refer to a Complete Price Deregulation. Do I understand correctly that by Complete Price Dergulation you mean a deregulation of new gas but not of old gas, that is, you would not remove it from expiring contracts? Is that much of it correct?

Mr. THOMPSON. Yes, deregulation of new gas produced from reserves added after January 1, 1978.

Mr. KRUEGER. And the assumption with regard to oil is that old oil would be allowed to be sold at world prices or at the current upper tier prices?

Mr. THOMPSON. In the Modified Price Regulation case, the price of oil produced from new reserves found after January 1, 1978, is allowed to go to the current world price; the prices of oil produced from the 2-tier level of old reserves are held at their regulated prices, and an oil equalization tax is imposed to bring the prices of that oil up to the current import level.

In the Complete Price Deregulation case, the price of all oil is allowed to go to the current world level with a windfall profits tax imposed on what is called lower tier oil and upper tier oil.

Mr. KRUEGER. What assumptions does the windfall profits tax have in the model, what kind of tax would the windfall profit tax be, a tax on, say, 50 percent or 70 percent, or some such figure, of the revenues that are derived from old oil, that is, such revenues as exist beyond the current price of old oil?

Mr. THOMPSON. You take the price of $5.25 per barrel for lower tier oil, the difference between that price and the price of $14—to approximate current import price—would be the oil equalization tax for the lower tier oil.

Mr. KRUEGER. And that full amount would be taxed as a windfall profits tax?

Mr. THOMPSON. Yes, in the case of lower tier oil and similarly in the case of the upper tier oil.

Mr. KRUEGER. Then there would not be any increased revenues to producers as a result of the sale of old oil at all, because it would be fully taxed; is that correct?

Mr. THOMPSON. There would be no increased revenues to producers from either lower tier oil or upper tier oil or from old gas.

Mr. KRUEGER. I see.

One further question that I have is, do you have any suggestion with regard to the proposal for stack scrubbers as it is recommended in President Carter's proposal? Do you have any suggestions on why the Carter administration might have required gas scrubbers from low-sulfur as well as high-sulfur coal?

I don't think we asked that question of Mr. Schlesinger. I realize that is probably the location the question should have been asked, but since it wasn't, can you see any rationale at all for requiring stack scrubbers for all coal, low-sulfur as well as high-sulfur?

Mr. THOMPSON. No economic rationale. I can only see a bureaucratic rationale, and that is it makes it easier to impose a uniform standard in environmental regulation across everyone. In this case it would be uniform. Everyone would have to use stack gas scrubbers.

Mr. KRUEGER. But it would be your judgment this policy would discourage the use of low-sulfur western coal and instead would prompt the mining of higher-sulfur eastern coal, which I gather is also more expensive because it is less likely to be strip-mined; is that correct?

Mr. THOMPSON. Yes. See, what actually happens is that the government will come into the coal markets, which, by the way, isn't being discussed very much, and they would raise the additional cost to every user of low-sulfur coal by the cost of the scrubbers, and in doing that they would expand the demand for high-sulfur coal in the Midwest and the East. So they will enter the market in two ways. They will have a negative impact on low-sulfur western coal by raising the cost to users of that coal, and in doing that they will expand the demand for the high-sulfur coal in the East and Midwest.

Mr. KRUEGER. I have some further questions I might wish to ask. I will go ahead and proceed at this time.

One of the consequences then of the Carter proposal, in your judgment, would be that it would discourage the use of western coal and encourage the use of eastern coal, and raise prices to consumers basically for environmental or economic benefit? Would that be correct?

Mr. THOMPSON. That is right. If the EPA standards that have been promulgated have been promulgated to achieve the air quality goals of the legislation, then we have an overkill here which is going to result in increased cost of electricity production in the South Central States and in the Far West States. It is going to result in a loss of revenues to low sulfur coal producers in the Far West, because the price is going to fall, and it is going to result in increased employment opportunities in the East, the mining areas of the East, and it will result in a windfall profit to a certain sizable portion of the high sulfur coal producers in the Midwest and the East.

Mr. KRUEGER. Let me turn to another question at this time. That is, you indicate that it would be your estimate that there would be something like $70 billion in new taxes, I believe, by 1985; is that correct?

Mr. THOMPSON. Yet, $70 billion of new taxes in 1985.

Mr. KRUEGER. In 1985, that is right, in that year alone there would be $70 billion in new taxes.

Mr. THOMPSON. Yes.

Mr. KRUEGER. Do you think that there would be any economic problems resulting from the fact that the Federal Government would be taking in a rather substantial amount of money, presumably holding it for a while, and then only later on recycling that money; that is, would there be some economic impacts from just the fact that that much currency would be pulled out of the marketplace for a period of time before it were in any way to be recycled?

Mr. THOMPSON. The whole rebate issue is largely unexplained in President Carter's program. We do not know; we really do not know who is going to get the money, and why they are going to get it.

There are going to be temptations associated with handling that amount of new money. As I mentioned, it will be equivalent to the

revenues received by all domestic oil and gas producers in the United States in 1985—in the Modified Price Regulation case. This money will have to be ingeniously recycled back to the economy to maintain some semblance of continuity in the capital markets, in the fossil energy resource markets, and in the end product markets that will be significantly affected by these rebates.

Mr. KRUEGER. One of the things that I am not sure of, since my only experience in business was with a small corporation, in which case we did pay our 47 or 52 percent corporate taxes, because I guess we were not ingenious enough to avoid them. I wonder, since I do not know that that is the case with larger energy companies, whether they in fact pay something like 50 percent of their profits in taxes.

It would occur to me that if we were already having, or if we are saying that at that time we would have $70 billion in total revenues to energy companies, to producers, and then another $70 billion that is going to go in Federal taxes directly, and that is all before the taxation inside the energy companies themselves, we are really talking about the majority of the money that consumers are paying would in fact be in taxation, is that correct?

Mr. THOMPSON. Yes, there would be a significant increase in the cost of energy to the consumer, and as you are pointing out, there will be ripple effects far beyond the fossil energy sector itself. Some of these will emanate starting right in the energy-producing firm because of their tax takes. There is a whole set of ripple effects that will be in all the sectors outside of the fossil energy sector in the economy.

On the one hand, when the government is pulling these moneys out of the economy, and on the other hand is putting them back in, sizable economic waves could be created by government action in withdrawing these moneys and putting them back in the economy.

Mr. KRUEGER. The time of the Chair is expired.

At this time the Chair recognizes the gentleman from Ohio, Mr. Brown.

Mr. BROWN. Mr. Thompson, just a couple of quick questions.

I would assume that our best policy would be one which discourages as much domestic use as possible, and encourages as much domestic production as possible of all kinds of energy, but puts the advantage on using that energy source which is the most cost-effective for the purposes, and also provides for the use of that energy source which seems to be the most available for such a cost-effective decision.

It has been suggested by other economists, some of them the government, that letting the price go without having it in some way controlled by the government, either with a price lid or with certain other impacts like the tax, would not accomplish this purpose, that we do not have the source of supply of natural gas and oil in our economy, and we have too many regulations in the use of coal to permit such a system to function without it becoming in some way aberrational, that is without the price of natural gas going to $5 or $6 an Mcf or the price of oil in some way being too severe and coal not being substituted for it due to the controls that are placed on the use of those fuels because of environmental considerations.

Does your experience in your modeling indicate the support for that position, or does it come out otherwise?

Would the so-called free market pricing permit us to get a rational use of natural gas for both the energy use and also the environmental considerations that gas has been used historically, rational use of coal in those locations where it is most effectively used with those kinds of coal that might be leased environmentally polluting, and domestic oil production that, along with these other forms of energy production, might force out an excessive use of foreign oil?

Mr. BROWN. Why not domestic coal, because of the environmental cost of its use?

Mr. THOMPSON. Now in the case of the modeling, the way it is set up right now, we are assuming that the use of oil and gas products will be prohibited in all new base load electric powerplants and in all new large industrial boilers. So we are already putting coal to those uses.

The remaining uses are generally those uses for which oil and gas have a much higher value in use, namely residential, commercial, feedstocks and so forth. So if you consider the hidden costs of regulation, which are the economic costs that the Nation must pay in energy costs and also in terms of employment opportunities throughout the economy, we are foolish in the Nation not to produce as much additional gas as we can at incremental cost less than the Btu equivalent of imported crude oil. We are doing that today. We are holding down prices by regulation and paying large hidden costs.

Mr. BROWN. What about the lack of supply cited by such estimable groups as the Central Intelligence Agency, the suggestions that it does not make any difference what we let the pricing do, that there will be no more gas coming on line?

Mr. THOMPSON. Just recently we have had the surprise entrance of the Central Intelligence Agency into the energy field.

Mr. BROWN. I thought it was startling. It makes me wonder what Mr. Schlesinger did in his previous life.

Mr. THOMPSON. Let's take a much more reputable group, the U.S. Geological Survey. The U.S. Geological Survey assumes a price for gas and assumes a set of taxing provisions, and then on the basis of those assumptions, they estimate the distribution—or the range—of future reserve additions for oil and gas.

Unfortunately, the U.S. Geological Survey keeps us completely in the dark as to what assumptions they make; for example what they assume about the price of oil and the price of gas, and what they assume about taxing provisions. They further do not tell us how they map their assumptions into consequences with regard to reserve additions. Let me say this as a summarizing comment. If you assume low prices and you assume unfavorable taxing provisions, you will then get low reserve additions. It is assured. However, if you assume higher prices, and favorable tax provisions, and you use the trend of cumulative finds—the rate of change of cumulative finds versus cumulative exploratory drilling since like 1962—you can get favorable additions to reserves. So we have here a case where it seems like we are intentionally keeping ourselves in the dark.

Mr. BROWN. It is not that I want to press you on what you feel confident about with regard to competence, but it has been suggested that at a slightly higher price than we are now bringing in conventional natural gas, that the drilling might be done a little deeper, and we might wind up with the prospect of geopressure gas, methane trapped in water or brine, and that for a slightly higher price we would have in effect the beginning of an unlimited or virtually unlimited supply of natural gas.

Are you in any way familiar with that, or do you have any feeling about it?

Mr. THOMPSON. I would suggest that you seek geological expertise to respond to that type of question. I am not the best person to respond to that.

Mr. BROWN. Thank you very much.

Mr. KRUEGER. The time of the gentleman from Ohio has expired. The afternoon has almost expired.

I wish very much to thank you, Dr. Thompson, for being with us, to thank the patient staff who have stayed with us throughout, and to thank you for your helpful testimony.

The committee will adjourn until tomorrow morning at 10 o'clock, at which time the markup begins.

[The following statements were received for the record:]

Center for Science in the Public Interest
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THE CASE AGAINST PRIVATE UTILITY INVOLVEMENT
IN SOLAR/INSULATION PROGRAMS

During the past year a growing number of the nation's private utility companies have launched programs to install insulation or solar units in the homes of their residential customers. In most instances, the recipient customer pays for these services through an add-on or surcharge on his utility bill. Generally, the surcharge for insulation programs involves the customer paying for this service until the utility has recouped the cost of the insulation material, the cost of labor involved in the installation, and some profit for the utility. For solar units, the surcharge has either been in the form of a lease payment (such as the monthly service charge on a telephone) or in the form of a installment payment in which the customer eventually purchases the solar unit.

To date, most of these programs have been undertaken either at the urging of state regulatory commissions or at the initiative of the individual utility. The argument on behalf of these programs has generally been that installation of insulation & solar systems are socially-desirable ends but that most customers cannot or are unwilling to afford the high initial capital cost for such installations. To circumvent this problem of high first-cost, the insulation or solar units are provided on an installment payment or a leased basis. The utilities are the logical group to provide this service, it is argued, because of their access to the large sums of capital needed to start and maintain such programs. Other arguments also exist on behalf of such utility programs including (1) the existence of the administrative mechanisms needed to run such projects within the utilities' operational framework, (2) the "obvious" technical competence of utilities to coordinate energy programs, (3) the need for utilities to conserve fossil fuel resources through insulation & alternative energy programs, and (4) the need to help the utilities remain fiscally sound through expansion into emerging energy technologies.

While there may be merit in some of the above "pro" arguments for such utility involvement in solar & insulation projects, a full debate of the merits and demerits of such involvement has yet to occur. To date, there has been no public discussion of the "con" arguments. In fact, in the rush to embrace conservation measures and solar energy, federal and state energy planners have not even sought to enunciate and consider what the con arguments might be. In the interest of fostering full public discussion of this issue, therefore, the Energy Project of the Center for Science in the Public Interest has prepared the following analysis of some of the problems that will be encountered in utility solar/insulation programs. It is vital that these problems be fully considered before the nation proceeds to commit itself to any program of giving the private utility companies such a major role in determining the course of our future energy policies. Such consideration is particularly urgent in light of the recent call by President Carter for aggressive (and in some instances - mandatory) involvement by the utilities in such programs.

Excessive Profit-Taking: Under most proposed insulation and solar leasing schemes, the utilities involved would be in a position to realize a substan-

tial profit. For example, the FEA's so-called "Rosenberg Plan" proposes to provide utilities a return factor of 17% for customer insulation programs. That is substantially higher than the usual profit margin allowed utilities for other services by public service commissions. In the case of solar units, if such a profit margin is permitted, it would make solar less economically competitive (and possibly completely non-competitive) with nuclear and fossil fuels. Presently, solar hot water units purchased retail are competitive with such other energy sources and solar space heating units are projected to become competitive by the end of this decade. However, that competitive edge will be substantially reduced if not eliminated if a high profit margin is permitted in rental schemes thereby lessening the move towards clean, renewable energy sources and away from more dangerous and environmentally unsound sources.

Monopolization/Favoritism: Utilities could swiftly monopolize the solar energy field and drive small solar industries out of business. This is made possible by the utilities' vast supplies of capital that would enable them to buy needed materials on a large scale from just one or two favored companies. By giving just a few companies the lion's share of the business rather than spreading around their purchasers, the utilities could effectively decide which solar companies will be allowed to continue in business. Small businesses already involved with solar concerns would be hurt. When buying on a mass scale, the utilities would be more likely to by-pass small business concerns. There is also the possibility that a utility could determine that it would be most economic to not only purchase from a given solar manufacturer/distributor but to also acquire that company. The utility would thus become integrated in much the same way as the nation's large oil companies are with the same attendant problems of (a) suppression of competition, (2) price maneuvering within the different levels/components of the integrated industry, (c) suppression or chilling of innovative research & development. In the instance of insulation programs, it is less likely that a utility could lessen competition among insulation manufacturers since there are presently a relatively few number of companies (most fairly large) in this field. However, large purchases from these big companies by the utilities could make it economically unviable for small business concerns to enter the field as the demand for insulating materials increases in the years ahead. Moreover, utility installation of insulation could endanger small and minority-owned or independent contractors that normally do such installations if the utility company undertakes to perform all the work itself.

Increased Costs to Consumers: Having utilities install insulation brings to issue the equity of requiring large numbers of gas & electricity customers who have already initiated conservation activities through other utility programs or by personal investments to pay through rate increases the costs associated with the program. That is, those who would have already installed insulation in their homes and incurred the expenses entailed would be forced to subsidize the installation of such materials in the homes of people who were less energy conscious. Invariably, as the utilities move into the insulation and solar product fields, they will justify investments in these areas as warranting increases in overall utility rates -- the increases to be used to cover alleged increases in administrative costs as well as costs associated with program R&D. This trend has already begun. In Los Angeles, the Southern California Gas Company is requesting a rate hike from the State Public Utilities Commission to fund a five-year solar demonstration project. If the proposed increase is granted, gas users can expect to pay some $11 million for the utility to install 315 solar heating units. Likewise, as solar units are in-

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stalled and insulation improved in customer homes, the demand for a utility's services will presumeably decline. The utilities will respond by asking for rate increases on those amounts of energy sold and can be expected to seek revised rate structures that place the heaviest burden on home owners with solar units. Using the euphemism "capacity displacement", the utilities argue that solar homes will fall back upon the services of their local utility only during peak periods; since peak power is generally more expensive for a utility to provide, the argument runs that solar homes should pay a higher rate for the electricity they use than homes relying fully on the utility. While this conclusion is debatable (see "Utility Pricing & Solar Energy Design" by Stephen Fledman & Bruce Anderson, Clark University, 9/76), it nonetheless carried enough weight to sway at least one state regulatory commission. Though it has since reversed itself, the Colorado Public Service Commission last year approved a rate structure proposed by the state's utilities that effectively charged solar homes more for electricity supplied than they would have been charged prior to the solar installation. Such rate structures when coupled with utility solar-installation programs present customers with a Catch-22 situation. The utilities would be able to install solar units in their customers homes and then charge for this service; in addition, the utility would also be able to enact higher rates from such customers to compensate for decreased electricity useage.

Homeowners Would Pay Twice: Much approved and pending legislation in state legislatures and the Congress include proposals for subsidies to homeowners who buy solar equipment and insulation materials. If utilities install solar systems or home insulation, they would receive the government subsidy. The result would be the homeowner paying doubly for the equipment/materials through taxation as well as paying to rent/purchase from the utility.

Lack of Accountability: Unlike municipal utilities (at least in theory), there is no accountability by large private utilities to their customers. The utilities have an essentailly captive market; in most communities there is only one company and thus a consumer has a choice between that company and having no gas or electricity at all. Thus, the lack of competition gives the utilities little incentive to seek to be responsive to the needs or wishes of their customers if those needs conflict with the utilities' own goals (usually found to be maximization of profits & corporate dividends). The only way customers can effectively impact a utility's policies is through a rate hearing before a state regulatory commission. However, such proceedings are complicated, time-consuming, and very expensive making them unvialbe for most consumers -- particularly those who are not organized. Accountability is vital in any program that can have a major impact upon future energy directions the nation chooses to chart for itself. Such issues as (a) which technologies are to be favored, (b) what types of life-cycle costing will be used, (c) role of public service employment opportunities, (d) pricing/rate systems, (e) extent of research into alternatives and improvements are among those that would be of vital interest to consumers and which utilities would have to be responsive to.

Lack of Commitment to Solar by Utilities: While proposals are increasing to involve the private utility industry in the commercialization of solar technologies, the utilities themselves are maintaining the posture that solar technologies will not play a major role in the nation's energy picture for decades to come. The utilities have expressed a continued preference for exhausting their nuclear and fossil fuel options before going solar. For example, the August 17, 1976 edition of the Wall Street Journal reports Mr. Starr of the Electric Power Research Institute commenting: "No one sees much help coming before the end of the cen-

tury from so-called exotic sources such as geothermal energy, solar power & wind. Anyone who says differently is perpetrating a fraud on the public." Likewise, Keith Turley -- President of the Arizona Public Service Company (one of 11 electric utilities that received a $500,000 FEA contract to construct a solar thermal plant in the U.S. Southwest) has commented: "We think it's important that we move forward in this area of research just as we have in prior years as part of the industry in nuclear research development. However, the impact of a 10,000 kilowatt solar project or a 100,000 kilowatt solar project is not very material. It's just not significant. Solar won't be commercially competitive until the early part of the next century. It may be the year 2025 before you really see solar making inroads into the coal-nuclear mix. So in my lifetime, I don't envision solar having a marked effect on our generating capacity. If we lose our ability to develop our coal resources or our ability to develop nuclear, we will not be able to meet the needs of our customers. Solar just won't be ready in time." The issue thus becomes whether it is wise public policy to rely upon an industry to lead the nation's solar commercialization efforts when that same industry has such a pessimistic view of the feasibility of solar technology. Nonetheless, ERDA's National Plan for Solar Heating & Cooling asserts: "The demonstration program will actively encourage utility company participation in developing plans for ... utility company ownership and lease of solar heating & cooling systems". This policy has been implemented with grants going to a number of utilities from the federal government (e.g. ERDA grant recently to the Florida Gas Company through HUD to install solar water & space heating/cooling in a demonstration home).

Social/Political/Ethical Considerations: Placing control of solar and insulation commercialization efforts in the hands of the utilities is to entrust the nation's energy future to the same decision-makers who have given the U.S. nuclear reactors, plutonium breeders, polluting coal plants, coal gasification facilities, all-electric homes, and inverted rate structures. In essence, the nation's energy future is being entrusted to the same people who have done such a poor job to date of anticipating and responsibly responding to the nation's past energy needs. Moreover, utility involvement in such programs will only be viewed by those companies in terms of how it will benefit them regardless of whether decisions they make will have a negative impact upon the balance of society. For example, in testimony before Rep. Mike McCormack's committee inOctober, 1975, several utility officials outlined the reasons they saw for entering the solar market. These reasons included (1) "providing a new business opportunity which would offset the inevitable contraction in utility sales implicit in dwindling supplies of natural gas" and (2) providing utilities with access to capital (federal grants) which would not be (otherwise) available". More succinct is the comment of Peter Bos of EPRI's solar program: "Our program is 'What can solar energy do for us?'" Thus, the policy question presented is whether it is rational to give substantial control over conservation/solar policies to those companies which in the past have done such a poor job in energy planning and whose present interest in such programs is openly self-serving.

Solar/Conservation Technologies Are Inherently Decentralized: Historically, the nation's gas and electric utilities evolved as a response to the need to provide large, centralized fossil-fuel (and later nuclear) plants with broad distribution systems. Economies of scale made it economic to build a few large generating plants rather than multiple small ones. Technical complexity also made it infeasible for small communities or individual residences to generate electricity from nuclear fuels. The development of the transformer facilitated the emergence of wide distribution systems for centralized generating stations. Thus, the

utilities owe their existence to a history based upon the development of large, expensive, and complex technologies. By comparison, though, solar and insulation technologies are simple, relatively low-cost, usually small, and suited to dispersed, decentralized applications. There are few economies of scale to be realized through centralized commercialization of these technologies other than the savings that may be achieved through the mass purchase of materials (savings which the utilities would negate, however, in leasing programs as a result of the profit they would exact). Solar & insulation technologies can be designed to meet individual residence's needs; thus, through multiple, small applications of these technologies, many more opportunities are presented for innovation ande development than is the case for singular, monolithic utility programs/technologies. As solar systems replace fossil fuel & nuclear systems, the reasons for the utilities' existence in the first place begin to rapidly fade. To involve utilities in solar/insulation programs merely to enable them to keep their financial heads above water is nothing short of trying to forestall the extinction of a dinosaur.

There Are Alternatives: The primary argument in favor of involving the nation's utilities in solar/conservation programs has been that there are no viable alternatives if the goal is rapid and efficient commercialization of these technology. This, however, is not necessarily true. There are other options. For example, those communities owning a municipal utility could rely upon it for solar/insulation programs. Unlike a private utility, a municipal utility is (in theory at least) far more accessible to the public since it is a public entity subject to direct control by publicly-elected officials. Further, municipals do not have a profit-motive and thus would not be likely to charge customers heavy add-ons to retail costs of solar units and insulation materials. The city of Santa Clara, CA already has its utility involved in such programs and the city of Ta-oma, WA has the concept under consideration. A second option would be to have the city governments themselves establish community co-ops (perhaps with the assistance of federal seed monies) that could purchase large quantities of insulation material and solar systems. These items would then be resold to local residences at cost (plus a small fee to cover administrative costs). Such a program (which was originally advocated by Senator Edward Kennedy in energy legislation -- S.2932, The Energy Conservation Act of 1976 -- he introduced in the 94th Congress) would enable cities to take advantage of economies of cost through large-scale purchases and these savings could in turn be passed on to residences. A third option is to rely upon the industries themselves that are manufacturing and distributing the insulation & solar units to institute leasing programs. There is not a need to add a middle man to the leasing scheme. Such a program is now underway in Ocala, Florida. These and other options could be supplemented by the Congress and state/local legislatures of measures designed to encourage or mandate the installation of insulation and/or solar units. Such measures could include: (a) tax credit & deductions for expenditures on solar/insulation materials, (b) rapid amortization of such investments, (c) prohibiting the increase in property taxes for homes that are insulated or contain a solar unit, (d) mandating that all new facilities (and possibly all facilities) have a certain minimum amount of insulation and a solar heating system installed to be qualified for sale or resale.

This Is a Decision for the Legislature: The involvement of utilities in solar and insulation programs could have ramifications upon the nation's energy picture for decades to come. The decision to allow or not allow utilities to be involved in such commercialization efforts is far too significant to be entrusted to the mere discretion of the individual utilities or to a state regulatory commission

or to an administrative agency (whether federal, state or local). This decision is properly one to be made by state legislatures (and possibly the Congress) only after extensive and through public hearings at which both sides of the issue are fully aired and debated. Moreover, this issue should be approached as part of a fuller effort to secure substantive reform of utility rate structures and decision-making procedures and not treated as an isolatable issue. Such debate has yet to occur. Actions to involve utilities in solar/insulation programs have been made to date largely in consultation with the utilities involved and almost no input from the general public.

These are only a few of the many "con" arguments which can be raised in a debate on the merits of utility involvement in solar and insulation installation programs. To date, none of these arguments have been addressed or resolved. Before further action is taken by any government agency to foster such involvement, these matters must be dealt with.

-Ken Bossong, Co-Coordinator
CSPI Energy Project, 5/4/77

TESTIMONY

OF

CHARLES H. PILLARD

INTERNATIONAL PRESIDENT

INTERNATIONAL BROTHERHOOD OF ELECTRICAL WORKERS

INTERSTATE AND FOREIGN COMMERCE COMMITTEE

WASHINGTON, DC

APRIL 19, 1977

Mr. Chairman and members of the Committee:

My name is Charles H. Pillard and I am International President of the International Brotherhood of Electrical Workers.

Today I represent the approximately 4,000 delegates gathered here in Washington, DC for the National Conference of the AFL-CIO Building and Construction Trades Department.

The purpose of the conference is to examine the conditions in the building and construction industry and to develop a program of corrective proposals to be presented to Congress.

Despite all the rhetoric and cries for action, the United States has continued to fall behind in its battle for energy independence.

Domestic crude oil production has been declining since 1970. Natural gas production is also falling. Yet 76 percent of our total energy is supplied just by these two resources.

Consequently, our country's dependence on foreign producers is growing day by day. This assumption of growing reliance on imports is easy to understand when we note that during one week early this year, United States oil production of 8.1 million barrels compared with average daily imports of 8.2 million barrels.

Oil imports now constitute one third of all oil consumed in our country and by 1985 that could grow to 50 percent if no new major actions are taken.

Even more disturbing is the fact that more and more oil is being brought in from OPEC countries.

At the time of the 1973 OPEC embargo, about 16 percent of our oil was coming from that area of the world. In 1976, that figure is up to 25 percent and climbing higher all the time.

In terms of total oil imports, the OPEC cartel provided 48 percent in 1973. Despite our proclaimed energy independence goals, that figure climbed to 59 percent in 1975.

All of this has contributed significantly to our exceeding high rate of inflation and unemployment. Expensive foreign oil is draining badly-needed capital from our economy, imposing a substantial burden on both the consumers and the business community.

The future economic growth of our country is also endangered. With little provisions being made for sufficient energy supplies we remain at the mercy of precarious foreign sources and dwindling domestic reserves.

Some experts predict that our supplies of oil and natural gas will last no longer than 40 to 50 years. According to these trends, the only legacy we will leave to the next generation is an exhausted, bankrupt economy and badly depleted energy resources.

At least 50 percent of the 17 million barrels of crude oil consumed in the United States today could be saved if other fuels were used instead of gasoline and petroleum products.

It is essential that whenever possible, oil and natural gas are replaced by other fuels. We should conserve our supplies of oil and natural gas for those necessary uses which currently have no substitute such as aviation fuel, lubricants, petro-chemical feedstocks, and gasoline for transportation.

Electrical generation by other fossil fuels and nuclear plants could serve as substitutes for oil. This would allow our consumption and our dependence on foreign oil to be reduced, and our own petroleum resources would be extended.

With more research, efficient processes might be developed to synthesize fuels, although costs might be restrictive.

The need for massive effort within our country on all fronts to attain energy self-sufficiency is very clear. No single measure will be adequate. -- All resources and all methods must be used.

Strong, bold leadership is desperately needed to help find solutions to our present energy crisis. Legislation for national planning of energy research and development is long overdue.

To help meet our energy needs, the Building and Construction Trades Department and its affiliated international unions urge:

1. That Congress adopt President Carter's plan to consolidate energy activities into a single department that would absorb the Energy Research and Development Administration (ERDA), Federal Energy Administration (FEA), and the Federal Power Commission (FPC). Such a restructuring is badly needed and should provide a more efficient mechanism for creating and implementing energy policy.

We caution however that in consolidating energy activities into one Agency some mechanism must be arrived at to make decisions and balance energy considerations against environmental considerations. Without such balance such an Agency may well be doomed to failure.

2. That Congress enact the Coal Slurry Pipeline Act of 1977 (H.R. 1609 and S. 707) to clear the way for the construction of coal slurry pipelines which are essential to the development of our domestic coal reserves.

3. Amendments to the Clean Air Act presently before Congress must be amended and made realistic. If we are to successfully use our vast coal resources we must be able to operate under reasonable clean air regulations. In regard to Surface Mining, we recommend that the Congress only adopt such legislation if the red tape provisions of the proposed Bill are amended and made workable.

4. That Congress adopt H.R. 38 and S. 36 to provide loan guarantees for the development of synthetic fuels. Vast coal and oil shale resources which can provide domestic supplies of gas and oil exist. Development is ready to commence if financing can be assured. Minimal

governmental involvement through loan guarantees will ensure this development.

5. That Congress adopt H.R. 18 which would expedite the siting and licensing of nuclear power plants. Unpardonable delays as long as five or six years are postponing energy projects and causing large cost increases.

6. That measures be enacted which would expand the nation's uranium enrichment capacity to assure an adequate supply of fuel for nuclear power plants. Congress must assure the scheduled completion of the Clinch River Breeder Reactor and further develop the breeder reactor program.

7. That measures be enacted which would close the nuclear fuel cycle by developing licensable and commercially viable facilities for the reprocessing of spent fuel and the storage of radioactive wastes and recycling of plutonium.

8. That Congress adopt measures to remove the incentives which presently are encouraging American companies to build refineries overseas.

9. That Congress enact legislation to promote energy conservation in new buildings and the retrofitting of old buildings to achieve better thermal efficiency.

The Building Trades industry has been impacted more than others by our country's failure to resolve its energy problem. This Department stands ready to cooperate in any way to help find a solution.

It is absolutely imperative that all Americans work together for this country's energy security and economic prosperity.

TESTIMONY

OF

THE NATIONAL OIL JOBBERS COUNCIL

BEFORE THE ENERGY AND POWER SUBCOMMITTEE

ON THE NATIONAL ENERGY ACT

SUBMITTED MAY 31, 1977

The National Oil Jobbers Council is a federation of 44 state and regional trade associations representing thousands of independent small business petroleum marketers. Members include gasoline and diesel fuel wholesalers, commissioned distributors of gasoline, gasoline reseller-retailers and a large number of retail fuel oil dealers. Members also wholesale or retail many other petroleum products, including kerosene, LP gas, aviation fuels and motor oils as well as residual fuel oil. Together our members market approximately 75 percent of the home heating oils and 25 percent of the gasoline sold in America under either their own private brand or the trademark of their supplier.

Because we are small, highly competitive, independent of the major oil companies, and close to the consumer, we believe we can offer some special insight into the formulation of the national energy plan. Our unique perspective and experience could be of valuable assistance in the development of effective and equitable energy policies.

The independent marketers represented by the National Oil Jobbers Council welcomed Dr. Schlesinger's invitation to submit our ideas for inclusion in the National Energy Plan. The proposals we offered emphasized incentives to achieve conservation in the short term and increase production of energy for the future. We called these recommendations "An American Energy Policy". A copy of that plan is attached to our comments for the convenience of the committee.

On April 20 our members were pleased to learn that many of their suggestions had been incorporated in President Carter's program. Most of the principles which he selected as a basis for his program were similar to ideas we had emphasized

- *conservation to reduce demand to a level consistent with the real cost of replacing the energy we use.*

- *an emphasis on incentives rather than mandatory restrictions on our citizens.*

- *energy prices which stimulate production and reflect the true replacement cost of oil and natural gas.*

- fairness, especially through equal treatment of similarly situated end-users.

And while the principles are not as consistently applied as we should wish, many of the President's specific measures were also quite similar to our own suggestions. Our members strongly supported and continue to support the President's proposals for

- tax credits for thermal efficiency measures in residential buildings

- federal insurance of credit extended for residential energy conservation measures

- a residential energy conservation program in which independent heating oil dealers and heating equipment contractors can compete fairly with electric and gas utilities.

- electric utility rate reform based upon cost of service

- excise taxes on inefficient vehicles coupled with rebates for efficient cars and trucks

- avoiding import quotas and end-user rationing

- incentives for the development of all conventional resources including oil, natural gas, coal, and refining capacity both domestically and abroad

- maintenance of appropriate environmental guidelines for the development and use of coal

- programs and incentives for the development of oil shale and coal liquefaction

- programs and incentives to develop solar and other renewable resources

- use of nuclear power only after safe and standardized technology is in hand and only to the extent that other alternatives cannot meet this nation's energy needs.

With these general observations in mind, let us turn to specific issues within the jurisdiction of this committee.

I. Utility Program (Title I, Part A - Energy Conservation Program for Existing Residential Buildings)

While strongly supporting conservation, independent petroleum marketers are reluctant to endorse the particular weatherization program set forth in H.R. 6831 That program requires electric and natural gas utilities to offer to perform inspection procedures to determine the conservation potential in almost every American home. When the home which is inspected is equipped with electric heat the proposal has no direct impact on our members. However, almost every home heated with fuel oil is also serviced by an electric utility. Independent heating oil dealers are generally fully capable of conducting the inspection and performing the necessary weatherization measures at a competitive price. Yet, the legislation proposed by the President gives inadequate recognition to this service and competition our members can provide.

The potential adverse effect on competition of the legislation as proposed is large. Given the extremely competitive character of the home heating market, it is impossible for our members to accept the proposition that an electric company energy auditor will enter the homes of fuel oil customers and fairly evaluate the energy efficiency of their heating units. In fact years of experience in competing with the often misleading promises made about electric heat makes it difficult to imagine a more clear cut conflict of interest.

This committee should know that even without the tax-credits or facilitated financing proposed in the bill currently under consideration, several independent heating oil companies for several years have been reinsulating homes and utilizing extended payment programs. This low cost effort could be severly

impeded if a monopoly is, in effect, granted to the utilities and oil heating contractors best equipped to do the work are ultimately excluded.

Moreover, there is a real danger that the regulatory formulas used to determine utility profits will encourage these monoplies toward extravagance in the equipment modifications they recommend. Where the return to the utility is a percentage of the costs, higher contractor prices translate directly into higher utility profits. Although the legislation as proposed would require the utilities to provide information regarding alternative methods of insulation installation and financing, there is no provision that assures a competing contractor or heating equipment dealer will be included in the list of available contractors before the list is sent to customers. Nor is there any provision for independent contractors to conduct their own audit and perhaps recommend a more modest weatherization program. Both these revisions must be made if the interests of the consumer as well as the viability of the community small businessmen are to be protected.

1. Because fuel oil dealers are not regulated public utlities, it would be inappropriate to mandate their participation in the weatherization program. But the FEA or its successor in the DOE should be specifically directed to promulgate regulations directing state energy offices to assist heating oil marketers in offering every service which the legislation requires utilities to offer. This assistance should include technical information about which conservation measures are appropriate for different locales of the state, financing, and state or federal assistance programs for small businessmen offering weatherization services.

2. To give teeth to the requirement that a utility must assemble a list of alternative contractors, the legislation should specifically require approval of the list by the State Energy Office before any offer or list is distributed. The State Energy Office could be required to resolve disputes between the utility and any contractor excluded from the list before approval is granted. A procedure to protect consumers from incompetant or fraudulent contractors should be established by requiring the listed contractors to post bonds.

3. To prevent subsidizing finance terms with inflated recommendations or prices, the legislators should require that all contractors, including heating oil dealers, have access to utility financing if the terms offered there are better than can be obtained elsewhere; or, at the very least, to prevent subsidizing that utility financing can be no more favorable than that of independent financial institutions serving the independent contractor.

4. To assure efficient and equitable administration, the legislation should require FEA or its successor in the DOE to establish an Industry Advisory Committee which would work with the agency to develop and co-ordinate the national framework for implementation of these plans. Membership on this committee should include a number of heating oil industry spokesmen proportionate to the percentage of homes in the country heated with oil as compared with the number of representatives from the gas and electric industries.

Amendments

An additional section should be added to Title I, Part A, sub part 1

"Competition"

a) Part C of Title 3 of the Energy Policy and Conservation Act is amended by adding at the end of Sec. 367(b) (2) (B) the following:

> "such program shall include procedures whereby State Energy Offices (or their functional equivalent) will provide independent fuel oil marketers assistance in the undertaking of energy conservation programs for existing residential buildings, including information of both technical and administrative nature which would be of assistance in performing all functions designated for utilities in Sec. 103 of the National Energy Act."

b) The Administrator shall promulgate rules

> 1. to establish a procedure whereby the list of suppliers and contractors prepared by the public utility pursuant to Sec. 103 (a) (2) (D) (3) be equivalent there of) prior to distribution.

2. The rules shall include provisions for notice and comment by interested parties prior to approval of the list.

c) Each utility program shall include procedures whereby approved contractors will be eligible on a non-discriminatory basis for utility financing of purchase and installation costs.

d) The Administrator shall establish an Industry Advisory Committee to assist the agency in development and coordination of the residential energy conservation plans. Members shall include representation from the heating industries proportionate to approximate market shares of the industries.

II Natural Gas (Title I, Part D)

NOJC believes that energy prices must be decontrolled. However we recognize that natural gas is currently in such short supply that prices could temporarily surge far past the level which a free market would ultimately set. For this reason it is widely thought that controls on even new natural gas must be phased out gradually. In this interim period we support a BTU equivalent price for new natural gas to avoid market disruptions created solely by Federal pricing policies.

BTU Equivalence Pricing Should be Implemented

The National Energy Plan specifically recognizes interfuel competitive problems and promises to address them fairly through equivalence pricing at replacement value. But the proposals for natural gas instead retain the most discriminatory element of the present program. New natural gas has a replacement value at least equal to the BTU equivalent price of newly discovered crude oil. Yet, the highest price proposed for new natural gas is equated to a weighted average cost of crude oil that will consist almost entirely of production from existing wells. As a result if prices continue to rise, the price of new natural gas will never become BTU equivalent to new oil.

This price policy repeats the most serious error in our previous policy. It maintains a regulated price below the market level, assuring that demand will always outstrip supply. That in turn means that there will always be excess demand which would cause a surge in prices if the price of new natural gas were completely decontroled. Thus, the Administration's plan offers no hope of ever ending federal regulations on the price of even new natural gas. The natural gas price provision in the legislation should be revised to adopt the principles and analysis offered by President Carter by establishing the BTU equivalent price of new natural gas on the basis of the price of new crude oil to facilitate a transition to a completely free market price of new natural gas.

The Carter Energy Plan concedes that the artificially low price of natural gas results in more demand for natural gas than there is supply of that fuel. In the short term the nation has accommodated this shortage by more severely curtailing industry and utility use of natural gas to reserve it for residential and small commercial users. But the great irony in this accommodation is that the gas companies continue to add new residential and small commercial accounts. During 1976, over 340,000 new natural gas hookups occurred despite public statements by the utilities that a cold winter could, as it did, force widespread curtailment and unemployment.

The gas company rationale is simple: Most of the new customers are residential users to whom utilities are permitted to charge the highest rates. But NOJC believes the national interest is equally clear: There is an immediate need to conserve dwindling supplies of natural gas for those already irrevocably dependent upon it. Moreover, because natural gas is the only fuel for which supply cannot meet demand, interstate supplies of natural gas must be allocated to share that shortage among those consumers already committed to the use of this fuel.

In order to conserve natural gas for existing users who cannot realistically be asked to convert to more plentiful fuels -- principally residential and small commercial consumers as well as certain industrial feedstock and processing users -- the legislation proposed by the Administration should be amended to direct the State Public Utility Commissions to prohibit, in so far as possible, new connections or conversions to natural gas. Obviously, there are areas where natural gas is the only heating fuel available, just as there are industrial processes which require natural gas, but where the adequate supplies of other fuels are available, conversions or new connections to natural gas are irresponsible as long as shortages continue.

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Restrictions of new connections and conversions are also made essential by the impact which natural gas shortages have on the price of alternative fuels. Ironically, the fuels from which residential and small commercial users convert become more expensive for the remaining users. As the production of natural gas continues to decline, ever larger curtailments have been increasing the demand for fuel oil — the fuel which can be most easily imported and burned in much of the industrial gas burning equipment. The increase in imports of oil causes continuing increases in the average cost of all petroleum products, including heating oil.

Residential fuel oil consumers are therefore now paying more for their fuel oil because of a policy of providing natural gas at artificially low prices to their gas-heated neighbors. As the worsening gas shortage causes increases in all imports, and thus increases in fuel oil prices, users of home heating oil have ever increasing incentives to convert to the fuel which is in shortest supply, natural gas.

Artificially induced distortions must cease until a rational relationship between the regulated prices of natural gas and oil can be restored. Until natural gas demand is balanced with supply, new nonessential residential and small commercial attachments and conversions by gas companies must be restricted.

In the past, NOJC supported allocation on a national basis of petroleum products in short supply. We believe that the authority to allocate among interstate natural gas pipelines so that the shortage of natural gas is spread evenly among those already dependent on this fuel, must be extended beyond the circumstances of a supply emergency.

In the event that restriction of new hook-ups is deemed inappropriate for policy or legal reasons, then we maintain that the new customers should bear the costs associated with obtaining the natural gas needed to meet added demand. The historical users are to a degree, trapped by reliance on the historical pricing policies of the government and gas utilities. To the extend that they are unable to convert to alternative more plentiful fuel sources for their residential and industrial use, these existing users should not be required to share the incremental expenses imposed on the system by new customer demands.

NOJC Opposes Any Increase In The Allocation Of Feedstocks For The Production Of Synthetic Natural Gas.

The National Energy Plan credits SNG production with keeping homes warm in areas critically short of natural gas during last winter. It therefore proposes creation of a task force dominated by the gas utilities to indentify areas of the country which would benefit form the construction of additional SNG plants. Feedstocks allocations to these plants would be given a high priority and total production of SNG could be expected to triple in the 1980's to approximately one trillion cubic feet annually.

Our members believe this policy rests on inaccurate assumptions and will result in further waste of our energy resources. We challenge the Administration to identify the homes which they claim were warmed solely because SNG production was available. We know of no such homes. In fact, the Energy Plan implicitly concedes that SNG plants are and will be used to fuel industrial boilers since the added cost of SNG production is to be allocated entirely to industrial users.

Moreover, in the process of converting naphtha into synthetic gas about 10 percent of the feedstock is consumed in process fuel or lost. In a naphtha reforming plant (the predominant type of plant) having a capacity to convert 48,000 barrels of naphtha per day into gas, it would be possible, according to FEA's estimates of conversion efficiencies, for that one plant to waste as much as 73.6 million gallons in just one year - equivalent to the gallons of fuel oil required to heat nearly 55,000 six-room homes in northern Illinois for one entire year.

But the most shocking element of the current SNG production is the fact that the gas produced is often used to convert existing users of other fuels to gas. Most of the operating SNG plants are owned by gas distributing companies. Of the nine distributing companies that operate their own SNG plants that reported customer conversion figures to the American Gas Association for the AGA's 27th and 28th Annual House Heating Surveys, virtually all were continuing to convert homes from other fuels to gas. These conversion figures are as follows:

Company	Amount of Conversions Per Year	
	1974	1975
Boston Gas Company	4,622	1,425
Public Service Electric And Gas	6,365	2,855
Brooklyn Union Gas	6,155	5,040
North Shore Gas (a division of People)	1,702	1,271
People Gas Light and Coke Company	60,730	34,270
Northern Illinois Gas Company	15,500	10,700
Consumers Power Company	8,912	8,307
Baltimore Gas and Electric	1,938	677
South Carolina Electric and Gas	1,745	1,036
Total	107,669	65,581

These nine gas utilites were responsible for 42 percent of the 257,500 total conversions reported for 1974, and 45 percent of the 145,000 total conversions reported for 1975. These conversion percentages for those companies operating SNG plants would be even higher if the other gas utilities operating these plants, had submitted their conversion figures to the AGA.

Thus, it is apparent that the National Energy Plan is seriously in error when it proposes abandoning the current policy of restricting feedstock allocations for new SNG production. The present FEA policy, supported by extensive documentation and a comprehensive environmental impact analysis should be maintained. To assure that it is maintained, we urge this Committee to amend the legislation before it to require FEA or its successor within the DOE to restrict feedstock allocations for SNG production to the minimum level essential to the operation of existing facilities and to require a compelling showing of gross hardship or serious inequality according to the meaning currently given those areas by FEA before any new feedstock allocations are granted.

III Public Utility Regulatory Policies

Electric utility rate reform is essential. At this moment the Federal Energy Administration is reviewing rate design alternatives pursuant to a Congressional mandate in Title II of the Energy Conservation and Production Act. The final version of this study should be submitted to the Congress soon in the form of proposals for rate structures which are most likely to reduce the need for new generating capacity, maximize efficient use of fuel resources and keep customer costs to a minimum. Thus, the Congress will soon have a comprehensive analysis with which to move quickly toward electric rate reform.

We recognize that the state public utility commissions have a particularly keen appreciation of the peculiarities of the areas' electric supply and demand situation and these commissions should be allowed some measure of flexibility in adopting rate structures. However, specific national objectives should be delineated for electric utility pricing as a part of the comprehensive energy plan. At the very least a set of federal guidelines should be adopted which provide for a cohesive and consistent program which does not unfairly burden any one region. Federal authority to intervene in state rate proceedings and financial assistance to the state public utility commissions already provided in Title II of the Energy Conservation and Production Act should ensure implementation of these federal guidelines with adequate allowance for local problems.

The foundation of these federal guidelines must be that price is based on the cost of service. We believe that it is economically unsound and improper to attempt to stimulate or retard consumption of electricity through rate structures which are not cost based. In the past, failure to observe this basic tenet has led to unnecessary expansion of electric utility generating capacity, price discrimination between and within customer classes, and an unfair disadvantage to the electric utilities' competitors. For these reasons we support peak responsibility pricing.

Furthermore, we believe that below cost rates for what is often characterized as a subsistant quantity of electricity (lifeline rates) are not only economically inappropriate but, in most cases, would undermine the nation's conservation goals.

— Rates which are artificially low have the potential for stimulating conversions from one fuel to another. In view of the transmission and distribution inefficiencies inherent in electric power generation, it would be a wasteful use of petroleum resources to encourage an increase in demand for electricity as long as oil and gas are being burned to generate that electricity.

— The lifeline rate concept is overly broad. The goal is to assist low income consumers of electricity by providing the minimal amount of electricity for those purposes which have become essential in every home. But lifeline rates as proposed subsidize not only the target group but also a wide range of middle and high income citizens.

— Serious questions remain about the assumptions upon which the lifeline rate concept is based. The low income consumer is not necessarily a low volume consumer. Many poor people live in under insulated dwellings and many more live in multi-family buildings without individual meters so that any benefits of lifeline rates would be out of reach.

Therefore, before the Congress endorses lifeline rate structures, a careful in depth study should be undertaken to determine whether the objectives desired would or could actually be realized through this mechanism.

Understand that we do not challenge the goal of public assistance to those citizens most heavily burdened by the escalating energy costs, i.e., the poor and those on fixed incomes. We oppose utilizing the electric rate structure to accomplish this. Energy assistance should not be limited to electricity

consumers when millions of homes are heated with natural gas and fuel oil. A fair and uniform approach would be a program to assist low income citizens with energy costs rather than electricity costs alone. We maintain that direct compensatory programs would be the most efficient and equitable means of dealing with this problem.

The electric rate portion of the National Energy Act is generally consistent with our proposition that rates must be cost-based. However, it provides inadequately defined direction in a highly controversial area. Because the subject of regulatory economics lends itself to arcane, erudite theoretical disputes and therefore broad variations in regional rate structures it is critical the governmental action taken here establish practical parameters in the form of minimum mandatory standards for state public utility regulators.

Technical experts agree that the most difficult problem in utility costing lies in the allocation of capacity costs. Theoretically, capacity costs are joint costs, and as such should be allocated based on the magnitude and elasticity of kilowatt demands placed on the system. However, little to date has been done in the area of estimating the elasticity of kilowatt demand and, as a result, proper and equitable distribution of capacity costs has been sporadic at best.

We submit therefore that specific effort should be made to develop models which integrate kilowatts, time and kilowatt hours into traditional models of consumer behavior such that a conceptual understanding of the impact of alternative rate designs can be obtained and used to construct practical rate structures which reflect economically sound principles.

The N.E.A. should be amended so that the methods for determination of cost of service are specifically defined. We support the approach to this problem advocated by Senator Brooke in Sec. 205 of S. 122, introduced on January 10, 1977. If it proves undesirable to do this within the text of the Act then authority should be expressly granted to the FEA to establish minimum mandatory elements of utility costing methods, utilizing input from concerned industry and consumer spokesmen.

IV. ENERGY EFFICIENCY STANDARDS FOR CONSUMER PRODUCTS OTHER THAN AUTOS

*In general NOJC supports the modifications to the current program of energy efficiency standards proposed in the plan. We have participated actively in the programs sponsored by ASHRAE and the National Conference of States on Building Codes and Standards as well as governmental agencies to assist in the development of such standards in the past. A comprehensive statement of our position relating to energy efficiency measures is attached to this testimony and we request that it be incorporated into the record of this hearing.**

We stress the critical importance of evaluating the efficiency of appliances in terms of BTU's consumed at the source of heat or power generation. Restricting the efficiency analysis to the point of on-site consumption will provide gravely misleading information with respect to proper utilization of energy. To avoid this type of distorted data, a meaningful analysis of energy efficiency must include the energy used in converting the primary fuel to electricity.

Use of fossil fuels for the generation and transmission of electricity results in a loss of two-thirds of the BTU potential of those fuels. In contrast, if gas, coal or oil is utilized directly in the building, rather than burned at the power plant, approximately 73 percent of the BTU potential is realized.

To illustrate the significance of the source analysis approach to appliance efficiency ratings in the national conservation plan we would use as an example an electrical device which is often characterized as an energy conservation measure -- the electric heat pump.

*This paper was originally submitted to the Federal Energy Administration for consideration in the development of a list of energy conserving measures.

If the heat pump is credited with an on site co-efficient of performance (C.O.P.) of two, which necessarily assumes that the temperature drops no lower than 32 degrees fahrenheit, the total efficiency of the system's energy use is only

$$0.3 \times 2.0 = 0.6$$

where 0.3 is the efficiency level of an electrical generating system using fossil fuel and 2.0 is the heat pump C.O.P. Thus using a generous assumption, the efficiency of a heat pump is barely 60 percent.

The lowest oil heat efficiency in any part of the country is 65 percent to 70 percent. Hence, in terms of efficient energy use, fuel oil in conventional furnaces comes closer to realizing the objective of significant resource savings than an electric heat pump because the amount of energy consumed to generate electricity for the heat pump is greater than the amount directly consumed in producing the same warmth at the site.

Only when compared to electric resistance heating, can a heat pump be a viable conservation alternative. When compared to gas and oil heating systems, a new heat pump is not as efficienct as existing installations. Because of the inefficiencies involved in the generation and transmission of electrical energy, close to 70 percent of the BTUs in the fuel burned at the generating source is lost before it reaches any electrical device.

Electric heat pumps have also suffered from high operating and maintenance costs. But the other most serious failing in terms of energy conservation is the fact that almost all of these devices are air-conditioners. Thus, promotion of electric heat pumps will add to the electric utility load in the summer, the very time when most utilities experience their system peak. This will result in the need for additional generating capacity rather than conservation.

Thus we recommend that the following paragraph be inserted in Section 201 of the National Energy Act:

"Energy efficiency standards established pursuant to this section shall reflect the source - to - use site BTU loss inherent in electric generation and transmission. And in no case shall the efficiency evaluation of an electrical appliance be limited to on site performance.

STRATEGIC STORAGE

Because the efforts to develop domestic, or at least secure, sources of energy cannot be expected to satisfy the American need for energy at prevailing market prices for many years, the federal government must expeditiously develop national security stockpiles of oil sufficient to survive an embargo or other international disaster. Moreover, a policy of holding our domestic resources in reserve while drawing upon insecure sources in peacetime also requires an extensive incentive program for capping new wells in addition to storing oil.

The current strategic petroleum reserve program depends solely upon crude oil storage. It is the position of NOJC that a regional finished product storage system is also necessary to protect the national security over the short term should an emergency situation arise.

There are sections of the country which historically are particularly dependent on imported products and in the event of an unanticipated emergency, adjustments to the transportation system necessary to get these sections supplied quickly from the gulf coast are unrealistic. Protection of homes and industry in these areas will require some amount of regional product storage. We support incentives for construction and use of private product storage. The federal government should have first call on this product, but title should remain in private hands because finished product must be turned over periodically to avoid deterioration. An immediate and economical source of product storage could be the reopening of bulk plants abandoned because of the new OSHA and EPA spill and vapor recovery regulations. Relaxation of these regulations may be appropriate at these facilities as long as they are used in a strategic product storage program.

We recognize that the most appropriate means of implementing regional product storage may be through the appropriations process but the subject is highly relevent to the present discussion of the energy plan and it is for this reason we have raised the issue at this time.

[Whereupon, at 5:15 p.m., the hearings were adjourned.]

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