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IMPLICATIONS OF HIGH ENERGY PRICES FOR LOW
INCOME PEOPLE

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HEARING
BEFORE THE
SUBCOMMITTEE ON ENERGY AND POWER
OF THE
COMMITTEE ON
INTERSTATE AND FOREIGN COMMERCE
HOUSE OF REPRESENTATIVES

NINETY-FIFTH CONGRESS

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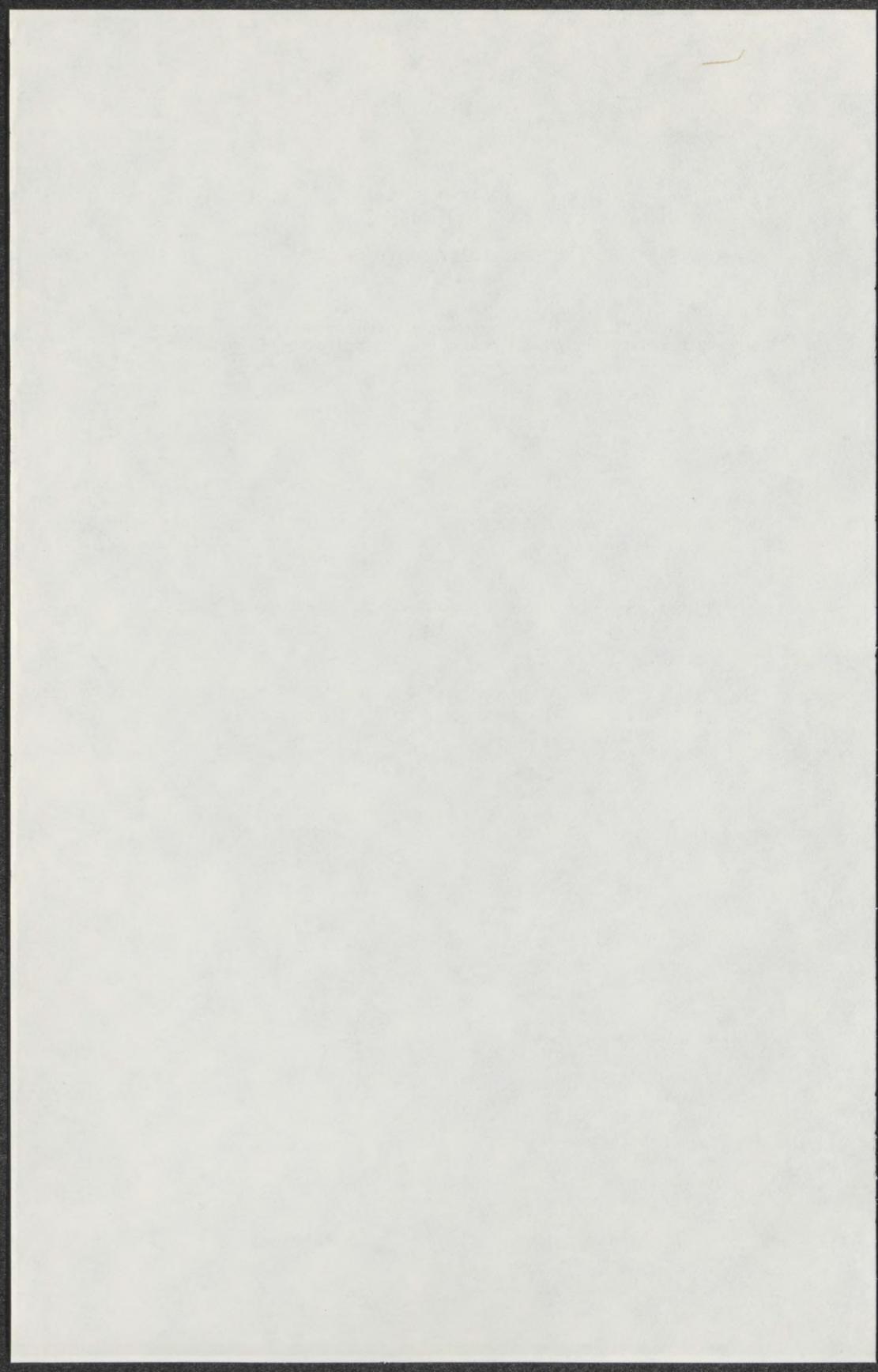
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IMPLICATIONS OF HIGH ENERGY PRICES FOR LOW INCOME PEOPLE

WEDNESDAY, SEPTEMBER 13, 1978

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

The subcommittee met, pursuant to notice, at 10:20 a.m., in room 2218, Rayburn House Office Building, Hon Philip R. Sharp, presiding (Hon. John D. Dingell, chairman).

Mr. SHARP. The Subcommittee on Energy and Power will come to order.

This morning we have another hearing with respect to the critical question of energy prices in this country.

We welcome this morning Dr. Kenneth E. F. Watt of the Interdisciplinary Systems Group, Institute of Ecology, at the University of California at Davis, Calif.

Dr. Watt, we are delighted to have you back with us to discuss a question that is obviously of great controversy in the country, and enormous concern to individual constituents of ours, as well as to those that are trying to make policy for the country as a whole.

With that, Dr. Watt, we welcome your statement.

STATEMENT OF KENNETH E. F. WATT, PH. D., PROFESSOR OF ENVIRONMENTAL STUDIES AND RESEARCH SYSTEMS ANALYST, INSTITUTE OF ECOLOGY, UNIVERSITY OF CALIFORNIA (DAVIS)

Dr. WATT. Thank you very much, Mr. Sharp.

Ladies and gentlemen, I might begin with a moment about what my qualifications are for making the kinds of statements I am making.

I am a professor of zoology and of environmental studies and research systems analyst in the University of California at Davis.

Since 1969 I have received rather large amounts of money from the Ford Foundation, the National Science Foundation, the State Department, some from this committee, and more recently from a large number of corporations to conduct statistical analyses of data and computer simulation modeling exercises to gain insight into the dynamic behavior of the United States and world economy.

My remarks are made on that basis.

The energy dilemma confronts democracy with a grave and perhaps novel type of crisis. Democracy can work well only when a large majority of the electorate has the facts and understanding necessary to vote in its own best interest.

Unfortunately, nothing could be further from the truth in the case of energy policy. Polls over the last 2 years show consistently that 38 to 50 percent of the adult U.S population does not believe we are importing any crude oil at all.

When we got to the more complex implications of energy policy, these are understood by only a tiny minority.

In my speechmaking trips around the country, I discovered that very few presidents of large corporations understand these phenomena.

From my advising to the CEQ Global 2000 study I have, however, discovered that the Office of the Director of the CIA, and people within that agency, and the Council on Environmental Quality are sensitive to the possible significance of whether fluctuations here and in other countries for the United States and world economies.

I might say that in my personal associations with people working for the Global 2000 study, I have discovered that senior economists for the World Bank and the Conference Board are sensitive to the new role of international trade as a determinant of the internal behavior of the U.S. economy.

Thus, I am making a difficult request of this committee that it listen to an argument for which there is no constituency.

But if Congress does not ultimately vote as implied by this argument—before there is a constituency for it we may have a grave problem—by the time there is a constituency for this argument it may be too late to take the necessary action.

Charts, tables, and necessary figures are in the handouts. In my experience, which I get daily, making presentations 4 hours long on this material all over the country, I discover that it is extremely difficult for people to follow it.

It has been discovered by a lot of polling of my audiences by various agencies that it is easiest if you try to focus on the oral argument, and study the graphs and charts in detail subsequently.

Given constant increases in the real cost of producing petroleum and natural gas in the United States, it is clearly an injustice to domestic energy producers for the Government to impose an arbitrary ceiling on the prices they can receive.

The conventional political justification for this price regulation is that without it there would be a deleterious impact on a large number of political constituencies, including labor, consumers, the poor and the middle classes.

The standard argument offered is that since energy is an input to the manufacture of a wide array of goods, any increase in the price of energy would ultimately be reflected in an increase in the retail prices of all those goods.

Consequently, the Consumer Price Index would rise, consumer purchasing power would drop and there would be a decline in the standard of living for Americans.

This argument is based on an extremely simplistic view of the workings of the U.S. economy. Hereinafter it will be demonstrated that the conventional political rationale for low energy prices is simply false.

In fact, there are six different arguments as to why cheap energy penalizes the very constituencies it is supposed to protect.

The conventional argument overlooks the various types of adjustments to cheap energy that occur in the U.S. economy, and in the linkage of the U.S. economy to other economies through the international trade and international monetary systems.

I am now going to discuss orally some of the kinds of causal pathways that lead me to make that statement, and there will be charts in the handouts that will allow you to see in great detail how some of these causal pathways operate.

The argument I am going to give you is essentially a scientific hypothesis, but a simply vast amount of data is available to show that the system does, in fact, respond to energy prices the way I say.

Each of the parts of the causal system that I am postulating is supported by the data.

Low U.S. energy prices discourage domestic energy production, but on the other hand encourage domestic energy consumption. These two phenomena jointly produce a shortfall in U.S. energy production relative to demand which in turn stimulates energy importation.

However, as energy importation increases, this stimulates the export of other commodities, particularly wheat, corn, soybeans, textiles, wood products, raw metal, scrap, ore, et cetera, in order to balance the U.S. trade with other countries.

But the extent to which the U.S. commodity exports can be increased depends upon both U.S. stocks of commodities available for export, but also the stocks of commodities in other countries.

Many factors determine the size of these variables in turn, but important system determinants are crop growing weather in other countries and in the United States, the acreage of crops planted in the United States and technology inputs to U.S. agriculture.

Years when crop growing weather is favorable on average, outside the United States, world demand for U.S. crops will not be great enough for us to balance up our international trade.

Thus, when U.S. energy prices are low, but also foreign demand for our crops is low, the U.S. trade deficit will be large. This causes U.S. money to accumulate in foreign banks at a rate in excess of the rate of demand for it, and the dollar drops in value relative to other currencies.

This in turn increases the prices of foreign goods in the United States and that has two bad effects. The U.S. inflation rate is increased, but also sales of foreign goods in the United States weaken.

This ultimately leads to a decrease in the rate of growth in foreign economies, which still further decreases their purchase of U.S. manufactured goods, which are already at a competitive disadvantage because of the high cost of our labor and the unsuitability of some of our products for foreign markets.

Large, energy inefficient cars obviously don't fit in the streets of Geneva or Tokyo. This, in turn, slows down the rate of growth in the U.S. economy.

But if U.S. energy prices are low, so that in some years our agricultural commodity exports are very large, but in other years good crop growing weather elsewhere decreases foreign demand for

our crops, this leads to a massive overhang of U.S. commodity stocks over domestic demand.

This drops the price of commodities. Farmers' earnings are lower than their costs. There is a depression in the farm sector which spills out to the rest of the economy if it persists.

However, if crop growing weather in other countries is bad, there is a tremendous drawdown in U.S. commodity stocks because of massive exports. The domestic commodities prices rise, and this can trip an inflation.

In other words, there are two most curious consequences of low energy prices in the United States. They always have an inflationary effect.

If our crop exports are large, inflation is affected by increased food costs. If, on the other hand, crop exports are small, then the inflationary impact comes from increased prices of foreign goods in the United States.

These are only two of the inflationary impacts of cheap U.S. energy prices. Others are found in other parts of the causal system.

Jay Forrester of MIT has pointed out that complex systems often behave in a counterintuitive fashion because it is difficult for the human mind to visualize the ultimate consequences of long chain causal pathways.

The other curious phenomenon involved in this system is that cheap U.S. energy prices render the economy remarkably sensitive to a number of phenomena produced by crop growing weather in major prospective consumers of U.S. food, particularly Russia and China.

This is particularly significant because crop growing weather in some other countries, particularly Russia and China, and hence crop production, is much more volatile from year to year than in the United States.

Thus, by keeping energy prices low in the United States, we create the surprising situation in which short-term fluctuations in the economy are made extraordinarily sensitive to a powerful and violently fluctuating destabilizing force, crop growing weather in countries with instable crop growing weather.

Much of the surprising behavior of the U.S. economy since we began importing vast quantities of crude oil is traceable to this situation.

With this flow chart as a backdrop, we now consider six arguments against low energy prices using illustrative data from standard U.S. governmental statistical sources.

Mr. SHARP. You say here arguments against low energy prices. You really would want to qualify that word "low" energy prices by some kind of adjective or modifier. You don't mean just the fact that energy prices are low.

But what you are saying really is unreasonably low or artificially low, is that correct?

Dr. WATT. Yes, unreasonably and artificially low.

Mr. SHARP. Would you want to amplify on that so that I am not putting words in your mouth?

Dr. WATT. Yes. Many people in this country argue that energy prices are too high. One way to assess the validity of a statement of

that sort is to examine the ratio between energy prices and gross national product per capita across countries.

When we do this, we discover that relative to gross national product per capita, energy prices in the United States are approximately one-third to one hundred-fiftieth what they are in any other country.

Now, a standard argument that one reads in the media is that we must keep energy prices low and energy consumption per capita high because otherwise the U.S. economy would collapse and go back into the caves.

In other words, a high and constantly rising level of energy consumption per capita, a low and constantly dropping energy price relative to labor costs or gross national product per capita, are necessary prerequisites for a healthy and growing U.S. economy.

Quite apart from any statistical arguments, we can see that there is something very curious about that argument because Japan and Switzerland, for example, in 1970 had a level of energy consumption per capita about equal to what the United States had in the year 1800.

Their energy prices, of course, were much higher relative to the costs of labor than is the case here. Sweden, for example, has energy prices much higher than we have here and has had energy consumption in most recent years about half as high per capita as here.

Yet, obviously there has been a slowdown in the rate of growth of the U.S. economy in the last few decades on average relative to the rate of growth in some of the other countries I mentioned.

This raises an interesting and nagging question; that is, perhaps there is something wrong about the way we view the significance of energy prices and energy consumption per capita as a necessary prerequisite for a healthy U.S. economy.

Maybe we have got it backward. Indeed, maybe by accident or by design some of the northwest European countries and Japan have stumbled on to a secret about the significance of energy policy prices and energy consumption that we ought to be exploring.

Indeed, that is what a great deal of my talk is about, what those secrets are.

So, to summarize, I feel that energy prices in the United States are unreasonably low and that this is a cause of a great deal of our current economic difficulty.

My first argument.

The impact of cheap energy on the purchasing power of the poor and middle classes. Elementary commonsense tells us that if the price of energy is kept artificially low by the Government, this will encourage Americans to use it, but also discourages domestic producers from producing it.

Thus, low domestic energy prices simply result in a discrepancy between production and consumption which gradually increases as the purchasing power of Americans increases relative to the retail price of energy.

This shortfall is met by gradually increasing the petroleum exports. But a country is like a family. On balance, over time, it must

sell goods and services at roughly the rate at which it buys goods and services.

Therefore, as the United States has increased its imports of petroleum, it has had to increase its exports of other items to raise the money needed to pay for the oil.

The reason for the economic and political problems related to petroleum pricing is that few Americans inside or outside Government grasp the full implications of the massive export required to pay for the imported oil.

One example. Few people understand that about three-quarters of some of our major agricultural commodity items may be exported in some years to pay for imported crude oil.

Now, we can do an analysis of the statistics on international trade of the United States with other countries, and what we are curious about is what do we see when we analyze trade by broad trade categories and find out how these are changing over time.

Well, when we do this, we discover that between 1970 and 1976 there was an increase in the net trade deficit of the United States, international trade with other countries, in the mineral, fuels, and related materials area of about \$28.3 billion.

In other words, the \$28.3 billion isn't the value of our net trade deficit in 1976. It is the amount by which it increased over 1970.

The question I am asking is, given this absolutely staggering perturbation being applied to the American economy, how did the American economy work out an adjustment to that; in other words, how did we raise the approximately \$28.3 billion extra in sales to other countries that was required to pay for the approximately \$28.3 billion extra over 1970 that we were spending to pay for the imported crude oil.

What did we sell to raise that money? Now, most people, on the basis of their commonsense understanding of the American economy, would say, well, we are a major world manufacturing power. Therefore, the indicated strategy for raising the \$28.3 billion extra in our international trade would be to increase exports of manufactured products and transportation equipment by that amount.

We tried to and we could not. It turned out that between 1970 and 1976 we were only able to increase our net exports of machinery and transportation equipment by about \$13 billion. So, we were about \$15 billion short.

Other manufactured goods didn't help us, and chemicals didn't help us. The subtotal for all manufactured goods and chemicals, transportation equipment, military hardware, everything, is that we only increased for that whole category our net exports by \$9 billion.

The question is how can we deal with this \$28.3 billion increase in our cost of fuel exports from 1970 to 1976? The answer is that we largely did it with renewable resources.

Three billion dollars of it was paid for by wheat and flour, about \$4.4 billion of it by increased exports of corn, a little over \$2 billion of it by increased exports of soybeans, almost \$1 billion of it by increased exports of textiles, and the remainder by others.

So, just looking at wheat, flour, corn, soybeans, and textiles, that allowed us to raise \$10.3 billion extra in our receipts from exports

between 1970 and 1976, to help us pay for the extra \$28.3 billion that we were spending on imported crude oil.

In other words, contrary to the opinion that most people would have, that we easily dealt with the increased cost of our imports of crude oil by increasing exports of manufactured products, in fact increased exports of raw materials were much more important.

As we come closer in time to September 1978, this statement becomes increasingly true. Indeed, in the last few weeks and months we have run into an even more embarrassing problem in that within the subcategory of manufactured goods and transportation equipment we now have a net trade deficit there also.

So, the fundamental problem here is that most people, thinking of this country as a major manufacturing nation, would expect the increase in imports of crude oil to be paid for largely by increase in exports of manufactured products.

The difficulty is that this assumption is based on a lack of awareness of the intensity of the competition the United States now faces in world markets from West Germany, Japan, and other manufacturing nations; thinking, for example, of commodities such as the A-300-B airbus from Europe and subassemblies of electronic components from Southeast Asia and Japan.

So, what we now need to think about is given that the United States is being backed into the position of having to largely pay for increases in imports of crude oil by great increases in net exports of a wide variety of other commodities, what are the consequences for this country of all these massive and gradually rising exports?

In fact, the consequences are remarkably pervasive throughout the economy. They include food prices, land prices, effects on city densities and the relative economic attractiveness of various types of transportation systems.

It is interesting, then, to track the impact of massive crude oil imports through the U.S. economy so as to reveal the way in which these affect the standard of living of the typical family.

Again, it is easy to do this using nothing but routinely collected statistics made available by the Government.

As an example, what I would like to do is try to establish the relationship between the costs in the United States to drill for crude oil and the impact on the food costs as a percentage of spendable earnings for the typical U.S. family.

From 1965 to 1974 the average cost per foot to drill for crude oil and natural gas in the United States increased from about \$13.44 to about \$29.93; in other words, it became enormously more expensive to drill for crude oil and natural gas.

This isn't just due to inflation. The pattern has become very startling in the last few years and months. The problem is that while we still have lots of energy in the United States, we have already exploited the energy which is cheap to exploit, because it is in large pools and is in readily accessible reserves onshore.

Increasingly the United States will have to get domestic energy by spending hundreds of millions or billions of dollars to extract it from very difficult places, such as 100 or more miles off the Atlantic coast.

The multinational energy companies are confronted by the problem that Government regulates the price at which they can sell

energy. Their response to this, their way of adjusting has been to supply the U.S. consumer with energy increasingly by getting energy from where it still is cheap at the source; namely, the Persian Gulf.

As a result, the value of crude and partly refined oil imports increased from about \$1.2 billion in 1965 to a little over \$19 billion by 1975. Of course, that increase has become more startling ever since.

How the U.S. economy adjusted to that—and indeed as I imagine we all understand there was a formal policy of doing this, as explained repeatedly by Earl Butz and other people—was to sharply increase exports of raw commodities largely by increasing the market for our raw commodities by a new round of understanding that Mr. Nixon and Mr. Kissinger had with Peking and Moscow.

As a consequence, when we began to sharply increase our imports of crude oil, we began to sharply increase our exports of a wide array of other commodities.

So, for example, in 1970 only 738 million bushels of wheat were exported, but by 1975 1,300 million bushels of wheat were exported.

The consequence of this increased export of all these raw commodities is illustrated by the situation for wheat. As recently as 1970 the old crop carryover of wheat in the United States was 983 million bushels.

By 1974, because of large exports to other countries that we had to conduct in order to pay for our imported crude oil, old crop carryover of wheat had dropped to 340 million bushels.

This same phenomenon happened in the area of housing and clothing and hardware, as well as in the area of food. Let's, however, track the consequences through the system and see what they did to the family's position with respect to food.

In 1965 food cost as a percentage of spendable earnings was only 43 percent. By 1972 food cost as a percentage of spendable earnings had dropped to 39 percent, for the typical family.

This is simply one way of describing affluence. We have become more affluent when a smaller proportion of our net earnings has to go into the basics—food, clothing, housing, et cetera. Affluence means that we have more money to buy the extras that improve our standard of living.

As a consequence of our vast import of crude oil and the corresponding enormous drop in carryover stocks on hand of wheat, which we found also for corn, soybeans and a very wide array of wood and textile and other commodities, we find that after 1972 food cost as a percentage of spendable earnings shot up from 39 percent to 47 percent in 1974.

To make a long story short, what this means is that by keeping energy prices down, thus stimulating a response in the international economy, in which the United States on average, year after year, sends out sharply increased proportions and amounts of other raw commodities, the ultimate consequence is that the typical family is forced to put increasing proportions of its spendable earnings into those raw commodities.

Or, to put the matter differently, what cheap energy really means is that the energy isn't cheap at all; it is more expensive than it would have been if the energy prices were deregulated.

What happens is that the energy that is cheap is in fact paid for at different places than the places where it is purchased.

If we have cheap energy, the typical family then winds up paying for a high proportion of their real energy costs at the grocery store, at the place where they buy their clothing, and at the real estate dealer's office, where they pay for their house, and in the lumber store when they go and buy their hardware and wood and so on.

We simply pay for energy everywhere else. It is not cheap at all.

So, we have this most curious phenomenon that because of the linkages of the U.S. economy to the international economy, after 1972 great increases in crude oil resulted in a drawdown of U.S. domestic stocks of commodities as illustrated by the wheat stocks.

The point is that this is because between 44 and 73 percent of the wheat being grown each year in the United States was being exported to pay for imported crude oil.

Consequently, years when there was a particularly heavy export of wheat, as between 1972 and 1975, there was a great increase in the price of wheat. Thus, from 1972 to 1974 the price of wheat per bushel increased by about 2.32 times, which in turn translated into a higher U.S. food cost for the typical family.

Where food had only taken 39 percent of the average family's spendable earnings in 1972 it took 47 percent in 1974. In short, cheap energy is an illusion.

The same kind of phenomenon occurs in a wide variety of commodity stocks.

However, the problem is more complicated than the way I am stating it. While the trend on average year after year—or maybe to use a better word, the trajectory in food, clothing, and housing—is for these budget items to take a progressively larger percentage of average spendable weekly earnings, that trend is obscured by deviations about the trend produced by variations in crop growing weather in countries that are prospective customers for U.S. commodities; that is, it will be noted that the percentage of spendable earnings taken by food declined from 1947 to 1975, and again to 1976.

Now, why should that be. Indeed, this may be a large part of our political problem. The violent fluctuations about the trajectories for higher food, clothing, and housing prices are going to obscure the fact that there is an underlying trajectory toward higher prices for those items.

So now we ask the question, why do we have these fluctuations.

Well, we can project, using simple mathematical models or statistics, whatever, a trajectory for the most likely foreign demand for the U.S. wheat each year, for example, on the basis of historical data.

Differences between actual demand and this projected trajectory of likely demand account for the year-to-year fluctuations in the U.S. price of food.

These fluctuations in turn can be traced back to fluctuations in food production in other countries, which in turn are largely the product of fluctuations in crop growing weather.

So, now what we want to do is try to figure out how we can relate these fluctuations to what happens in the U.S. economy.

In other words, to make a long story short, we will begin noticing surges in actual exports of various commodities relative to likely expected exports in any given year which surges will be explainable in terms of weather fluctuations and the extent to which the economies of other countries produce the food they need to produce relative to what one would have expected had one been a planner there.

At the beginning of my discussion I asserted that commonsense indicated that low energy prices would encourage energy use but discourage energy production.

What does the evidence actually say about that?

First, with respect to the effective energy price on use within the United States, energy prices have never actually increased enough to have any discernible impact on use.

Everybody talks about how energy prices have increased enormously, but in fact retail gasoline prices are actually lower now relative to average spendable weekly earnings than they were in 1965.

In other words, the point is that the impact of gasoline on the economy depends on its ratio relative to average earnings. It is the ability of people to buy gasoline and other forms of energy that determines its impact on the economy.

So, to discover the likely impact of any significant energy price increases on U.S. energy use, we have to turn to comparative international data.

In fact, the ratio of energy price to labor cost has never changed enough in the United States over the last several decades to give us any real idea of what would happen to the American economy if there were a big increase in energy prices relative to labor costs.

However, to expose the effect of energy prices on use per capita, it is not adequate to simply use the price. We have to use the price corrected for the ability to pay for that price.

Hence, in our analyses, we examine the relationship between gasoline use per capita relative—as a function of price, and the use of gasoline in other countries after however we correct the price of gasoline in the various countries for the ability of people to pay for that.

When we make that correction, we find a very striking dependence of gasoline use on price.

Thus, we bring out an important point about the United States and the world energy policy. It is meaningless to increase energy prices by a factor of two in the name of conservation over a sequence of years in which average spendable earnings are increasing by a factor of three. This would actually increase the use of gasoline.

There will be no real energy conservation in the United States until energy prices are allowed to increase at a faster rate than wages.

Also, we discover when we examine U.S. energy prices relative to the ability of the population to pay for them, as compared to that same ratio in other countries, that energy here, far from being outrageously expensive, in fact is cheaper than it is anywhere else in the world, except Venezuela.

So, we find, for instance, in most of the European countries energy is of the order of 3 to 10 times more expensive than it is here, with Sweden being at the low end of that range and Greece being at the high end.

Now, what of the argument that low energy prices discourage production?

First, we consider traditional sources of energy. We see that while there has been a large increase in the price per barrel of crude oil at the well, this increase has been no more than that justified by the increase in cost per foot to drill for oil.

Thus, the ratio of price to cost is essentially the same in 1975 as it was in 1960. In other words, there is no more profit incentive to drill for oil in the United States now than there was in 1960.

So, we simply do not know what would happen to the rate of oil production in the United States if the price of crude oil were to rise faster than drilling cost. No one has yet done the experiment to find out.

However, the data we have does not reveal the complete story of the situation in which oil producers find themselves. Oil exploration and production will increasingly shift from onshore to offshore.

While onshore costs of drilling for oil only increased by 2.03 times from 1960 to 1975, offshore costs increased by 2.58 times. In other words, the oil and gas industries will be forced to move to offshore sites as onshore sites are depleted, but the offshore exploration is far more capital intensive.

Higher profitability for oil- and gas-producing companies can be regarded as an obscene and grossly inequitable redistribution of the capital in the United States.

But given the likely future of the industry, a far more reasonable interpretation is that the industry needs to be more profitable in order to raise the capital that will be necessary to fund the enormously expensive program of energy exploration and development that is on the way.

But there is another reason for raising energy prices. There is much talk about the need to develop new energy technologies, such as solar and wind power. However, these developments will be inhibited unless energy prices rise to a level at which they will be sufficiently attractive to risk capital.

As long as energy prices are kept down by regulation, new energy technologies will be an uncertain investment.

Now, where do I get that from? I travel around the country talking to every imaginable type of group. One of the constituencies I have talked to is the constituency of very small solar energy companies that are interested in retrofitting energy systems in old houses or in putting new systems in new houses.

That industry, of course, is having its development impeded by the fact that it is competing with a competitor for whom the energy prices are artificially low.

So, that is the end of my first argument. My first argument is basically an argument dealing with inflation, and tracking back through the national, international economic system, the causal pathways that lead to inflation.

So, my first argument says that it is a fallacy to assert that low energy prices help those constituencies that perceive low energy prices as being in their interest. You in fact hurt those constituencies.

You gentlemen may be interested in my attempts to communicate this argument to those constituencies. I have had no success at all in trying to interact with Mr. Meany.

I have, however, had some success in trying to interact on the United Automobile Workers. In fact, they have a very impressive research capability which I have had some interaction with.

Their position was basically as follows:

Dr. Watt, everything you are saying is eminently plausible. Over the intermediate and long-term, we buy it. In fact, we think energy prices ought to go up.

But our position is that the U.S. economy for some years now has been in the position of a professional football fullback who was in an oxygen tank in intensive care in a hospital ward.

If you increase the energy prices, you in effect are going to send the fullback out to have the No. 1 position in a game on Saturday, and he is going to die on the field.

My counterargument to them has been, the reason the fullback, or the U.S. economy, is in the oxygen tent is precisely because of the low energy prices, and we are never going to get him out of the oxygen tent unless we get the energy prices up.

At that point we came into conflict with each other and the dialog ceased.

But the automobile workers at least accept the argument that the energy prices must go up over a period of time.

Of course, one of my arguments with them is if energy prices go up a lot, one of the adjustments that will occur in the United States will be an enormous increase in the number of buses being manufactured, which will take up some of the slack created by a decrease in the number of cars being manufactured.

In any case, one of the adjustments will be toward cars that are three times as energy efficient as those we have now. So, the impact on the automobile industry won't be as great as it might appear at first glance.

Indeed, the problem I have with most constituencies is they don't perceive many of the adjustments which will allow for many non-traumatic shifts of the U.S. economy toward an energy that is three or four times as expensive as now.

Now, I would like to deal with my second argument, which has to do with the impact of cheap energy on the U.S. economic stability which, of course, affects all constituencies.

Many people will have noticed that within the last few years the U.S. economy has developed an alarming tendency toward large and unexpected economic fluctuations.

In 1974 agricultural commodities prices were unusually high, and there was a tendency to inflation radiating outward from the commodities sectors of the economy. But by 1977 there had been a great drop in the value of agricultural commodities.

Farmers were going bankrupt because they could not sell enough of their commodities or get high enough prices to allow them to pay for their inputs.

But also there was a deterioration of the U.S. trade balance, the United States could not sell enough to pay for imported crude oil,

U.S. dollars were piling up, unwanted, in many countries, and the value of the dollar was dropping fast relative to a number of other currencies, particularly Japanese yen, Swiss francs, and German marks. How did this come about?

If the Government keeps the price of energy down, thus stimulating massive oil imports, this means that the health of the U.S. economy becomes sensitive to two other factors.

First, we must be able to produce enough goods for export to pay for the imported oil. Second, other countries must have the demand for enough of our exports for us to raise the cost of the crude oil bill from OPEC.

In other words, we have to get the money that we need to pay OPEC by having other countries need enough of the stuff we want to export to give us the money that we then in turn give to OPEC.

But in turn the demand of other countries for our agricultural produce depends upon the ability of prospective customers for our food to produce that food themselves. This, in turn, is dependent on their crop growing weather.

Particularly in some of the Communist bloc countries which may import massive quantities of our food in certain years, their crop growing weather is extraordinarily volatile because their principal crop growing regions are in the center of massive land masses remote from the moderating effects of oceanic currents and wind systems.

To make a long story short, (a) the amount of food produced by some of the countries that produce food is very large in comparison to the food we produce; (b) furthermore, their fluctuations are very large relative to the total amount we produce.

In the worst sequence of years recently, Russia had a shortfall of wheat alone that was equal to about three-quarters of our entire crop. So, now we can construct a table in which we can explore the consequences for the U.S. economy of various combinations of crop growing weather here and in other countries.

To make a long story short, we can assign a probability to each of the scenarios from our knowledge of crop growing weather historical trends.

What we find is there is about a 55 percent probability of occurrence of the scenario we have been into for the last 24 months. In other words, the crop growing weather is quite good in the United States and elsewhere. Therefore, we can't export enough to pay for imported crude oil.

So, the value of the U.S. dollar drops relative to that of other currencies and we have a tendency to a depression radiating outward from agriculture.

There is a roughly 36 percent probability of a situation we had in 1973 and 1974. Crop growing weather is good here and bad elsewhere. The consequence is we have a stabilizing value of our currency.

We don't have a depression in the farm sector, but we have a very serious commodity price inflation radiating from the agricultural sector.

So, to make a long story short, the second argument for increasing energy prices is to get more control over the stability of the U.S. economy.

My third argument has to do with the impact of cheap U.S. energy on the world economy.

What this comes down to is that we are now in the position of asking the Japanese and German economies to help us in preventing a world recession.

But they cannot do that if our dollar has dropped so low that it becomes progressively more difficult for our people to buy the manufactured goods from Japan and Germany that give them the economic health they need to help us keep the world economy rolling along.

In other words, cheap energy here increases the probability that the Japanese and German economies could weaken enough to help us slump into a world recession.

My fourth argument is the impact of cheap U.S. energy on resource substitution. When Congress continually votes to keep energy prices low, but to allow the minimum wage to rise, they are simply voting for a substitution of the cheap energy for expensive labor.

In turn, this means they are voting for all the other phenomena that accompany that substitution: high rates of unemployment and crime, high costs for unemployment insurance and police protection, high costs of operating government, an inefficient economy, and a low rate of economic growth.

None of this is theory. Each step in the implied arguments can be demonstrated by statistical analysis of available data.

Argument five is cheap energy and the survival of the United States. This argument is one that has been known to a few energy specialists for a while. But let me lay it out very, very quickly.

If you analyze the time it has taken for each of coal, oil, and gas to build up to the point where they were supplying 30 percent of national energy needs, you find that that time was remarkably long and remarkably similar from the one to the other—72, 78, and 69 years, through the Civil War, through two World Wars, and some violent inflations and recessions, and a depression.

Is there some sort of a fundamental scientific principle that would explain why those times were so long? It turns out yes, there is such.

If one attempts to build up the U.S. national population of energy generating plants of a particular type too rapidly, one runs into the risk that there is no net money or energy obtained from that population.

So that, for instance, simulation scenarios show that if you try to build up the U.S. national population of nuclear power plants such that the growth rate in gross output is increasing in excess of 24 percent per annum, there is no cumulative net energy or money out of the system.

In fact, up to 1976 the actual figure for the United States had been 38 percent. In other words, if we stall too long getting new energy technologies in place, we will be defeated when we try to because in order to get enough energy from them to meet our needs, we will have to build up the populations of generating systems so rapidly that they will consume more energy in the construction than they will produce when they are operating. That will be true cumulatively indefinitely.

My sixth argument has to do with cheap energy and the spatial design of American society. Cheap gasoline is encouraging American cities to develop a pattern of urban sprawl which builds a tremendous hidden overhead cost into all activities.

But further, a great deal of the Nation's capital is being invested in a physical plant which will be difficult to maintain when the price of gasoline begins rising rapidly in response to worldwide increases in the cost of obtaining energy, an inevitable development once all cheap OPEC crude is depleted in the late 1980's.

I am reminded of Houston, where I was a couple of days ago, which is essentially 60 miles one way and 80 miles another. There are many American cities like that.

One can develop a theory showing how in either high or low density cities average cost-of-living rises with increased city area, whereas average incomes drop at very high city areas. Also, incomes rise as a function of city density for any given urban area.

The maximum possible size that a city can be is determined by the area at which the income and cost-of-living lines cross. For cities of all densities, this maximum possible area must drop when gasoline price increases drive up the cost of living.

Clearly, unless gasoline prices are allowed to rise faster than the average wage very shortly American cities are going to get locked into a continuing pattern of sprawl that will be a terrible financial burden for everyone once the inevitable future gasoline price increases do occur.

Putting it differently, our cities are being encouraged to evolve in response to energy prices which are not an accurate reflection of the state of the world, but an artificial reflection created by interference in the free marketplace.

Now, is this a theory? Again, to summarize, one can get data from the U.S. Bureau of the Census, including the Census of Retail Trade, and show that the kinds of phenomenon and relationships that I argued for are, in fact, operative.

In other words, there are very striking and startling relationships between income and cost of living on the one hand and the area and density of cities, and these things have implications for the maximum viable size of cities at given gasoline costs.

So, there is a hidden transportation overhead in the economy due to expensive energy that has an effect on the spatial design of society.

So, very quickly, and without going into all the details, I have gone through six arguments.

There is a simple solution to all six of these problems. The United States currently has an overall policy of making low energy price a basic national policy, then allowing policy in every other policy area to follow from that.

Thus, national agricultural policy, foreign policy, our strategies of international agricultural development, military policy and all other policies are determined by our commitment to cheap energy no matter how much mischief results.

Thus, for example, instead of shipping wheat, corn, soybeans and rice to other countries so we can raise the money we need to pay for imported crude oil, it would make far more sense for many other countries, particularly in the tropics, to shift from the grow-

ing of cash crops for export to us to growing wheat, corn, rice, and soybeans.

We would not have to export commodities to them if energy prices were high enough so that we could be self-sufficient in energy.

Further, if countries were all more independent in agriculture, thus eliminating a lot of unnecessary agricultural shipments across the oceans, the whole world would be more energy efficient.

It would seem to be worthwhile to become energy efficient now, voluntarily, through wise planning, rather than waiting a few decades and having efficient use of energy forced on us, with some trauma, as worldwide depletion forces higher prices.

Thank you very much.

Mr. SHARP. Without objection, the full text of Dr. Watt's statement will be placed in the record.

[Testimony resumes on p. 55.]

[Dr. Watt's prepared statement with charts and graphs follow:]

WHY ENERGY PRICES SHOULD BE DEREGULATED

Kenneth E. F. Watt¹

Given constant increases in the real cost of producing petroleum and natural gas in the United States, it is clearly an injustice to domestic energy producers for the government to impose an arbitrary ceiling on the prices they can receive. The conventional political justification for this price regulation is that without it, there would be a deleterious impact on a large number of political constituencies, including labor, consumers, the poor and the middle classes. The standard argument offered is that since energy is an input to the manufacture of a wide array of goods, any increase in the price of energy would ultimately be reflected in an increase in the retail prices of all those goods. Consequently, the consumer price index would rise, consumer purchasing power would drop, and there would be a decline in the standard of living for Americans.

This argument is based on an extremely simplistic view of the workings of the U.S. economy. Hereinafter it will be demonstrated that the

¹ Kenneth Watt is a professor ^{of} zoology, and of environmental studies, and research systems analyst in the Institute of Ecology, at the University of California, Davis; of course, all positions expressed in this article are his alone.

conventional political rationale for low energy prices is simply false; in fact there are six different arguments as to why cheap energy penalizes the very constituencies it is supposed to protect.

~~The basic weakness in the~~ ^{conventional} ~~argument for cheap energy is that it~~
 overlooks the various types of adjustments to cheap energy that occur in the U.S. economy, and in the linkage of the U.S. economy to other economies through the international trade and international monetary systems. Figure 1 illustrates some of the causal pathways that will be discussed, and serves as a backdrop and introduction to the first three arguments for higher energy prices. This flow chart by itself is clearly only a complex hypothesis as to how part of the system responds to energy prices; however, data can be found which demonstrate the existence of all the postulated causal pathways in this chart. Low U.S. energy prices discourage domestic energy production (causal pathway 1) but encourage consumption (2). These two phenomena jointly produce a shortfall in U.S. energy production relative to demand (3,4) which in turn stimulates energy importation (5). However, as energy importation increases, this stimulates the export of other commodities, particularly wheat, corn, soybeans, textiles, wood and raw metal, in order to balance U.S. trade with other countries (6). But the extent to which U.S. commodity exports can be increased depends on

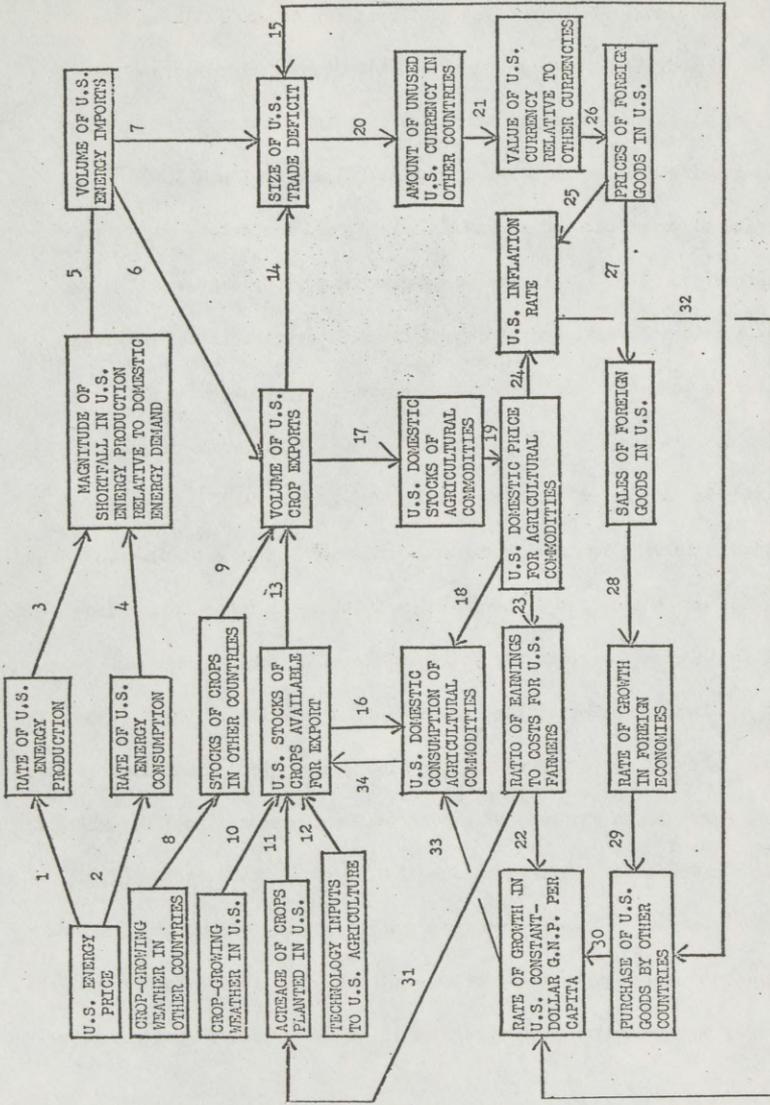


Figure 1. Flow chart illustrating some of the effects of U.S. energy prices on the U.S. economy operating through out the international trade and monetary systems.

both the U.S. stocks of commodities available for export (13) and the stocks of commodities in other countries (9). Many factors determine the size of these variables, in turn, but important system determinants are crop-growing weather in other countries (8) and in the U.S. (10), the acreage of crops planted in the U.S. (11), and technology inputs to U.S. agriculture (12). Years when crop-growing weather is favorable, on ~~average~~ ^{average}, outside the U.S., world demand for U.S. crops will not be great enough for us to balance up our ^{international} ~~trade balance~~ (14). Thus, when U.S. energy prices are low, but also foreign demand for our crops is low, the U.S. trade deficit will be large (7). This causes U.S. money to accumulate in foreign banks at a rate in excess of the rate of demand for it (20), and the dollar drops in value relative to other currencies (21). This in turn increases the prices of foreign goods in the U.S., and that has two bad effects: the U.S. inflation rate is increased (25) but also, sales of foreign goods in the U.S. weaken (27). This ultimately leads to a decrease in the rate of growth in foreign economies (28), which still further decreases their purchases of U.S. manufactured goods (29) which are already at a competitive disadvantage because of the high cost of our labor, and the unsuitability of some of our products for foreign markets (e.g. large, energy-inefficient cars). This, in turn, slows down the rate

of growth in the U.S. economy(30). But if U.S. energy prices are low, so that in some years our agricultural commodity exports are very large, but in other years good crop-growing weather elsewhere decreases foreign demand for our crops, this leads to a massive overhang of U.S. commodity stocks over domestic demand (17). This drops the price of commodities (19), farmers' earnings are lower than their costs (23) and there is a depression in the farm sector which spills out to the rest of the economy if it persists (22). However, if crop-growing weather in other countries is bad, there is a tremendous drawdown in U.S. commodity stocks because of massive exports (17), the domestic commodities prices rise (19) and this can trip an inflation (24).

This chart brings out two most curious consequences of low energy prices in the U.S. They always have an inflationary effect. If our crop exports are large, inflation is affected by increased food costs (24). If crop exports are small, the the inflationary impact comes from increased prices of foreign goods in the U.S. (25). These are only two of the inflationary impacts of cheap U.S. energy prices. Other are found in other flow charts. Jay Forrester of M.I.T. has pointed out that complex systems often behave in a "counterintuitive" fashion because it is difficult for the human mind to visualize the ultimate consequences of log chain causal pathways.

The other curious phenomenon revealed by this flow chart is that cheap U.S. energy prices render the economy remarkably sensitive to a number of phenomena produced by crop-growing weather in major prospective consumers of U.S. food, particularly Russia and China. This is particularly significant, because crop-growing weather in some other countries, and hence crop production is much more volatile from year to year than in the U.S. Thus, by keeping energy prices low in the U.S., we create the surprising situation in which short-term fluctuations in the economy are made extraordinarily sensitive to a powerful, and violently fluctuating destabilizing force: crop growing weather in countries with instable crop-growing weather. Much of the surprising behavior of the U.S. economy since we began importing vast quantities of crude oil is traceable to this situation.

With this flowchart as a backdrop, we now consider six arguments against low energy prices, using illustrative data from standard U.S. government statistical sources.

Argument 1. The impact of cheap energy on the purchasing power of the poor and the middle classes. Elementary common sense tells us that if the price of energy is artificially kept low by the government, this will encourage Americans to use it, but also discourage domestic producers from producing it. Thus, low domestic energy prices simply result in a discrepancy between production and consumption, which gradually increases as the purchasing power of Americans increases relative to the retail price of energy. This shortfall is met by gradually increasing petroleum imports. But a country is like a family: on balance, over time, it must sell goods and services at roughly the rate at which it buys goods and services. Therefore, as the United States has increased its imports of petroleum, it has had to increase its exports of other items to raise the money needed to pay for the oil. The reason for the economic and political problems related to petroleum pricing is that few Americans inside or outside government grasp the full implications of the massive export required to pay for the imported oil.

Table 1 reveals the impact that increasing crude oil imports have had on the U.S. balance of trade with other countries, and shows how various categories of U.S. exports to other countries have increased to compensate for this increasing importation from O.P.E.C. countries. The table brings out two key facts. First, the increase in the cost of oil imports from 1970 to 1976 has been very great: about 28.3 billion dollars. The other fact is less well

Table 1. The Relative Roles of Manufactured Products and Raw Materials in Maintaining the U.S. Trade Balance in the Face of Massive Increases in Crude Oil Imports. All Amounts in Billions of Dollars. Data from tables 1478 and 1479, Statistical Abstracts of the U.S. for 1977.

Item	Value of	Value of	Value of	Value of	Increase (+) or
	1970 U.S. exports	1970 U.S. imports	1976 U.S. exports	1976 U.S. imports	Decrease (-) in Net U.S. Trade
					Balance, 1970 to 1976
Mineral fuels and related materials	1.595	3.075	4.226	33.996	-28.291
Machinery and transportation equipment	17.882	11.172	49.510	29.824	12.976
Other manufactured goods	7.636	13.285	17.777	30.179	- 6.753
Chemicals	3.826	1.450	9.958	4.772	2.810
Subtotal, manufactured goods and chemicals					9.033
Wheat and flour	1.112		4.041		2.929
Corn	.824		5.223		4.399
Soybeans	1.216		3.315		2.099
Textiles	.543	.202	1.426	.249	.836
Subtotal, renewable resources					10.263

known. Most people, thinking of the U.S. as a major manufacturing nation, would expect this increase in imports of crude oil to be paid for largely by increase in exports of manufactured products. This assumption is based on a lack of awareness of the intensity of the competition the U.S. now faces in world markets from West Germany, Japan, and other manufacturing nations. Thus, we see in the table that only about nine billion dollars of the increased fuel costs could be covered by an increase in exports of all manufactured goods and chemicals. In fact, over ten billion dollars of the increase in fuel import costs was paid for by an increase in U.S exports of just a few raw commodities, particularly wheat, corn and soybeans. But there has also been a great increase in net exports of a wide variety of other raw commodities from the U.S. : textiles, wood and metal ores and scrap. Too little attention has been given to the consequences for the U.S. economy of all these massive, and gradually rising exports. In fact, as Figure 2 shows, the consequences are remarkably pervasive throughout the economy. They include food prices, land prices, and effects on city densities and the relative economic attractiveness of various types of transportation systems.

It is interesting to track the impact of massive crude oil imports through the economic system so as to reveal the way in which these affect the standard of living of the typical American family. Using nothing but routinely-published government statistics, we do this in Table 2. As the real price

THE RELATIONS BETWEEN THE REAL AVAILABILITY OF RESOURCES, THE U.S. INTERNATIONAL TRADE SITUATION,
AND THE BUYING POWER OF THE TYPICAL FAMILY

Year	Average spendable weekly earnings in current dollars	Average woody food cost in current dollars	Food cost as per centage of spendable earnings	Wheat exports (millions of bushels)	Old crop carryover and partly of wheat refined oil imports (billions of bushels)	Value of crude oil and partly refined oil imports (billions of dollars)	Average cost per foot to drill for crude oil and natural gas in the U.S. (all wells) Dollars
1965	86.3	37.5	43	887	535	1.22	13.44
1970	104.6	42.9	41	738	731	1.45	18.84
1972	121.1	47.1	39	1186	438	2.61	20.76
1973	127.4	57.1	45	1148	247	4.59	22.50
1974	134.4	63.6	47	1039	327	16.48	28.93
1975	145.9	67.2	46	1300	479	19.25	

Conclusions: 1.
2.

It is no myth that the U.S. is running out of cheap energy. It is. Congress is trying to mask that fact by keeping prices down. This merely transfers the site at which the consumer discovers that energy is becoming more expensive from the pump island to the supermarket, the real estate dealers' offices, and the hardware and clothing store, etc. (Every category of consumer goods shows the same pattern as above: a higher proportion of wages since 1972). In effect, Congress is flashing the consumer the economic message that the consumer is not depleting world energy supplies fast, when that is just what the consumer is doing.

3. The consequence is a rapid erosion of consumer buying power, which will increase from now on.
4. Two other factors will have a big impact on the rate of erosion of consumer buying power: the price of energy (higher prices for energy will mean lower prices for everything else), and the weather. The better the weather is, the more likely we will be able to produce enough food to (a) export enough to pay for imported crude oil and (b) keep domestic food prices down. But the long-term prognosis for weather is working against us.
5. There is no more cheap energy. No matter where or how we get it from now on, it will be vastly more expensive than the energy we have been using to date.
6. The reason why the stock market and all other measures indicate that the U.S. economy has stopped growing is that it has. Too much buying power is being used up on consumer expenses to support profligately wasteful use of energy for there to be adequate capital to support necessary capital investment in economic infrastructure that promotes growth. We are drawing down the principal in the bank, as well as the interest.

it became increasingly uneconomic, in the face of government price regulation, to supply the U.S. market with domestic crude oil. Consequently, the U.S. oil market was increasingly supplied with foreign, as opposed to domestic crude oil (third column). One of the means used to pay for this was wheat exports, which accordingly rose (fourth column) in years when other countries had major crop production shortfalls. This meant that in the years following 1972, great increases in crude oil resulted in a drawdown of U.S. domestic stocks of commodities, as illustrated by the wheat stocks statistics in column five. This was because between 44 and 73 per cent of the wheat being grown each year in the U.S. was being exported to pay for imported crude oil. Consequently, years when there was a particularly heavy export of wheat, as between 1972 and 1975, there was a great increase in the price of wheat. Thus from 1972 to 1974, the price of wheat per bushel increased by 2.32 times. This, in turn translated into a higher U.S. food cost for the typical family (last column). Where food had only taken 39 per cent of the average family spendable earnings in 1972, it took 47 per cent in 1974. In short, "cheap energy" is an illusion. By keeping the cost of domestic crude oil down, the government simply plays the cruelest type of political hoax on the electorate. Energy becomes more costly than it would have been if the price had been deregulated, but the family pays for energy everywhere except at the pump island. The same phenomenon as revealed for food costs in this table is found for housing

and clothing.

However, while the trend in food, clothing and housing is for these budget items to take a progressively larger percentage of average spendable weekly earnings, that trend is obscured by deviations about the trend produced by variations in crop-growing weather in countries that are prospective customers for U.S. commodities. Thus, it will be noted that the percentage of spendable earnings taken by food declined from 1974 to 1975, and again to 1976.

Table 3 gives more understanding as to why there should be fluctuations about a gradually rising trend line in the last column of Table 2. Table 3 shows how we can project a trajectory for the most likely foreign demand for U.S. wheat each year, on the basis of historical data. Differences between actual demand, and this projected trajectory of likely demand account for year-to-year fluctuations in the U.S. price of food. Table 3 shows how, in turn, these fluctuations can be traced back to fluctuations in food production in other countries, which in turn are largely the product of fluctuations in crop-growing weather. The second column gives the trend in world population, exclusive of the U.S.A. The third column computes a likely trend in world per capita demand for wheat, exclusive of the U.S., on the assumption that that trend is a simple linear function of gross world product each year. The fourth column gives world per capita likely

wheat production, on the assumption that that trend is a simple linear function of year number. The fifth column gives a likely trend in foreign demand for U.S. wheat, computed from world population multiplied by the difference between per capita wheat demand and production (from the previous two columns). The sixth column gives actual U.S. wheat exports. The difference between actual wheat exports, and the trend in likely foreign demand for U.S. wheat is in the seventh column. Prior to 1972, this difference was large, because prior to the great increase in U.S. imports of O.P.E.C. crude oil, it was not necessary for the U.S. to export vast quantities of agricultural commodities to balance up its international trade, and further, there was an insufficient market for U.S. wheat amongst nations able to pay for it. This market was created with the Nixon understandings with Moscow and Peking. After 1971, discrepancies between actual wheat exports and likely exports can be accounted for on the basis of fluctuations in the wheat harvests in world major wheat-growing countries, particularly the Soviet Union. Thus, the big surge in actual exports relative to likely expected exports in 1973 is attributable to a shortfall in Russian wheat production in 1972 (see Table 6).

At the beginning of this discussion, it was asserted that common sense indicates that low energy prices would encourage energy use, but discourage

Table 3. Computation of likely trend in foreign demand for U.S. wheat,
and difference between this trend and actual U.S. wheat exports.

Year	Non-U.S. world popula- tion (millions)	Per capita non-U.S. world wheat demand production (bu.)	Per capita non-U.S. world wheat production (bu.)	Foreign demand for U.S. wheat (millions of bu.)	Actual U.S. wheat exports (millions of bu.)	Actual U.S. wheat exports less foreign demand (millions of bu.)
1967	3225	3.25	2.99	839	761	-78
1968	3286	3.31	3.03	920	544	-376
1969	3362	3.37	3.06	1042	606	-436
1970	3430	3.41	3.09	1098	741	-357
1971	3502	3.44	3.13	1085	610	-475
1972	3576	3.49	3.16	1180	1135	-45
1973	3648	3.49	3.19	1094	1217	123
1974	3720	3.54	3.23	1153	1019	-134
1975	3795	3.58	3.27	1176	1173	-3
1976	3871	3.61	3.30	1200	950	-250
1977	3948	3.65	3.33	1263	1145	-118

energy production. What does the evidence say? First, with respect to the effect of energy price on use, within the U.S., energy prices have never increased enough to have any discernable impact on use. As Table 4 indicates, retail gasoline prices are actually lower now, relative to average spendable weekly earnings than they were in 1965. To discover the likely impact of any significant energy price increases on U.S. energy use, we have to turn to comparative international data. However, to expose the effect of energy prices on use per capita, it is not adequate to simply use the price: we must use the price corrected for the ability to pay that price. Thus, in Figure 3, a plot of gasoline use per capita as a function of price, there is only a slight relationship (the fitted line is based on the data for all countries). However, when the price of gasoline is expressed as a proportion of G.N.P. per capita as in Figure 4, a very striking dependence of use on price is revealed. These two graphs reveal an important point about U.S. energy policy: it is meaningless to increase energy prices by a factor of two, in the name of conservation, over a sequence of years in which average spendable earnings are increasing by a factor of three. This would actually increase the use of gasoline. There will be no real energy conservation in the U.S. until energy prices are allowed to increase at a faster rate than wages. Figure 4 also indicates how low U.S. energy prices are relative to those in other countries,

Table 4. The increase in gasoline prices, relative to the increase in average spendable weekly earnings.

Year	Retail price index, regular and premium gasoline ¹	Average spendable weekly earnings, worker in private non-agricultural industry with 3 dependents ²	<u>Price of gasoline</u> <u>Average earnings</u>
1960	92.5	73.0	1.27
1965	94.9	86.3	1.10
1970	105.6	104.6	1.01
1971	106.3	112.4	.95
1972	107.6	121.1	.89
1973	118.1	127.4	.93
1974	159.9	134.4	1.19
1975	170.8	145.9	1.17
1976	177.9	156.5	1.14
1977	189.2	182.7	1.04

¹ From Table 784, Statistical Abstracts of the U. S. for 1977.

² From Table 666, Statistical Abstracts of the United States for 1977.

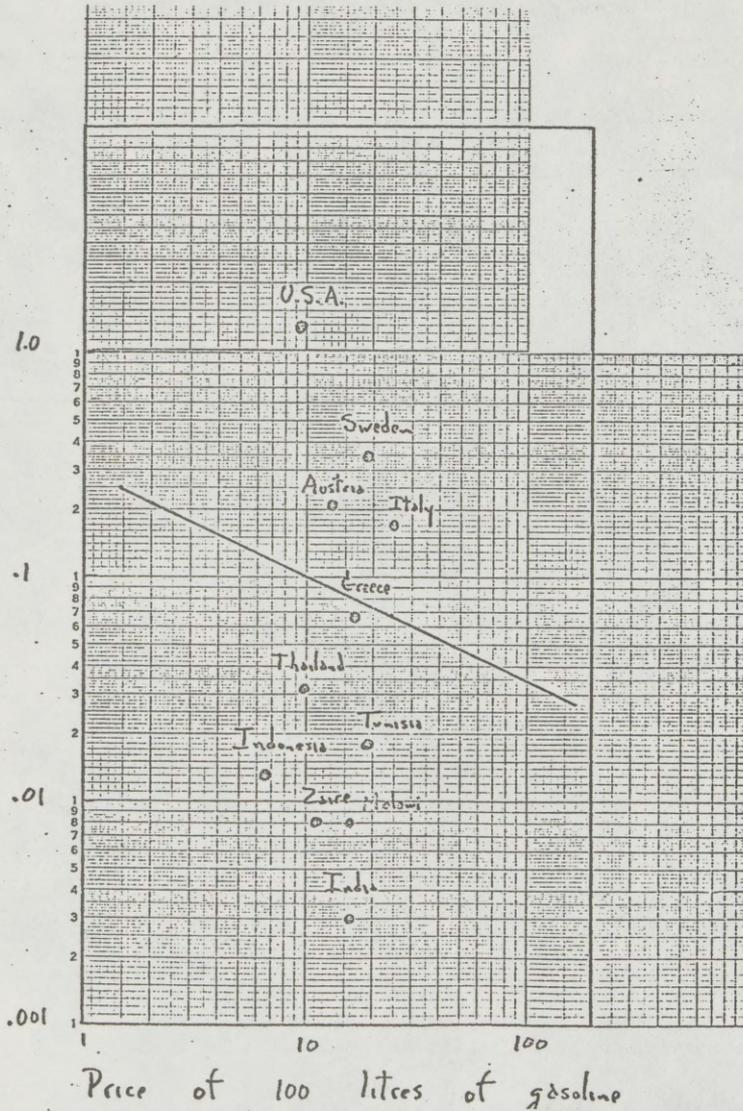
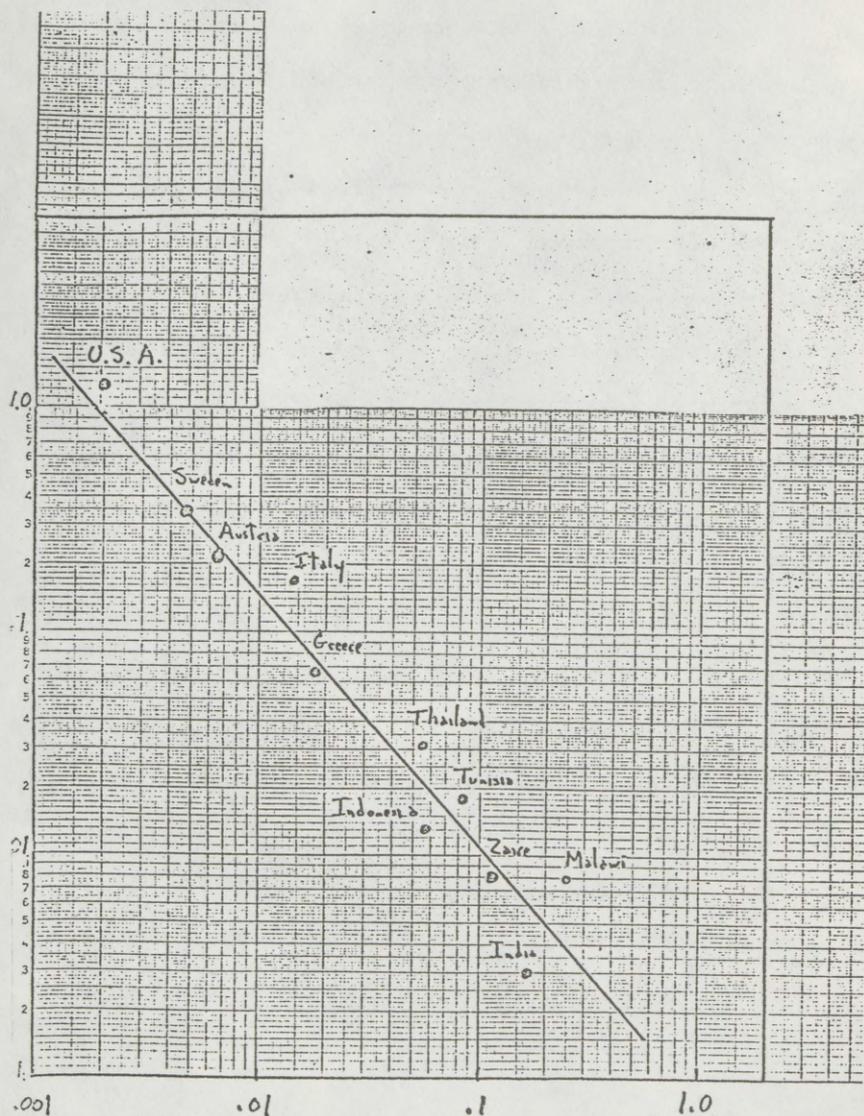


Figure 3. The relation between gasoline price and use per capita: cross-sectional analysis across countries. Based on statistics published by the International Road Federation.



Price of 100 litres of gasoline as a proportion

Figure 4. The relation between energy price and use per capita; when price is corrected for ability to pay for gasoline.

including Sweden, which has a G.N.P. per capita higher than in the U.S. Clearly, the argument that higher energy prices would be inimical to economic growth needs reexamination.

Now what of the argument that low energy prices discourage production? First, we consider traditional sources of energy. In Table 5 we see that while there has been a large increase in the price per barrel of crude oil at the well (column 2), this increase has been no more than that justified by the increase in cost per foot to drill for oil (column 3). Thus the ratio of price to cost is essentially the same in 1975 as it was in 1960. In other words, there is no more profit incentive to drill for oil in the U.S. now than there was in 1960. So we simply do not know what would happen to the rate of oil production in the U.S. if the price of crude oil were to rise faster than drilling cost: noone has yet done the experiment to find out. However, Table 5 does not reveal the complete story of the situation in which oil producers find themselves. Oil exploration and production will increasingly shift from onshore to offshore. While onshore costs of drilling for oil only increased by 2.03 times from 1960 to 1975, offshore costs increased by 2.58 times. In other words, the oil (and gas) industries will be forced to move to offshore sites as onshore sites are depleted, but the offshore exploration is far more capital intensive. Higher profitability for

oil and gas producing companies can be regarded as an obscene and grossly inequitable redistribution of the capital in the U.S. But given the likely future of the industry, a far more reasonable interpretation is that the industry needs to be more profitable in order to raise the capital that will be necessary to fund the ^{expensive} enormously program of energy exploration and development that is on the way.

But there is another reason for raising energy prices. There is much talk about the need to develop new energy technologies, such as solar and wind power. However, these developments will be inhibited unless energy prices rise to a level at which they will be sufficiently attractive to risk capital. As long as energy prices are kept down by regulation, new energy technologies will be an uncertain investment.

Table 5. The increase in the average price of a barrel of crude oil, relative to the average cost per foot to drill for oil.

Year	Average price per barrel of crude oil at the well	Average cost per foot to drill for oil	Average price of a barrel of crude oil relative to cost to drill one foot
1960	2.88	13.01	.22
1965	2.86	13.44	.21
1970	3.18	18.84	.17
1972	3.39	20.76	.16
1973	3.89	22.50	.17
1974	6.74	28.93	.23
1975	7.67	36.99	.21

Argument 2. The impact of cheap energy on U.S. economic stability.

Many people will have noticed that within the last few years, the U.S. economy has developed an alarming tendency towards large, and unexpected economic fluctuations. In 1974, agricultural commodities prices were unusually high, and there was a tendency to inflation radiating outwards from the commodities sectors of the economy. But by 1977, there had been a great drop in the value of agricultural commodities. Farmers were going bankrupt, because they could not sell enough of their commodities, or get high enough prices to allow them to pay for their inputs. But also, there was a deterioration of the U.S. trade balance, the U.S. could not sell enough to pay for imported crude oil, U.S. dollars were piling up, unwanted, in many other countries, and the value of the dollar was dropping fast relative to a number of other currencies, particularly Japanese Yen, Swiss Francs, and German Marks. How did this come about?

If the government keeps the price of energy down, thus stimulating massive oil imports, this means that the health of the U.S. economy becomes sensitive to two other factors. First, we must be able to produce enough goods for export to pay for the imported oil. But second, other countries must have the demand for enough of our exports for us to raise the cost of the crude oil bill from O.P.E.C. But in turn, the demand of other countries for our agricultural produce depends upon the ability of prospective customers for our food to

produce that food themselves. This, in turn, is dependent on their crop-growing weather. But particularly in some of the communist block countries which may import massive quantities of our food in certain years, their crop-growing weather is extraordinarily volatile, because their principal crop growing regions are in the center of massive land masses remote from the moderating effects of oceanic currents and wind systems.

Table 6 indicates just how variable crop production is in various countries. Notice, first, that the absolute amounts of food grown in other countries are very large relative to the total amount of food the U.S. can grow. Thus, the largest Soviet wheat crop was 89 per cent higher than the largest U.S. wheat crop. But further, the crop production shortfalls in other countries can be very large relative to the largest crops the U.S. has ever produced. Thus, the decrease in the Soviet wheat crop from 1973 to 1975 was equal to 75 per cent of the largest wheat crop the U.S. ever produced. This means that if the U.S., on average every year, must produce enough of a crop surplus to pay for imported crude oil, some years we will have produced way too much, and other years we will have produced way too little. Either of these eventualities throws a gigantic perturbation into the U.S. economy.

Table 7 suggests some of the kinds of perturbations that can be introduced into the U.S. economy by various combinations of crop-growing weather conditions throughout the world. Clearly, by keeping energy prices low and thus

Table 7 . Impact of weather on economic scenarios for the United States

	U.S. crop growing weather in weather countries in importing U.S. crops	U.S. crop exports stocks commodity price infla- tion	U.S. domestic commodity stocks price infla- tion	Value of U.S. dollar rela- tive to other currencies	Tendency to depression radiating outward from agri- culture	Approximate probability of this scenario	
Good	Good	High	Very high	Little	Dropping	High	.55
Good	Bad	Very high	Very low	Serious	Stabilizing	None	.36
Bad	Good	Very low	Low	Serious	Dropping	Moderate	.01
Bad	Bad	Low	Extremely low	Very serious	Stabilizing	Moderate	.08

Conclusion: Congress, by keeping energy prices so low as to encourage massive importation of crude oil, makes the U.S. economy very sensitive to violent economic fluctuations between inflation and depression.

stimulating massive energy importation and massive food export, Congress makes the U.S. economy very sensitive to violent short-term economic fluctuations triggered by crop-growing weather in other countries, particularly Russia.

Of course, these violent economic fluctuations produce some utterly unexpected consequences. Many U.S. corporations have recently been bedevilled with foreign exchange currency translation losses. These losses occur when a company sells a product in the U.S. imported from elsewhere, but then has to pay the producer when the U.S. currency has dropped in value relative to the currency in which final payment is made. In effect, the U.S. corporation is trapped into selling cheap and buying dear, due to circumstances completely beyond its control. These circumstances are changes in the rate at which the U.S. dollar is dropping in value relative to other currencies, produced by changes in the rate at which we are exporting commodities to pay for imported crude oil; the ultimate causes are changes in the amount of crop shortfall produced in other countries in response to changes in their crop-growing weather. Of course, this crop-growing weather can be neither predicted nor managed. Thus by keeping energy prices down, Congress and the White House are turning the management of U.S. enterprises into a vast game of chance. This is true *on enormous diversity of activities, including* for Exxon, the farm sector, the importer of European sporting goods, or of German stained glass.

Argument 3. The impact of cheap U.S. energy on the world economy.

In years when the U.S. can not export enough food to pay for imported crude oil, U.S. dollars accumulate in other countries because they can not buy enough from us to use up all the dollars we have spent buying the crude oil.

(This is an oversimplification of the situation, but in essence it is correct.

Complications occur, as when Saudi Arabia sells unwanted U.S. dollars for gold, and the ^{dollars are} used, ultimately to purchase U.S. wheat). When these dollars accumulate, their value drops relative to the value of other currencies.

This, in turn means that a Volkswagon, Toyota, Sony, Rolls Royce jet engine or A300B airbus cost more in the U.S. That, in turn means that all other factors remaining constant, we would be less likely to buy the foreign product.

That is serious, because many foreign economies are more dependent on export markets than the U.S., because their national populations are not large enough to give them significant and competitive economies of scale in manufacturing.

Thus, enough of a drop in U.S. purchases of German, Japanese and other products could lead to significant slowdowns in their economies, and ultimately, a significant slowdown in the world economy, including the U.S. economy.

In short, cheap energy in the U.S. has implications which go far beyond the internal dynamics of our own economy. We can not, on the one hand, expect Germany and Japan to keep the world from sliding into a new recession, yet on the other hand adopt an energy price policy which makes it impossible for them to sell enough to us to prevent that from happening. Our failure to grasp this is the root cause of a lot of the world's economic problems.

frequently expressed by foreign business and government leaders and reported in the Wall Street Journal and elsewhere.

Argument 4. The impact of cheap U.S. energy on resource substitution.

When Congress continually votes to keep energy prices low, but to allow the minimum wage to rise, they are simply voting for a substitution of the cheap energy for expensive labor. In turn, this means they are voting for all the other phenomena that accompany that substitution: high rates of unemployment and crime, high costs for unemployment insurance and police protection, high costs of operating government, an inefficient economy and a low rate of economic growth. None of this is theory: each step in the implied arguments can be demonstrated by statistical analysis of available data. Thus, in making comparisons between countries, we find that high crime rates accompany cheap energy.

Argument 5. Cheap energy and the survival of the United States. Normally, as the real cost of producing petroleum increased, this would be converted into a signal to the market place, in the form of higher retail prices. That signal, in turn, would have several effects, besides conservation. One effect would be to intensify the search for existing energy sources (oil, gas, coal). Another effect would be to stimulate *research and development for* ~~technological innovation to develop~~ new energy sources and technologies. However, by keeping energy prices artificially low, Congress

and the White House prevent such a message from being flashed to the market place. That, in turn means, that when the U.S. begins to run short of conventional sources of cheap energy, there will be a mad scramble to develop and find energy sources for which the search should now be underway. But can we make up the lost time under crisis conditions? This, in turn raises the question as to long it takes to get new energy technologies in place. In fact, as Figure 5 shows, it has taken a very long time indeed to get new technologies in place. The times it took before coal, oil and gas supplied 30 per cent of U.S. energy consumption were 72, 78 and 69 years, respectively. So the times were not only remarkably long, they were remarkably similar. The reason is that the rate at which a national population of energy generating plants of a particular type can be built up is limited by a thermodynamic constraint. If the population builds too rapidly, too high a proportion of the entire population has just been constructed or is under construction. In that case, there would be no net energy or money output from the entire national population of plants. Thus, a problem with a national policy of keeping energy prices down is that we might get caught in a "systems trap" in ten or twenty years: we might get trapped into trying to build new energy generating systems so rapidly that there was no net energy output from the construction process at all.

To illustrate, when the gross energy output from the entire national population of nuclear plants grows at 24 per cent or more, there is no net energy output at all. To 1977, that

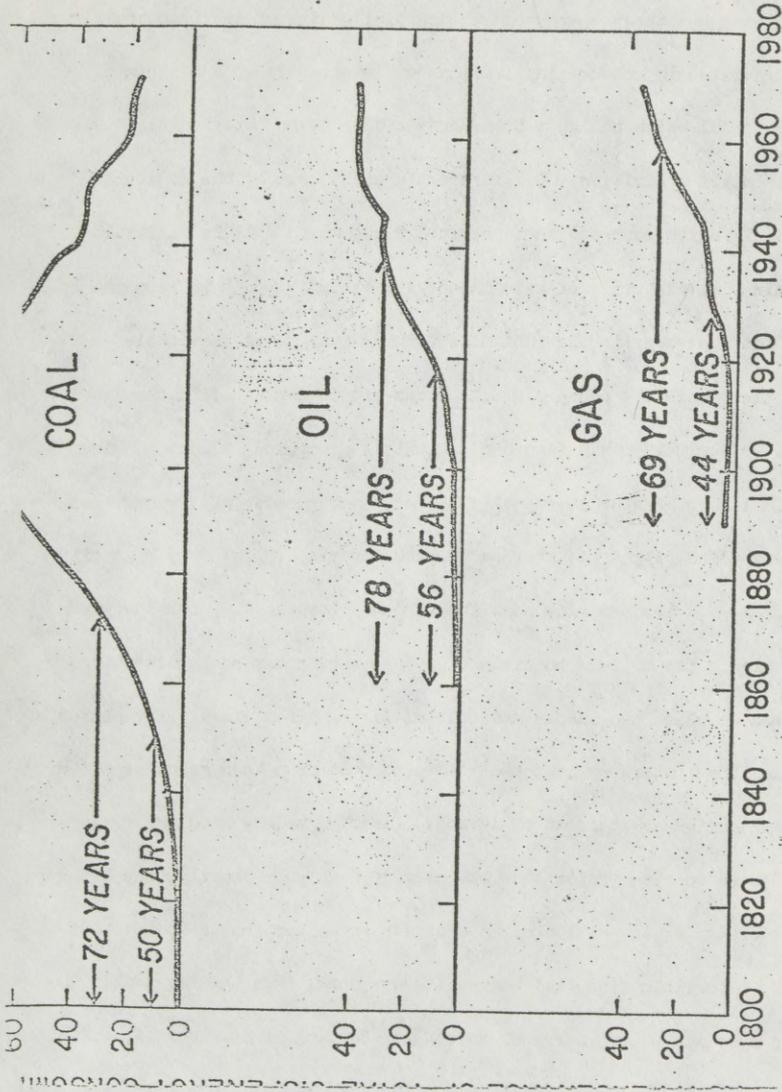


Figure 5. The time it took to have each of coal, oil and gas supply ten, and thirty per cent of national energy consumption.

Argument 6. Cheap energy and the spatial design of American society.

Cheap gasoline is encouraging American cities to develop a pattern of urban sprawl which builds a tremendous hidden transportation overhead cost into all activities. But further, a great deal of the nation's capital is being invested in a physical plant which will be difficult to maintain when the price of gasoline begins rising rapidly in response to worldwide increases in the cost of obtaining energy, an inevitable development once all cheap O.P.E.C. crude oil is depleted, in the late 1980's or early 1990's. Figure 6 presents a graphical theory showing how, in either high or low density cities, average cost of living rises with increased city area, whereas average incomes drop at very high city areas. Also, incomes rise as a function of city density, for any given urban area. The maximum possible size that a city can be is determined by the area at which the income and cost of living lines cross. For cities of all densities, this maximum possible area must drop when gasoline price increases drive up the cost of living. Clearly, unless gasoline prices are allowed to rise faster than the average wage very shortly, the U.S. cities are going to get locked into a pattern of continuing sprawl that will be a terrible financial burden for everyone, once the inevitable future gasoline price increases do occur. Putting it differently, our

cities are being encouraged to evolve in response to energy prices which are not an accurate reflection of the state of the world, but an artificial reflection created by interference in the free marketplace by Congress and the White House. Figures 7 and 8, based on analysis of data from the Bureau of the Census, census of population and of retail trade in gasoline show that the theory graphed in Figure 6 does in fact describe the situation. In short, the federal government is now in the ironical position of encouraging U.S. cities to evolve rapidly in the fashion of dinosaurs, which became extinct because they had adapted to an environment which did not last. Further, this inappropriate spatial design already is having a large, but veiled impact on the U.S. economy. The hidden transportation overhead on all transportation of goods and passengers affects our ability to compete in the international market place for manufactured goods with the other developed countries. This phenomenon is revealed when we conduct statistical analyses ^{cross-sectional} ~~(cross-sectional)~~ to discover the factors that determine the rate of growth of various economies. When we do this we discover that population density shows up as a beneficial factor in promoting economic growth. What this actually reflects is not a beneficial impact of high population density, but rather of hidden transportation efficiency ^{and} lowered transportation systems overhead when a society has a spatial design which promotes energy efficiency

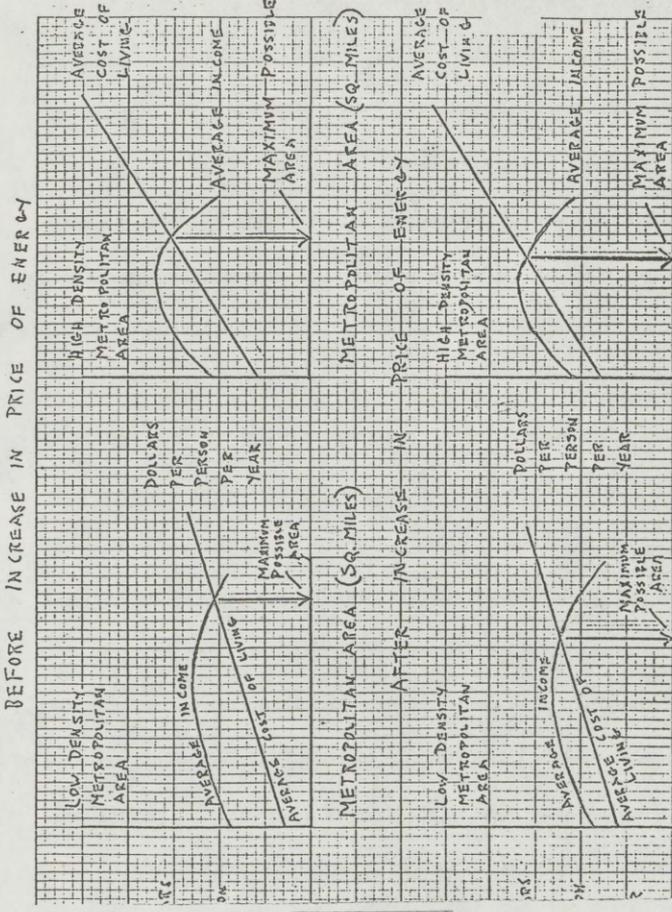


Figure 6. A theory of the relation between average income, average cost

of living, city density and city area. Note that these relations

determines the area of a city which is economically viable; also note that

this maximum viable economic area shrinks in response to increasing

energy prices.

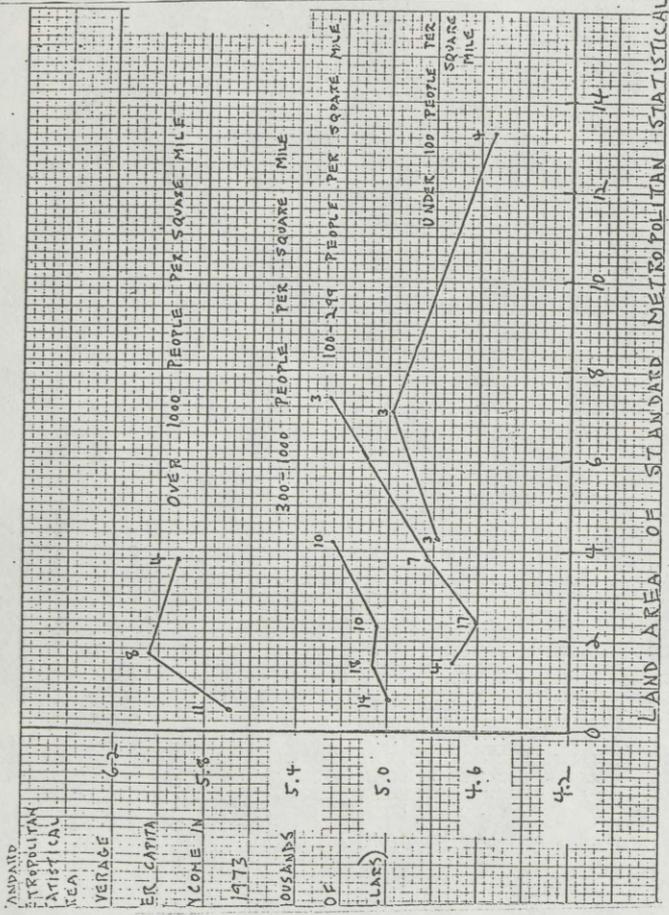


Figure 7. Test of the notion that average incomes are related to

city densities and areas, using Bureau of the Census data. Numbers above the lines indicate the number of metropolitan areas averaged to make each point in each line.

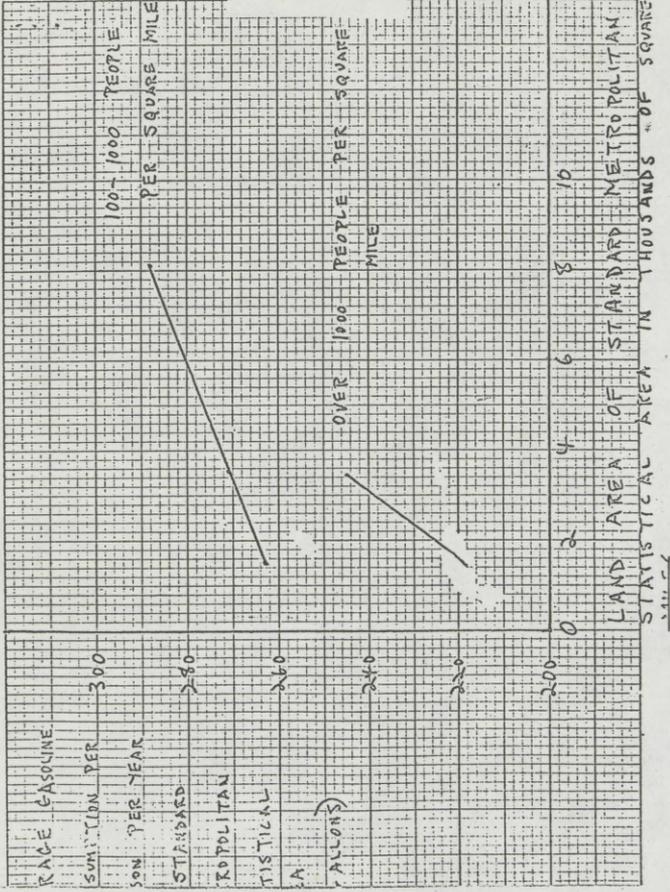


Figure 8. Test of the notion that average living cost is affected by city density and area, using data from the Census of Retail Trade. The lines are drawn through points obtained by averaging data from a great many metropolitan areas.

in passenger and goods movement. This efficiency is associated with short average distances for passenger and goods trips, both within and between cities. Particularly as transportation energy costs rise, the U.S. will only be able to compete with other nations manufacturing goods competitive with ours if our transportation energy efficiency is increased. One way to do this is to make our cities more compact. Otherwise, this nation will have stumbled into a "systems trap" by failing to look ahead to the implications for the spatial design of society of higher future energy prices.

There is a simple solution to all six of these problems. The U.S. currently has an overall policy of making low energy price a basic national policy, then allowing policy in every other policy area to follow from that. Thus, national agricultural policy, foreign policy, our strategies of international agricultural development, military policy and all other policies are determined by our commitment to cheap energy, no matter how much mischief results. Thus, for example, instead of shipping wheat, corn, soybeans and rice to other countries so we can raise the money we need to pay for imported crude oil, it would make far more sense for many other countries, particularly in the tropics, to shift from the growing of cash crops for export to us to growing wheat, corn, rice and soybeans. We would

not have to export commodities to them if energy prices were high enough so that we could be self-sufficient in energy. Further, if countries were all more independent in agriculture, thus eliminating a lot of unnecessary agricultural shipments across the oceans, the whole world would be more energy-efficient. It would seem to be worthwhile to become energy-efficient now, voluntarily, through wise planning, rather than waiting a few decades and having efficient use of energy forced on us, with some trauma, as worldwide depletion forces higher prices.

It would make far more sense to have national agricultural policy be the basic policy from which all other policies flowed. In that case, we would determine a reasonable price to farmers for their produce, and a reasonable price for consumers to pay for food, and let national energy policy be determined by the free play of market forces, given national agricultural policy. The problem with present policy is that it has produced economic distortions simultaneously in farming, coal, oil and gas industries. This is, on the face of it, a remarkable state of affairs. Surely we can do much better.

Mr. SHARP. Dr. Watt, obviously you have helped us understand, and we have been at this for several years now, trying to understand the enormous impact of the dramatic increase of the import of oil in this country, which has an impact far beyond just higher oil prices here, which clearly adds to inflation here.

But one difficulty I have with your analysis is your emphasis upon the fact that farm policy derives from oil policy.

I just have to tell you, I represent an area where we have a lot of agriculture, and the driving motivation for farm exports is not simply to pay for oil—though that of course is a part of the Government's concern—but the fact is that they see this as a way of making money with surplus crops in the United States.

So, I don't think the change in oil prices is going to lessen the desire of the United States to export surplus crops.

Dr. WATT. First of all, there are two perceptions with this problem. There is a perception at the top end of Government and a perception amongst farmers themselves.

We have analyzed statements by leading figures in the executive branch of Government for many years to try to ascertain what official policy is on this issue.

It would be our perception that when I state that there has been a conscious policy to export or to increase exports of agricultural commodities to pay for crude oil, in the first place people have said things that sound almost exactly like that, like Earl Butz. But in the second place—

Mr. SHARP. I don't think that was Earl Butz' driving motivation. He realized that there was a better deal for farmers in this country if we had a freer market in the agricultural sector and sold abroad.

That is not going to change, I think, regardless of what we do in oil. I don't disagree with your total analysis. I just don't think everything derives from energy, in other words.

Dr. WATT. Certainly. Now, let's go down to the perception of farmers. Certainly it would be my view that farmers, until perhaps very recently, had the perception that the name of the game is growing what they can grow, as much as they can grow.

I think in the last 12 months perhaps there have been the seeds of a notion of cartelization and withholding from commodity traders and so on, which I think is intelligent on the part of farmers.

My problem is that the way this system is now designed, the way all the blocks of policy relate, farmers and purchasers of food in retail outlets are being whipsawed by a set of phenomena that have nothing to do with farming, and that doing what in their best judgment seems like the optimal strategy for them is now leading farmers to a terrible situation.

In fact, the fact of the matter is that if farmers were to figure out how to decouple from the rest of the economy as far as possible, they would have some startling effects on themselves.

To make one point that is coming up in the scientific and lay literature more and more, a very strange way to do this is for the operators of small farms, particularly in hilly areas, to turn back to horses.

Very careful analyses are suggesting, while it seems ludicrous, that is an indicated strategy because the farmer then is getting his inputs from himself and doesn't have to purchase them from other

places. So, he gets control over this vise he is caught in where on the one hand—

Mr. SHARP. I think that shows there are a lot of other factors involved because it is exactly a matter of habit that our farmers are not likely to turn back to the utilization of horses.

Dr. WATT. My overall argument is that energy policy has become the basis from which all other policy in the United States seem to flow, perhaps unconsciously. I say looking at large policy areas, I think it would make much more sense to have us look at other raw commodities and make national policies on those issues the basis from which everything else flows.

I didn't get a chance to go into my statement in too much detail. Another curious example is most people would be very unhappy to have national land use policy dictated by Congress. In other words, most people want to have the freedom to live where they want to.

The Government, in having a policy of keeping energy prices down, unwittingly therefore is adopting a national land use policy because it is having an effect on the rate at which land is transferred from one kind of use to another at the periphery of our large metropolitan areas, where there may be agriculture on the outskirts.

Mr. MOFFETT. Would the gentleman yield.

I regrettably have an 11:30 appointment. I hope I will be able to come back, but I may not be able to so I appreciate the Chair's courtesy.

I just wanted to say for the record, and I want to say this while the gentleman from Michigan is here, that I usually start off in these hearings by congratulating the gentleman from Michigan, the distinguished chairman of the subcommittee, on presenting a balanced hearing with an impressive array of witnesses representing vastly different points of view.

With all due respect to the witness today, I must express my disappointment at the way in which this hearing was put together. I am not sure that the best leadoff witness, or more accurately the first and last witness, for hearings of this type is a professor of zoology from Davis, Calif.

I would hope that we would add other witnesses if we are going to explore this particular area.

I happen to have a district that has many UAW people in it who oppose higher energy prices, you may have heard from some UAW leadership that they favor higher energy prices but they also favor national health insurance. They also favor dramatic tax reform. They also favor intervention in the housing area, in order to give people a better break on houses.

The problem I have with your argument is that you are offering us this great panacea to increase energy prices and solve our problems, without taking into account these other issues.

You yourself referred to it as one simple solution. At the same time you mentioned places like Sweden as an example of high energy problems providing a solution. I have talked to the Swedish Energy Minister, who told me:

Higher prices for you, deregulation for you would be disastrous because you don't have the programs to cushion the blow like we do.

You don't have national health insurance. You don't have a tax system that rewards people. You don't have anything to help people when they hit that misery line where their home heating oil prices go up, and they go on welfare, they cannot pay their bills.

I wonder how you come out on those issues, on national health insurance, what we do when people start slipping, into welfare especially the elderly. What is the society's responsibility at that time?

Dr. WATT. First of all, I am not advocating that the price of energy be changed rapidly. All systems people that have ever discussed this with me, whether it be Jay Forrester or Richard Bellman or whoever, would argue that any rapid large perturbation for society, even if it was in principle a good thing, would be very destructive.

The society must have the leadtime to make the adjustments of the sorts that you have mentioned to this change. If you did it suddenly, it would be a disaster.

Mr. SHARP. I think that is important. I may have missed that in the testimony.

Dr. WATT. I didn't say that.

Mr. SHARP. Isn't that the Government's policy today? Isn't that in fact what is on the books, what we are talking about? While Mr. Moffett and I will disagree on natural gas, because I am sure he thinks it goes up too fast, among other things—but isn't that really what we are driving toward, is a transitional period to allow the society to adapt to it?

Dr. WATT. I would say that is correct, but it strikes me as being too little, too late.

Mr. SHARP. Especially after the dramatic increases we got with the OPEC cartel.

Dr. WATT. As I pointed out to you, we keep talking about the dramatic increases, but what has happened to wages in the meantime? We have a table in the handout—

Mr. MOFFETT. Let me answer that question.

Mr. DINGELL. Will the gentleman yield.

Mr. MOFFETT. I would be happy to yield to the distinguished subcommittee chairman.

Mr. DINGELL. I don't want the record to indicate that Dr. Watt's appearance here is the only appearance in a continuing scrutiny by the subcommittee of the long-range implications of the U.S. policy or energy policy.

So the gentleman is well aware, I would like him to know that Dr. Watt's appearance was scheduled over a month ago, and it was decided that this is part of the kind of continuing dialog and discussion that should take place in this committee with regard to long-range energy policy.

His appearance has absolutely no relationship to the fact that there is a discussion going on on natural gas pricing.

Mr. MOFFETT. I know the chairman would never have scheduled this to coincide with attempts to get the rather inflationary natural gas bill passed. But I also know that the chairman is well aware that it does fall into the period when some of us are trying to demonstrate that the gas bill is going to be inflationary and burdensome.

Second, the Chair has compiled an incredibly impressive record of encouraging participation by members in hearings, of saying to the other members we are having a hearing on the impact of energy prices on the poor, do you have any ideas.

In my short time here I have never been more a participant in any of the four subcommittees I sit on than in the subcommittee that the Chair heads. That is why I was just expressing my astonishment.

I don't want the record to show that I am unhappy the professor is here, because I am delighted that he is here. It is just that we do have a system which I think works quite well where witnesses counter each other in order that issues can be better delineated.

Mr. DINGELL. We will have other witnesses.

Dr. WATT. I would like to say to Mr. Moffett that my being here at this particular time is an innocent accident. I happened to be within 600 miles of Washington last night and Mr. Potter, who knew my schedule, availed himself of the opportunity to have me come here.

Mr. MOFFETT. This is not your burden, sir. But there are people far less than 600 miles away who know a lot about this subject and who could have come in to sit beside you.

Dr. WATT. A lot of them would say the same thing.

Mr. MOFFETT. As Mr. Sharp suggested, the bill that we passed on August 5, 1977, would have increased natural gas prices gradually until 1985.

Where we disagree is whether or not at that point the lid should go off without assurances that there will be some equilibrium between supply and demand.

Mr. SHARP. Let me ask you another question. The presumption seems to be if we only had the market forces doing this, everything would have worked out.

But isn't it in fact true that the free market gave us the low energy prices to begin with, but you are now decrying its being so bad because the way oil comes on is in big gushes, and it comes on to the market, and therefore people get locked into a cheap supply?

That is why we went abroad to get the cheap oil. We had a Government policy in this country to try to keep the oil price down.

Dr. WATT. I don't think there would be a very violent perturbation.

Mr. MOFFETT. There is something called the cartel that is there now, which wasn't there before.

Dr. WATT. And the cartel has great difficulty getting the prices up a lot. They argue amongst themselves.

Mr. SHARP. You will have to excuse us, Dr. Watt. We are going to have to recess for a few minutes to vote. We will come back.

[Brief recess.]

Mr. SHARP. Dr. Watt, I guess one of the questions that we obviously didn't capture from the gist of your statement was sort of the pacing of this question of how do we get from what you believe to be artificially low prices to a more reasonable price level?

It is my impression that of course we have seen price increases I realize relative to some other kinds of price increases that have not

been as dramatic. But it is the kind of thing we are only beginning to see the real impact of what happened 2, 3, 4 years ago.

We are only beginning to see the conservation effects, for example. I tend to have a little greater faith in the price mechanism now than I did 4 years ago.

But I guess that is the thing that we have the most trouble grappling with. How do we see to it that people have the opportunity to adjust, and how do we pace that?

I guess some of us feel that a dramatic change in Government policy would lead to dramatic increases in prices and, therefore, the average citizen would be hurt.

Even though you may argue, in the long run he is better off, if it is too dramatic, it is something the average citizen cannot absorb, and perhaps the average industry cannot absorb, either.

Dr. WATT. I would like to see the Government legislate a schedule of allowable price increases. I would like to see a legislated schedule, announced long in advance, of 3 percent a month in current dollars of energy prices for 60 consecutive months.

Now, that gets you to something significantly higher than anything you are talking about. But that is necessary to start to operate on the ratio of energy prices to wages, and also to provide a sufficient incentive to manufacturers and the construction industry and so on to make adjustments that would be significant.

In other words, a counterargument to me always is, "Dr. Watt, you are a cruel and vicious man because you want everybody to pay three times as much for everything."

My argument to that is no, if the energy cost of inputs increases by a factor of three, and everybody knows for sure in advance that is going to happen, there will be a tremendous incentive to the market to produce things that are three times as efficient. So, the ultimate cost is exactly the same.

Mr. SHARP. But it seems to me one of the difficulties that we continually run into is representing a whole variety of citizens in different economic positions, some very poor, some rich, different occupations.

While the theory in general may work out as neatly and cleanly as it sounds on paper, the fact is that it doesn't work out that way for individual citizens and individual groups. Some are able to adjust and some are not.

Dr. WATT. Then my position would be that there must be legislated cushions to protect people who are going to fall hard. I have no opposition to that whatsoever.

My basic position is that a lot of dysfunctions and dislocations and distortions are coming about in the American economy because energy prices are not high enough relative to the cost of labor.

In other words, I am arguing for a new kind of society in which there is much more concern with efficiency in a wide variety of senses, including spatial efficiency.

Mr. SHARP. Of course, while you probably disagree with the degree, because we don't go as fast, in fact I am supporting the natural gas compromise very strongly. I think it is the only option we have, and we must provide certainly to people that there is something going to happen and that they know what is going to happen.

But that in fact does follow your basic line of thinking, that we have to have a scheduled increase. Primarily we have to create a national market for natural gas. But that will help us on the imports of oil and will also send the signals to people that this is what is coming between now and at least 1980, and really after as well.

Maybe I should ask you directly whether you get into the specifics of that sort since it became the subject earlier in the hearing.

Dr. WATT. The issue of this particular piece of proposed legislation, of course, comes up everywhere I go. I am talking to different groups all day, every day, all over the country now.

The constituency I meet with most frequently, corporation executives, is dismayed because of the bureaucratic problems implied by the need to handle this extraordinarily complex piece of legislation.

I believe that the number has been mentioned in recent newspaper articles that there would be 26 different prices.

Mr. SHARP. Well, you see, that is part of the problem. It is complex in the law, but the reason it is complex in the law is because most of the parties concerned wanted it written down, they wanted it to be clear. They didn't want to have a lot of bureaucratic decisions.

So, contrary to the common complaint about it, all we have done instead of the normal process of disguising complexity by a simplistic statement in the law, we have written as clearly as we possibly could to avoid as much litigation, to avoid as much bureaucracy as is probably possible in this field.

Now, I can't personally defend everything in there as the best way to go. But the problem is if it is all or nothing—we have to take the whole thing.

Also, I would say that in fact I think it is a lot simpler than a lot of people think because there are only a few basic categories that really make a difference.

In almost all the others you know whether you are in the category or not. So those determinations, I think for those that are willing to look at it, they will be surprised.

Now, of course, if you think you can get some other option, you may not want to go that route. I don't think there are any other options.

Even next year there will be a mixed system—those that want immediate deregulation or total—I don't think either party is going to get a clean shot of those options. Therefore, something is going to be in a mixed system.

While one may argue we will have a better one 2 years from now than now, I don't think there is any certainty in that. I tell you that because you are talking to audiences and I hope you would help them to understand that the country may darned well be lucky that we were able to get any agreement at all.

We haven't for 20 years, and the assumption that somehow it will be easier next Congress I think is a very naive one.

Frank, do you have some questions?

Mr. POTTER. You were talking earlier about the virtues of deregulation. It seems to me you are not really talking about the virtues of deregulation. What you are talking about is the virtues of higher energy prices, which may or may not be the same thing.

The price of oil is not a deregulated price. It is a price regulated by a group of people over whom we don't have any control.

Are you satisfied that the present world price, which is dictated by OPEC, is the correct price that is going to send all the signals that you are interested in sending, or may it be higher or lower than what the correct price would be?

I am not a mathematician, but 3 percent per month for 60 months seems like real growth on the order of 400 percent.

Dr. WATT. Yes, absolutely. That is right.

Mr. POTTER. That seems like a very large increase.

Dr. WATT. Yes, that is right. Basically, it is to force society to prepare for a new world which must come. We have a choice. We can fall off a cliff, or we can roll down a hill.

What I am arguing for is arranging that we all roll down a hill knowing what we are doing. The other option is that we come to the end of the cliff and then fall off. I don't want to see that happen to us.

In other words, everybody keeps arguing no, it is harmful to the poor and harmful to everybody to keep energy prices going up, and to keep them rather low. All of a sudden we really do run out.

My figures indicate that at current prices the input of domestic crude into American refineries will hit zero in 1989. If we don't allow prices or force prices to go up rather rapidly, we are going to get to 1990 and then some really traumatic things are going to happen.

Mr. SHARP. It sounds to me you would go beyond market forces. I don't have the impression that the market would take us to that level.

I have the impression that in fact people like yourself may be back in saying, "Gee, they have suddenly got so much oil on the market temporarily that now we are not properly preparing for the future."

This is one of the problems we have right now, is people ask us, "Gee, we know there is more oil out there, gas prices are actually below the controlled price, there must not be a crisis."

I realize we have to help explain to them that the fact is that long term that is not going to be the way it is.

Dr. WATT. You are absolutely correct. I point out repeatedly to corporations they might think of myself as a spokesman for their position since we both want higher prices. But I point out if they examine the details of my position, they probably realize that I had a different position than theirs.

Mr. POTTER. Well, I understand your arguments. I have to say, however, that I am not sure I agree with them entirely, but if I understand your arguments, we are in effect paying for energy in a different way through buying food, and all of the other things, for the necessities as well as the things that are not necessary.

Is it necessarily true that by raising the price of energy you bring this back into equilibrium, or is it not possible that if energy prices were to rise at a high enough rate that in effect you do pay more for energy than you do for the other things that the energy buys?

Dr. WATT. Certainly you do. But that would be adjusted for by an increase in the efficiency of the devices that use energy.

Mr. POTTER. Over time?

Dr. WATT. Yes.

Mr. POTTER. But I mean your housing market turns over every 50 years.

Dr. WATT. But you can do retrofits in old houses. My argument is that most industries have available to them now patents or devices which would allow an enormous increase in the energy efficiency of all kinds of things, and they just don't use them.

Mr. POTTER. The information that we get—

Mr. SHARP. That it would be economically sound for them to.

Dr. WATT. Yes.

Mr. POTTER. The information we get is that at or near current energy prices most of the efficiency improvements available to industry probably are not taken. You may very well say yes, but that is under current energy prices, and if you raise the price of energy suddenly you make a whole new generation of technology attractive.

Dr. WATT. My students and energy associates have gone into this issue very carefully. We conclude there are all kinds of things available that could be done which are not done because the energy price is not high enough.

Mr. SHARP. It is my impression that what we saw first with the OPEC cartel was just the easy stuff where you didn't have to make a major investment to cut energy consumption. Now that they are purchasing new equipment, it clearly is a factor that was not in their consideration in the past.

Therefore, we are beginning to see the impact of the price rise. One of the problems was it is coming 3 or 4 years after the price increase rather than at the time. I think some people sort of assumed it would come immediately. It obviously takes time.

Dr. WATT. So I think this helps creating the argument for a schedule that is planned well in advance, and for which there is lots of lead warning.

Mr. SHARP. I think there is another factor. One of the problems of assuming that the price increase will just trigger lots of changes in behavior is I think we operate on lots of different kinds of stimuli and not just on price.

While I suspect industry is more alert, more capable of rationally assessing their costs, and therefore adjusting to them, I think most of the families and individuals are not quite so good at it.

I know, therefore, some studies in the electric utility industry on a local level where they discovered it was less the increase in the cost of electricity and more just having information, just knowing what it is that you do in your house, or how you can respond to a price increase and therefore avoid it, is the critical part.

You tend to learn more, of course, when you face a crisis situation, but there is a lot more that needs to be done to help people be able to relate specific behavior to a specific price increase.

You must be able to change your behavior. If you are in an apartment house and all the electricity is paid for in one big chunk, and you are saving, unless your neighbor's do, doesn't help—we have got to get it down to more individual responsibility kinds of things, or people cannot respond as I think you would like them to.

Dr. WATT. Because of the limitations of time, I gave a very oversimplistic view of the situation. In fact, there are a large number of other forces involved in what we are talking about than I indicated. I would like to give an interesting example.

Two professors at Berkeley who have an interest in energy policy have Swedish wives. Their wives urged them to take a fine tooth comb approach to both economies, to find out why it was that Sweden was able to have a gross national product per capita of the order of ours when they use about half as much energy per capita, what it is going on that is different.

I am going to give you one example to illustrate some of the surprising things that came up.

As we would all expect to find, two of the conclusions with respect to automobiles was that theirs work more efficiently and they tended to have a larger number of passengers when they were moving.

The third thing came as a surprise; that is, that automobiles in Sweden are used far less on very, very short trips than in the United States. Now the question comes up, Why do we use cars so much on short trips? What is the significance of that issue?

If a high proportion of all automobile use in the United States is on very short trips, then that implies that a high proportion of all the energy consumed in American automobiles is for warming up the engine rather than forward propulsion.

Well, if you think about it, if you are a young woman living in the downtown part of a metropolitan area and at 6 o'clock at night you decide you want three or four light items for a salad, or you are preparing a meal for company, and you want to go to the supermarket, four blocks distant, do you walk or do you take the car, and why?

To put it in the most brutal frame, the car at this point is an anti-rape device.

Similarly, if you are a young man in the same situation, it is an anti-assault protection. So, we have to look at a combination of factors when we are trying to sort all this out.

Mr. SHARP. Also, we are looking at a whole lifestyle based upon a level of affluence that—one of the difficulties in price increases is those who don't live in affluence clearly feel it and those that do may not respond to it if it is not a big jump in prices.

The questions that we constantly put to people—"What if the price goes up," and "How much do you have to increase gas before people really take it seriously?"—I tend to think it affects more their buying habits and the automobile itself than in the question of driving. At least the marginal increases we have had.

Dr. WATT. Let me pick up that theme. One thing there is immense discussion about now amongst builders and designers of new communities and subdivisions in the United States is the whole question of the impact of future energy price increases on how you design a very pleasant lifestyle for people.

A lot of numbers are available on this. One of the most pleasant lifestyles I am aware of is in new European developments called cities within a building—Lignon on the Swiss-French border, Cern on the outskirts of Geneva—this structure is for people who have

an average gross national product per capita much higher than would be the case with most Americans.

They are very affluent—United Nations workers in many cases and World Health Organization. The design of this structure, which basically brings all living, shopping, schools, churches, and so on into a small area, surrounded by a large recreational area; that is, natural forest, in effect—involves going up and down stairs or elevators to buy groceries, rather than getting the car and driving out, perhaps a great distance, to buy groceries.

We have examined that very carefully and it appears that that could result in an energy savings of a factor of seven on that buying activity.

So, if you took the poor or the affluent and moved them from a cheap energy lifestyle to an expensive energy lifestyle, it doesn't necessarily involve a deterioration in the quality of life.

For instance, on Saturday I was living at Woodlands, a new planned community out on the outskirts of Houston. That certainly is not an unpleasant lifestyle. That is as attractive a lifestyle as could be found in the world now. Yet, it is very energy-efficient in terms of that community.

Mr. POTTER. Energy-efficient?

Dr. WATT. Efficient.

Mr. POTTER. The Woodlands has changed since I was there 4 years ago because at that time it was energy-efficient and wasteful.

Dr. WATT. I would say the housing units are close together, the places where you buy things are very close to the place where you live. The energy is used in taking the food to the distribution center in Woodlands.

They are planning to put a large shopping complex in there, which may not have been there when you were there. I am talking about the Woodlands Conference Center.

Mr. POTTER. I was thinking of that. But what I was impressed by at the time—I live in Reston, so I know about having shopping close to where you live. But as I remember, the Woodlands Conference Center was designed so that the air-conditioning was on all the time. There were single-pane windows, some of which were opened to the outside.

Dr. WATT. I was thinking more of the shopping.

Mr. SHARP. Of course, those kinds of things we are assuming—that is still based on the assumption that we had it all free or cheap.

Dr. WATT. I nearly died of pneumonia every night the last five nights, and I was living in cities with 85° or 95° temperature in the evening.

Mr. SHARP. A lot of that has to do with general values rather than income. How I spend my income is not just a function of prices but also a function of what I value.

I come from an area of the country where people no longer have their own farms, so what I want is a yard and a house. That, of course, is not as efficient energywise as crowding everybody into a building. But that is not the way we want to live, most of us.

I realize more people in the cities are in the habit of living in concentrated areas. That is the habit in Europe. So, in terms of fuel use, it is perhaps more efficient.

Dr. WATT. I didn't think it was appropriate in my testimony to speak to the kinds of things that are coming up now. But what we are in effect talking about is a paradigm revolution, or a revolution with respect to a cultural belief system.

What I am trying to urge Congress to consider is legislation which would minimize the trauma involved and facilitate and expedite the transition from an old paradigm to a new paradigm; an old paradigm of maximizing production to a new paradigm of maximizing efficiency.

Mr. SHARP. That is where you come into conflict with some of your people that you discuss it with in the business community. While they would normally laud efficiency, the chief point is maximizing production.

They argue for allowing the market to raise prices on the basis that they think they can do that more effectively.

Also, they value less the question of the actual economic result and just value more the ability to not have to deal with Government institutions or bureaucracies telling them, influencing various decisions; in other words, they put a high priority on that, over and above I think the end result of the production or the distribution of goods.

Dr. WATT. I have stumbled on an argument which softens the resistance of my corporate audiences to this argument I am presenting. I ask them to go home and open up the Wall Street Journal to the page which gives you yesterday's listings for the New York or the American stock market listings, and look not at what happened to the share price yesterday but what happened to it in the last 12 months.

Then go down the columns and classify corporations as to whether or not they are operating in accord with the old production or new efficiency paradigms, and look at what the implication is of which the two groups you are in are for the rate of change in the value of the shares. They do get the message.

For the last year, for the shares in companies which are operating in accord with the new paradigm, there could have been a tripling in the value of the share. With the ones that are struggling to operate in accord with the old paradigm, there may have been little or no growth.

That particular audience is remarkably sensitive to that kind of argument.

Mr. SHARP. But oddly enough—of course, the problem is getting any of us to see our enlightened self-interest, and define what that is over the long haul. Just like on the tax bill.

As I understand it, there are probably many more efficient ways than what we have done in capital gains to encourage investment in more efficient equipment, and to see to it that people are helped in that direction—maybe the depreciation schedule would be a better method, for example.

But that is not what happens in terms of the political debate, even of those who feel very strongly about the investment need and the need for the tax to stimulate it.

They tend to do like all the rest—well, there is an opening and we will take what we can get, where we can, rather than focus our

guns on those things that might serve that end. We all have that problem of misperceiving, perhaps.

Well, Dr. Watt, we appreciate again your being with us.

Dr. WATT. Thank you very much for having me. I am very grateful for the opportunity to be here and make these statements.

Mr. SHARP. Thank you very much.

The subcommittee is adjourned.

[Whereupon, at 12:10 p.m., the subcommittee adjourned.]

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