SYNTHETIC LIQUID FUEL RESEARCH AND DEVELOPMENT ACT OF 1974

HEARING

BEFORE THE

SUBCOMMITTEE ON SCIENCE, RESEARCH, AND DEVELOPMENT

AND THE

SUBCOMMITTEE ON ENERGY

OF THE

COMMITTEE ON SCIENCE AND ASTRONAUTICS U.S. HOUSE OF REPRESENTATIVES

NINETY-THIRD CONGRESS

SECOND SESSION

ON

H.R. 17400

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CONTENTS

WITNESSES

SYNTHETIC LIQUID FUEL RESEARCH AND DEVELOPMENT ACT OF 1974

TUESDAY, DECEMBER 17, 1974

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND ASTRONAUTICS,
SUBCOMMITTEE ON SCIENCE, RESEARCH, AND
DEVELOPMENT, AND SUBCOMMITTEE ON ENERGY,
Washington, D.C.

The subcommittees met, pursuant to notice, at 9:30 a.m., in room 2318, Rayburn House Office Building, Hon. John W. Davis, chairman of the Subcommittee on Science, Research, and Development; Hon. Mike McCormack, chairman of the Subcommittee on Energy, presiding.

Mr. MCCORMACK. The meeting will come to order.

This is a joint meeting this morning of the Subcommittee on Science, Research and Development and the Subcommittee on Energy to hear testimony on H.R. 17400, introduced by Congressman Carl Perkins of Kentucky. The bill reported to the committee, as introduced by Mr. Perkins, would amend the Organic Act of the National Science Foundation to authorize the Director to establish a program of research and development in the production of synthetic liquid fuels.

(H.R. 17400 follows:)

93D CONGRESS
2D SESSION

H. R. 17400

IN THE HOUSE OF REPRESENTATIVES

OCTOBER 16, 1974

Mr. PERKINS (for himself and Mr. TEAGUE) introduced the following bill; which was referred to the Committee on Science and Astronautics

A BILL

To amend the National Science Foundation Act of 1950, as amended, to promote scientific research and development in the production of synthetic liquid fuels, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That this Act may be cited as the "Synthetic Liquid Fuel Research and Development Act of 1974".

SEC. 2. It is the policy of the United States that there shall be available at all times, in the interest of the national security and the national economy, adequate supplies of liquid fuels. It is further declared to be the policy of the United States, in order to supplement supplies of petroleum and

petroleum products produced in the United States and imported from foreign countries (1) to initiate a major program of research into the methods and feasibility of producing low-cost synthetic fuels, including a sufficient number of demonstration projects to test out various possibilities on a large-scale basis; (2) to foster and encourage, through this research and development program, the production in the United States of synthetic liquid fuels from coal, oil shale, and other substances; and (3) to provide, through contracts with private industry, for the construction and operation of such number and types of commercial-sized synthetic liquid fuel plants as are required to furnish an adequate basis upon which to demonstrate that a rapidly expandable and technologically advanced synthetic liquid fuel industry can be developed.

SEC. 3. The National Science Foundation Act of 1950, as amended, is amended by adding the following new title:

"TITLE I—SYNTHETIC LIQUID FUELS RESEARCH AND DEVELOPMENT

"SEC. 101. (a) The Director of the National Science Foundation is authorized to establish a program of research and development in the production of synthetic liquid fuels in the United States. Such program will be designed to test the methods and feasibility of producing synthetic liquid fuels on a commercial scale.

"(b) The Director is authorized to provide financial assistance directly or by contract for—

"(1) studies and other research into the technology and methodology of synthetic liquid fuel production;

"(2) demonstration projects;

"(3) construction and operation of such numbers and types of commercial-sized synthetic liquid fuel plants as are required to demonstrate that a rapidly expandable and technologically advanced synthetic liquid fuel industry can be developed; and

"(4) technical and other financial assistance to organizations engaged in similar kinds of research and development activities.

"(c) All findings and technical information from programs assisted under this title shall be published and made available to the public.

"SEC. 102. For the purpose of carrying out the program described in section 101, there is hereby authorized to be appropriated such sums as may be necessary for the fiscal year ending June 30, 1975, and for the two succeeding fiscal years.".

Mr. McCormack. This legislation recognizes that the most abundantly available fuel resource in our country is coal. It further recognizes that new and imaginative approaches to the uses of coal must be investigated in order to insure that the most effective use is made of this resource. It recognizes that in order to develop these new approaches, we must begin now to develop, through research and development, the new ways of using coal.

We are pleased today to have the Honorable Carl Perkins with us, and we welcome you here this morning, and ask you to proceed with your testimony, and following your testimony we will have testimony from Dr. Guy Stever, Science Adviser to the President and Director of the National Science Foundation; Mr. William Gammon, administrative vice president, Ashland Oil Co.; and Dr. Raymond L. Zahradnik, Acting Associate Director for Technical Operations, Office of Coal Research.

[The opening statements of Congressman Davis and Congressman McCormack follow:]

OPENING STATEMENT BY CONGRESSMAN MIKE MCCORMACK

I wish to express my great personal pleasure to join with a close friend, John Davis, in chairing today's hearing. Without the support that Congressman Davis provided for the Task Force on Energy during the 92nd Congress, there would have been little basis for the creation of the Subcommittee on Energy. The legislation we have passed on energy research and development in this Congress must certainly draw its early history from the work done in John Davis' Subcommittee on Science, Research, and Development.

Energy Research and Development has taken many forms: Solar, Geothermal, Nuclear Fission and Fusion. However, most research has dealt with power sources that are either stationary, or such that they will be used to produce electricity or heat.

Another important aspect of research and development lies in the area of "portable" fuels. Today this means petroleum and its by-products: gasoline, diesel, and aviation fuels as our reserves of oil are depleted and foreign sources continue to be unreliable we must look to alternate ways to meet our needs for portable fuels.

This effort must be two pronged—first, we must review our usage of these fuels to see where we may conserve, and we must promote research to improve conservation practices, particularly of gasoline.

Second, we must increase our research efforts to produce synthetic liquid fuels from coal, oil shale, tar sand and solid wastes. I am happy to see that the legislation proposed by my colleague, Mr. Perkins, is intended to promote part of this program.

My Subcommittee on Energy has held hearings on Oil Shale and Bioconversion of wastes to produce liquid fuels. Each hold promise for the future.

In conjunction with the Library of Congress, the Subcommittee is currently preparing a report on the status of Tar Sands in the United States and Canada.

Coal, however, is of great importance, and the hearings we initiate today will, I am certain, emphasize the necessity of our pursuing research and development with respect to t scshreuoifx
ment with respect to this source of energy with great intensity during 1975 and on into the future.

STATEMENT BY HON. JOHN W. DAVIS

It is a special privilege for me to call to order this joint hearing by the Subcommittee on Science, Research, and Development and the Subcommittee on Energy. On this occasion I am joined in occupying the chair by my good friend from the state of Washington, Mike McCormack, who so ably has served as chairman of the Subcommittee on Energy in this Congress.

The bill before our two committees, H.R. 17400, was introduced by a distinguished and long standing member of the House of Representatives from

Kentucky, Mr. Perkins. This bill would amend the Organic Act of the National Science Foundation to authorize the Director to establish a program of research and development in the production of synthetic liquid fuels.

This legislation recognizes that the most abundantly available fuel resource in our country is coal. It further recognizes that new and imaginative approaches to the uses of coal must be investigated in order to insure that the most effective use is made of this resource. And it recognizes that in order to develop these new approaches, we must begin now to develop, through research and development, the new ways of using coal.

We are fortunate that the author of this bill is with us today to give us the benefit of his views on this subject and on the merits of this bill. We will also have testimony from the Director of the National Science Foundation and his associates on the pioneering program now being carried out under project RANN in the fields of coal gasification and coal liquification. We will hear from a respected representative of the coal industry, Mr. William Gammon of the Ashland Oil Company, and from Dr. Raymond Zahradnik who has been intimately involved in studies in this field and who now is with the Office of Coal Research.

Mr. HECHLER. Mr. Chairman, I would like to join in welcoming our colleague, Congressman Perkins, who adjoins my Congressional District. He represents the district in which the pilot plant for coal liquefaction will be located.

I commend you, Mr. Chairman, for initiating these hearings, and we are very pleased that Congressman Perkins has introduced this pioneer bill, H.R. 17400, in the House of Representatives because this is a very exciting program which gives a great deal to the nation. I welcome my colleague, Mr. Perkins.

Mr. PERKINS. Thank you.

Mr. BELL. Mr. Chairman, I'd like to take the opportunity to welcome Chairman Perkins before this committee. Our congressional districts are a few miles apart. However, I would like to say that I have had the opportunity of working under him, on the Committee on Education and Labor, on which he's doing such an outstanding job as the leader of that committee, and anything that he would have to say to this committee I'm certain will be well thought out, well planned, and well expressed, because he shown great capability in this area.

Mr. MCCORMACK. Thank you, Mr. Bell.

I do want to express my regret that Chairman Davis is unable to be with us, at least at this time this morning, and he will be able to join us later.

Congressman Perkins, if you would go ahead with your statement.

[A biographical sketch of Congressman Perkins follows:]

HON. CARL D. PERKINS

Congressman Perkins is serving his thirteenth consecutive term in the United States House of Representatives from the Seventh Congressional District of Kentucky. He is dean of the Kentucky delegation to the U.S. Congress and Chairman of the Education and Labor Committee of the U.S. House of Representatives, a post to which he was elected on January 23, 1967.

Mr. Perkins was the sponsor of the landmark "Elementary and Secondary Education Act of 1965." As Chairman of the sub-committee considering this legislation, he expedited action on the legislation, holding hearings in an unprecedented extension of sessions in order to avoid delays in the consideration of the bill. As a consequence, the measure passed the House of Representatives on March 26 and the Senate on April 9, 1965. It was signed by the President on April 11, 1965 (Public Law 89–10). The bill received strengthening amendments in the Perkins sub-committee and only one minor amendment was made to the

legislation on the Floor of the House and none in the Senate, a credit to the careful work performed by Perkins.

As Chairman of the General Education Subcommittee, Congressman Perkins sponsored and brought to a successful vote the Vocational Education Act of 1963, which has expanded the old and inaugurated a new Federal program for vocational education. He sponsored legislation which when enacted into law in 1968 greatly enlarged Federal support of vocational education.

Continuing his interest in expanding quality education, particularly in the rural and economically disadvantaged areas, Perkins has sponsored legislation to provide general support for elementary and secondary education to be distributed among school districts according to financial need. Included in the proposals are substantial allocations of funds for construction of school facilities.

In 1961, the Congressman wrote and sponsored the Adult Basic Education Act. For several sessions the Rules Committee of the House had blocked full membership consideration of this legislation, but Perkins was successful in getting the program adopted as an amendment to the President's antipoverty legislation. This Act by Congressional passage in 1970 of Perkins' H. R. 514 has been extended to June 30, 1973.

As one of the sponsors of the 1956 Library Services Act providing aid for public libraries in rural areas he was an active leader in guiding it through the Committee for eventual passage and played a leading role in the 1966 amendments which greatly expanded the program.

He has been an outspoken advocate of student aid programs including Federal scholarships, work study and student loans. He is the author of the vocational education student work study programs from which the college work study program is modeled. The Congressman actively participated in writing the National Defense Education Act which has enabled secondary schools throughout the country to strengthen their science and foreign language programs. He was the chairman of the Senate and House Conference on the Higher Education Amendments of 1972.

Perkins was a co-sponsor of the Area Redevelopment Act, the Manpower Development and Training Act, the Public Works Acceleration Act, the Small Water Protection Act, the Water Pollution Control Act, and actively cosponsored and participated in the formulation and enactment of the Appalachian Regional Development Act, the Environmental Education Act and the Drug Abuse Education Act.

Mr. Perkins has been an ardent advocate of flood control and water resource development in Eastern Kentucky and elsewhere in the nation. Currently, as a result of his extensive efforts, major reservoir projects have been completed recently or are under way, the Fishtrap Reservoir, the Paintsville Reservoir, the Grayson Reservoir, the Cave Run Reservoir, the Carr Fork Reservoir, and the Red River Reservoir.

Perkins was the author of P.L. 91–230 extending the Elementary and Secondary Education support through June 30, 1973, and the Vocational Education Amendments of 1968.

Perkins also wrote the "Black Lung Benefit Provisions" of the Coal Mine Health and Safety Act of 1969 which provide disability payments to miners and their widows on account of a miner's disability or death attributable to the coal dust related disease, pneumoconiosis or "Black Lung." Dissatisfied with the Social Security's strict administration of the Act he obtained passage by the U.S. House of Representatives on November 10, 1971, of his bill, H.R. 9212, liberalizing the benefit provisions.

Born in Hindman, Knott County, Kentucky, October 15, 1912, where he still resides. Law degree, elementary, secondary and college education at local Kentucky schools. Served two terms as County Attorney, Knott County, Kentucky; member of the General Assembly of Kentucky in 1940; was a member of the Armed Forces in the European Theatre in World War II; elected in 1948 to the 81st Congress and re-elected for every succeeding term; married Miss Verna Johnson, Mousie, Knott County, Kentucky; one son, Carl Christopher, born in 1954.

STATEMENT OF CONGRESSMAN CARL D. PERKINS

Mr. PERKINS. Thank you, Mr. Chairman, and my dear colleagues.

First let me express my deep appreciation for being able to appear before the committee this morning.

I am cosponsoring the legislation with Congressman Teague, and I want to thank the chairmen of the two subcommittees, Congressman John W. Davis, chairman of the Science, Research and Development Subcommittee; and Congressman Mike McCormack, chairman of the Energy Subcommittee, for holding this hearing at a time when we all are so busy wrapping up the 93d session of the Congress.

I will stick to a prepared text until I get through, and then I will make some extemporaneous remarks, Mr. Chairman.

The fact that this hearing is being held here today signifies the importance of the subject we are inquiring into—which is making this country independent when it comes to energy, and providing that energy at a price the people can afford.

I believe energy independence will come about when coal liquefaction and coal gasification plants are built throughout the coal regions, as well as shale refineries in the oil shale areas. I see this as being done by the private sector, with Government support, and I don't doubt for a minute that we can do it, if we will make up our minds to do it. The time to make up our minds is now, because sooner or later, we are going to have to move to a synthetic fuels industry, or give the productive, distributive, transportation, and other resources of our country away in exchange for imported oil, and that would be a sad situation.

I do not want to see that happen; no Member of Congress I know wants to see that happen; no individual I know wants to see that happen—but it is happening right now.

We know that the quadrupling of prices for imported oil has pulled at least $25 billion in excess out of our economy this year, and a total of $55 billion in excess out of the industrial nations to pay for foreign oil. We hear that these so-called petrodollars will be recycled, but there is no real cycle involved. They come back only to buy the factories, the farms, and the mineral resources of our country—which means that our dollars are used to buy our country, and transfer the ownership to Middle East oil people. Then additional money will have to be spent for more exorbitantly priced Middle East oil, and once again our dollars go out to the oil sheiks.

What kind of a cycle is that?

The answer is that we are on the losing end permanently, while the oil exporting nations are on the winning end permanently, and it must stop.

We have seen the economic effect of extortionist oil prices already in 1974, and it has been a disaster. It is a very significant, direct part of our inflation through high prices for gasoline and other fuel. It is also a part of the rise in costs of food, because of the use of oil and gas in agriculture, especially in the production of fertilizer. And it has spread throughout the economy.

Now, we are suffering the added injury of hearing the Middle East oil suppliers say they must raise their prices again, because of inflation in the developed countries, which they blame on us, instead of themselves, as the cause.

Just last Friday, December 13, the Organization of Petroleum Exporting Countries said its members were stabilizing prices for 9 months. As I understand it, that stabilization is actually another price

increase, and these countries say that we ought to be thankful to them because as a sign of goodwill, or cooperation, they have agreed to hold that higher price for 9 months.

Well, when that price increase is transmitted to every consumer in the economy, through nearly everything he or she buys, in addition to gasoline, I do not believe the average American will consider it a sign of goodwill. I do not, and I hope this government does not.

As a matter of fact, I do not believe the price will hold for 9 months. One thing at least that we should have learned out of all this is that nothing said by the Middle East oil suppliers is believable. We have repeatedly heard our highest administration officials intimate that a price decrease is on the horizon, but that sun never seems to rise. I have as much faith in the oil exporting nations as I have in the old-time horse trader who used to ride up into the community from somewhere far off, with a string of horses to trade. Invariably, he rode off considerably richer, and the people were left with poorer transportation than they had before he showed up. We are in a comparable position with the Middle East countries—not only have we less money, but we have less horsepower.

It is late, but not too late, for all of us to recognize the fact that we cannot believe what we hear from the leaders of these countries. The truth is not in them.

Dealing in the truth is just not a value held highly with them—it is not the way they operate. I am sure they think we are the biggest fools in the world because of our gullibility, but they have yet to see this Nation aroused and ready to act.

I believe we are at that point, but I would now like to mention something that happened on the floor of the House a little over 20 years ago, because I think it will be a useful reminder.

Back then, in the early 1950's, we had two coal liquefaction demonstration plants operating in Louisiana, Missouri. They were producing liquid fuel at a cost of only about 2 cents a gallon more than it was being produced from petroleum at that time.

But a new administration was elected in 1952, and this administration—at the urging of the giant, international oil companies—decided to leave $2 million out of the budget needed to continue that research. Those of us from coal areas fought to get that $2 million back, but we were too few, and the administration lined all of its power up against us. The money was not included in the appropriations, and those plants were demolished. We were talking about a few million dollars back then that very well could have given us perpetual independence so far as energy is concerned, and also could have meant a thriving economy in our economically distressed coal mining areas.

Now, I want to say, Mr. Chairman, that if you go back and read the Congressional Record back in the spring of 1953, it is well documented that the know-how was present at that time. In fact, the technicians had even been proposed a coal-to-oil plant in Illinois on a commercial basis, which would cost about $300 million, and some of the oil people objected at that time, and they objected so strenuously they almost blew the roof off the Department of Interior.

We still have this know-how today. There is a successful coal-to-oil plant operating now in South Africa on a commercial scale. This

knowledge on underground coal gasification is also available. We had it at that time, back in the 1950's, at Gorgas, Ala. It was all in the same ball of wax, involved in the same demonstration appropriation. Shale oil technology was working perfectly at that time, on a demonstration basis.

So we've put a lot of money this year, maybe $400 or $500 million, into research, which is all well and good. We can improve the technology; undoubtedly we need it.

But the point is, with the know-how we have, we should get along today with some commercial plants, and the only way that the private firms will build these commercial plants is to make sure that we do not permit the Mideast oil countries to come along and jerk the rug from under them, and destroy their profit. That's the reason your shale plant's not progressing.

Now, the Government has got to come in and guarantee these companies a reasonable price for their fuel so they can go ahead, and they will go ahead, and they want to go ahead, on a commercial scale. We've been dillydalling around now for 2 years with this oil situation throughout the country, and not one commercial plant has been started, with all this know-how that we have. If we had the plans down here in the Department of Interior in 1951 and 1952 for commercial plants, where are they today? Where are those engineers? Where is that know-how to do it? For us to continue to talk and not perform, we might as well talk about the folly of the misspent youth, insofar as solving this oil crisis in this country. It's time to move on, and that's the reason I'm here.

Now, we all know the domestic fuel situation. In November of 1974 domestic oil production was 8.6 million barrels a day, well below the all-time high of 9.6 million barrels per day in 1970. Natural gas production has also slowed down. All of this means that our percentage of imported petroleum was 23.2 percent in 1970 but was 36.2 percent in 1973, and right now it is 38 percent.

The unbelievable and unacceptable projection for 1985 is 50 percent from overseas. We will be broke by then, unless we move, and move now, into the areas where we should be heading, including synthetic fuels on a commercial scale.

Congress has taken some significant moves, and the members of this committee have been in the forefront, to their credit. Just this week we are scheduled to vote on H.R. 11343, which will establish a national fuels and energy conservation policy for this country. But for all these years up to now we have been operating without an official, Congressionally approved energy policy, and that is one of the main reasons for our perilous situation today. I hope that the Council on Energy Policy, which the energy policy bill would create, will move ahead along the lines I am discussing, and will help bring about a commercial scale synthetic fuels industry without delay.

Let me say the reason that I know that we have never had a national fuels policy in this country:

When I came here in 1949–50, of course, the better water sites for electric power, which we all supported, were being exhausted, and they needed to burn coal and firm up the situation. The demand on TVA was so great, they put some boilers in down there, but by 1951

they commenced to burn natural gas at the TVA boilers in Tennessee on an interruptible basis, to buy it for 8, or 10, or 12 cents per cubic feet in the summer months, and cut off when the market became good in the Appalachian area, where they'd get 40, 50, 60, 70 cents in the winter months.

I took that complaint myself, documented it, filed it through the Federal Power Commission here in Washington, because I knew it was a disgrace for such a precious fuel in such scarcity as natural gas to be wasted in TVA furnaces, when we had these billions of tons of coal that we needed to sell, and they should be buying. We finally won it down there, after about a 2-year fight after I first came to Congress.

That's the reason I tell you that we never had a national fuels policy.

Now we may be getting on the way, but we are late, and we've got to become self-sufficient, and we've got the know-how, and I think, when we've been derelict so long, that we should move ahead.

One of the Council on Energy Policy's duties, according to the conference report, is to make "recommendations concerning the level of funding for the development and application of new technologies," and I hope the levels will be adequate to get the job done.

It would have only taken $2 million to continue the job back in the early 1950's, that was being done at the Missouri coal liquefaction sites, and quite likely not more than $10 million back then would have put us where billions today have not yet brought us. There is no use crying over spilled energy opportunities, but it is very disagreeable to think that we had to send an excess $25 billion out of the country to pay for foreign oil in 1974, and compare it to the $2 million appropriation in 1954 that would have moved us considerably ahead in technology and put us well along—if not all the way along—toward energy independence through coal liquefaction and gasification.

I want to say to my colleagues we all have to be educated, but if you'll go back and read that 1953 Congressional Record, and there are some reports around, we were making gasoline within 2 cents as cheap as they could from crude oil from coal at this demonstration plant, back in 1952. They brought all of this know-how over here from Germany during World War II and immediately following World War II, and spent $60 million to $80 million to set up these demonstration plants, which were later completely dismantled. And that debate will be educational, because it shows you that we now have the know-how and can move ahead and let contracts in all of these areas.

But these companies, these private oil people, are not going to do it if they know that the Middle East countries can jerk the rug out from under them any day in the week.

Good morning to you, Mr. Chairman, and glad to see you here. You've been a great leader, and we all appreciate your appearance here this morning, Mr. Davis.

Mr. DAVIS. Our regards are mutual.

Mr. PERKINS. Congressman McCormack is very aware of these figures, since he is a conferee on another piece of important energy legislation which will also be before us this week, the conference report on S. 1283, the Federal Nonnuclear Energy Research and Development Act of 1974. This legislation has been written to make sure that Congress and the people have every possible energy option to choose from for the future.

I would just like to call the committee's attention to one of the options mentioned—item O on page 6 of the conference report, which is listed as "to determine the economics and commercial viability of in situ coal gasification."

At the same time in the early 1950's the coal liquefaction demonstration plants were operating so well in Missouri, we had another demonstration plant operating near Gorgas, Ala., doing exactly the kind of research and development as item O describes.

Unfortunately, the $2 million or so dollars we could not get from the Administration also meant the end of that operation.

I am going to call the attention of the Administrator of the Energy Research and Development Administration to this, and, hopefully, that agency will have a good takeoff point which will allow it to move ahead rapidly.

I am also very glad to note the inclusion in the conference report of items D and E, which have to do with accelerating the commercial development of coal gasification and coal liquefaction. Earlier this year, on May 30, 1974, I introduced H.R. 15107, which would bring about commercial scale coal liquefaction and gasification, as well as oil shale development, and I see the bill we are holding hearings on today, H.R. 17400, as a vital complement to H.R. 15107.

H.R. 15107 would establish a Mineral Gasification and Liquefaction Administration, which would, according to section 3 of that bill, establish a program for assistance to private industry in the development and commercial operation of facilities for the liquefaction and gasification of coal and the production of shale oil.

I am glad to see that Congressman McCormack's conference report on Federal Nonnuclear Energy Research and Development does not call for Federal corporations to do the work, but discusses Federal assistance and participation instead. My legislation on coal liquefaction and gasification, and shale, sees this assistance and participation taking the form of loans and purchase agreements or price supports so there is a reasonable profit on the product.

H.R. 17400, the bill before the subcommittees today, would authorize the Director of the National Science Foundation to provide financial assistance, directly or by contract, not only for research and demonstration projects, but also for construction and operation of commercial scale synthetic liquid fuel plants.

These contracts should be with private industry. I believe private development is essential to the success of the program. If we get into a fight over whether synthetic fuel is produced by a Federal corporation, or by private industry, we will be delaying this for years and years, when we ought to be moving ahead with as much backing as we gave development of the atom bomb or development of the space program. This is just as important.

Congress needs to keep from getting into a fight over private or public liquefaction and gasification plants, but Congress also has to recognize that it will cost enormous amounts to get this industry going. We also have to recognize that the oil sheiks can flip their prices around to suit themselves, with no regard for its effect on our economy or the economies of other countries, this type of arrangement and other opportunities.

The sheikdoms and other oil producers can stand up all day and night and say that they have no interest in seeing our economy destroyed, but they demonstrate consistently that they are only talking. No, we will have to protect the liquefaction and gasification industry from the risks that the sheiks—who starved us first and then extorted our financial resources in exchange for oil—might turn around and start flooding us to kill the synthetic fuel industry.

At any rate, it will be cheaper than the $25 billion which we paid in 1974 in quadrupled oil import prices.

When we bring our synthetic fuel industry into existence, as we can and should, we will have saved the economy of this country, but we also helped develop a greater degree of competition in the energy industry, and that fact should not be overlooked.

I would like to make one additional point, and it concerns liquefaction and gasification technology. This technology exists. It has existed for years and years, and I want to say the technology exists on oil shale. At the same time we had a successful oil shale technology in Rifle, Colo., as that record back in 1953 shows. We have the know-how there today, and there's no reason why we should not go in on a commercial scale on the oil shale because we have the know-how.

During World War II, the Germans fueled their war machine with coal, which had been converted into liquid fuel. For years now, South Africans have been driving their cars and trucks with gasoline produced from coal. Of course, additional research is needed. But with the worldwide energy situation being what it is, I say we must go ahead with commercial scale plants now. At the same time we go ahead with research to make the processes more efficient. I would like to point out that often we hear that our fossil fuel resources are limited—they cannot last forever, but coal is a fossil fuel in such abundance that, for all practical purposes, its supply is forever. Any time estimates say we have a 300- to 500-year supply, we know that all we need can be made available for the foreseeable future. I have not discussed oil shale in any depth because you will be hearing experts in that area here today, but we know that it is also so abundant we cannot accurately measure its quantity.

Mr. Chairman, in conclusion, let me state that when I came here I represented only eight coal producing counties. We were concerned about the welfare of coal. We thought it would jump to a billion tons by 1950. We were only producing about 450 million at that time. But 10 years later we were only producing 450 million tons. Twenty years later we were only producing 450 million tons.

But what hurts me is to see us drag along here over all these number of years without a national fuels policy, while we have the know-how for coal conversion. All you've got to do is to go back and read the record in 1953 and hunt up the Interior Department's report, where they were making liquid fuel out of coal in Louisiana, Missouri, and sending electricity out, for hundreds of miles with what Representative Clarence Cannon called in a debate "a great spare tire."

We had the same in Gorgas, Ala., underground gasification, effectively operating, furnishing electricity for 50 to 100 miles outward, and we knew how to manufacture electricity underground from under-

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ground coal gasification. We learned it in that experiment. We learned how to get the oil from shale in Rifle, Colo.

All those projects were in existence, but they were closed out of operation. But we have the know-how today, and let's get this thing going on a commercial scale, and not dillydally any longer.

Yes, continue with the research, but get going on a commercial scale. It didn't take us long to get going on the synthetic liquid fuel projects during World War II, and this is just as important, and I don't think we should let these Mideast countries dominate to a great extent our economy in the future, and bring about so much inflation in America.

It's much cheaper to say to these oil people, "We want you to go ahead. We are going to enter into contracts with you." Do this on a commercial scale, and let's make this country self-dependent, independent of foreign countries of the Mideast.

Of course, we always want to trade, but this is reasonable and should be done, and it was so reasonable back in 1953, but we were so gullible, the Congress, back then, to close all these experiments down.

At the time, some of the big oil companies talked to me. The Gulf representative at that time talked to me about it. They were opposed to it. They opposed it, for reasons unknown to me, saying that it was a grave mistake, and the administration went along.

But there are only two ways to get this done. Let the private sector do it. They're willing to do it. And let's make sure that they don't lose money. Let's not let the Mideast jerk the rug out from under them. Let's get some contracts going.

The other way is for the Government to get into the business, which I don't think is essential, and I think that would be the last resort.

But if we got into a war or something, where would we be?

But we can move this thing along today. We've got the know-how for commercial coal-to-oil plants, and let's get them started.

These companies cannot afford to take the risk, when they can develop this oil in the Mideast for 75 cents a barrel and jerk the rug out from under them any day in the week.

I grew up in a gas and oil section, and I think I know something about gas and oil, to a limited degree anyway. But I've read quite a lot, and I would ask all of you to go back and read this Record in 1953, when the Interior Department appropriation bill was on the floor, and you will find everything that I've said here today well documented, and admitted by the opposition.

Then, all this dillydallying that we've done within the last years just makes you sick to see that we are not moving ahead like we should be moving ahead.

I'm thankful for the opportunity to appear before such a distinguished committee.

Mr. DAVIS. As always, Mr. Chairman, you're most gracious to come before us and to express your thoughts with such eloquence and such obvious sincerity.

One little thought occurred to me, and that is, I agree with you wholeheartedly, we do have the technology.

But do your foresee that we have a shortfall—I believe that's the word some people use—in the amount of capitalization? Do we need an RFC type assistance from the Federal Government?

Mr. PERKINS. I am not an expert in that area, but I would think that private industry would do it. They would need a contract to guarantee them against loss, so that they could make a reasonable profit on their return. I mean reasonable. I don't mean an exorbitant profit or profits. I think that could be worked out.

In working that out, it would be up to the committee to decide how you wanted to do that. But it certainly should be done because we all know that oil over there can be produced so cheaply, 50 or 75 cents to a barrel, and with all of these huge profits, and recycling it over here, they'll soon own this country, if we let this thing go on 8 or 10 years, like we have the last 8.

Mr. DAVIS. Thank you so much.

Mr. McCormack.

Mr. MCCORMACK. Thank you, Mr. Chairman.

I want to congratulate Congressman Perkins on his presentation this morning, for his sponsorship of this bill, and for sounding the alarm, by calling attention to not only some of the more serious aspects of the energy crisis as far as this Nation is concerned, but for offering some constructive solutions, and I'm very pleased to have this opportunity to hear his testimony this morning.

There are some questions that are raised in my mind, Mr. Perkins. I wonder if I could ask you a couple of them.

Do you know who was doing the coal liquefaction in 1953?

Mr. PERKINS. I did, and I may be able to find it. I talked to some of those engineers at the time, it was in Louisiana, Missouri, and got definite information at that time that it was being done within 2 cents as cheap as gasoline refined as it could be from crude oil. They were so badly disgusted because they were just getting the operation going in a good way. I don't know who tipped me off, but I think the first reporter who told me about it was from the St. Louis Post Dispatch, and I know I called out there and questioned the people, and they began to tell me about the rumors, and I made the first speech on the floor about it, because of our great investment, and because it was the hope of the coal industry.

I had even gone so far, back at that time, as to introduce a bill to provide two plants on the Big Sandy River, because of the great depression that we had in the coal area there.

Then this budget decision came along and just folded things up.

Mr. MCCORMACK. There are some pretty fundamental questions that should be asked about this.

Mr. PERKINS. The Government was altogether doing this research at that time.

Mr. MCCORMACK. There are some other aspects. These are capital questions, fundamentally.

How would construction of such plants be funded? For instance, do you think if we were to guarantee some specific price per gallon for gasoline, or for the number of barrels production per day or per year, or for a number of years, that that would be an incentive?

Mr. PERKINS. We have a witness who is here today I've asked to come, from my section, who can give you some direct information on that. He's Mr. Gammon from the Ashland Oil Co., and can speak on

the economics of how this might be done. I'm not an expert in that area.

I know that things should be done, that we have the know-how, and that we are dillydallying, and this country could go down the drain while we're not doing it.

Mr. McCormack. What about the production control? This is another aspect of it, and I want to get your thoughts on this. One of the things that's troubled us in our previous hearings in consideration of this question is the fact that the coal industry simply claims they're not able to produce coal fast enough, even to meet the rapidly growing demand that we have on coal.

If we were to try to go to a coal gasification and coal liquefaction program, it would ultimately involve doubling or tripling our output of coal.

Mr. Perkins. Let me say this.

We had enough deep mines back in the 1940's and the 1950's in Kentucky that went out of business which could have increased the coal production from 400 million tons to 1 billion tons a year. We had that type of operation, if there had been a demand for the coal at that time.

Of course, thousands of coal cars have become dilapidated, outmoded. There's a shortage of coal cars. This will involve another element, of establishing priorities for raw materials to make sure that we get this thing going.

But the coal is there. It's no problem in this country to double the production of coal, if there is a market for it, which there is today with the utilities. There is no problem at all in the production of coal, even without strip mining, by increasing the deep mining

Mr. Hechler. Would the chairman yield briefly at that point?

Mr. Perkins. Yes.

Mr. Hechler. I agree 100 percent with my friend from Kentucky.

As a matter of fact, in the last few years a large number of the mines have closed down, which have not been worked out, both in the gentlemen's area and in my area, and we certainly agree with you that we do have the potential to expand mining capacity to supply the necessary coal for the program which we're talking about.

Mr. Perkins. More than 50 percent of them have been closed down because it was easier to strip, more than 50 percent of them.

Mr. McCormack. Again, Mr. Chairman, I want to congratulate Mr. Perkins for his presentation today, and thank you for your comments. Thank you very much.

Mr. Perkins. Thank you, gentlemen. You have some good testimony here, and I hope we can get this on the right track.

Mr. McCormack. Mr. Chairman, please don't leave. Perhaps some of the other members have questions.

Mr. Davis. Do the other gentlemen have questions?

Mr. Symington. Mr. Chairman, I was interested in your discussion of the Missouri aspect in the 1950's. Since that was Clarence Cannon's district, Louisiana, I would have thought that he would have given you some help there. Did he take an interest in this?

Mr. Perkins. Let me say that he took a great interest in this, but the thing was so stacked against us at that time. The Gulf people in particular were running around here, and some of the other big oil

people. I presume at that time they felt when the day came about that they might want to do it themselves.

But I'm not objecting to that today. I think, we ought to let industry do it. I think Congress made a mistake back then, because the administration lined up with them. But the mistake's been made; it's been done. We still have the know-how. So they took the know-how to South Africa, and they they've got a commercial plant. It was the same German operation that we had in our country.

But the record shows Clarence Cannon describing one great generator that they had in that coal-to-oil plant as a spare tire that furnished electricity for hundreds of miles around, and even the underground gasification at Gorgas, Ala. was furnishing electricity to the public at that time.

So these operations were not something that were playthings. They were actually there; had demonstrated themselves; and were actually producing.

Mr. SYMINGTON. Mr. Chairman, that's an interesting record. I'd like to look at that.

One other question with respect to the outflow of dollars to the Middle East now being $25 billion annually.

Do you think that we should stop sending them that kind of money?

Mr. PERKINS. I certainly do. It's all right for trade to be reasonable. Certainly this is exorbitant, exorbitant prices for oil. We should stop sending that type of money, and if we would stop, their prices would come down.

The only reason that the German people went out of this operation after World War II, of course, was that we destroyed a lot of those plants. Also, they paid their coal miners higher than any other wages that were paid by any other industry in Germany, and it was so difficult to obtain that coal by shaft mining. Also, after the war they had access to the crude in the nearby countries that they could get for $1 or 50 cents a barrel, and that's the only reason in the world that they went out of the liquefaction business.

Mr. SYMINGTON. We should, then in your view conserve what we have to conserve, and, in order not to be dependent, in the short term, guarantee a reasonable return on investments in these alternative fuels, in coal gasification and coal liquefaction, and hope to bring them on line as quick as we can?

Mr. PERKINS. Absolutely.

Mr. SYMINGTON. You could either tax people or ration in the interim.

Mr. PERKINS. The first priority is moving ahead with liquefaction and gasification. I have discussed with the witnesses here what I have been so concerned with; that I've been so concerned, since the Congress has not caught on, since it has been so derelict, in not taking advantage of all this know-how.

I see Mr. Fuqua has just come in.

We had this operation from coal to oil, making gasoline within 2 cents as cheap from coal as it could from crude oil back in 1952, and the underground gasification in Gorgas, Ala., going out 50 to 100 miles there; the underground oil to shale at Rifle, Colo., in perfect operation. Everything closed down, and now doing all this research all over again, when we've got the know-how.

Fine. Let's separate this research. It's money being well spent. But we are killing ourselves, and killing this economy, by not getting into commercial scale coal-to-oil plants, coal liquefaction and coal gasification in this country, when we've got the know-how.

These firms can't afford to go into the liquefaction and gasification as private industry because they might get the rug jerked out from under them with the Mideast countries able to produce oil so cheap, and that's the reason why we've got to enter into contracts with these private firms and let them make a reasonable profit for their product and get this country self-sufficient; and that should be started within the next 30 days.

Mr. SYMINGTON. Thank you, Mr. Chairman, very much.

Mr. DAVIS. Mr. Thornton.

Mr. THORNTON. Thank you, Mr. Chairman.

Chairman PERKINS. I want to add my appreciation for your testimony.

At the risk of making an error in identification of the company who had the project, would the name Chemco sound right to you, that had the project in the 1950's? It seems to me that was the name.

Mr. PERKINS. In Louisiana, Missouri?

Mr. THORNTON. Not Chemical, but Chemco, C-h-e-m-c-o.

Mr. PERKINS. I've got that in my files. I can dig it out and give you all that information.

Mr. THORNTON. I would appreciate having that.

Mr. PERKINS. It's a huge file we developed back in 1950, 1951, 1952, 1953.

Mr. THORNTON. All right.

(Information was subsequently provided stating that the plants were Government operated, with the Department of Interior in charge.)

With regard to the effect of the outflow of dollars and the effect on our national confrontation with research shortages, I wonder if you would agree that the effect on our economy is truly devastating?

Mr. PERKINS. It's devastating on our economy, and it's bringing about so much of this inflation in this country, we hardly know how to guage it. But I would say it's a high percent, maybe 20 or 25 percent; this one factor alone is bringing about that much inflation.

Mr. THORNTON. As you recall at the end of World War II, when the economists were at work initiating a plan called the Marshall plan.

Mr. PERKINS. I well recall it, I was here, and voted for it, because for 5 years we felt we should spend $50 billion and get out of it, and that would be the cost. I took part in it; voted for it every year.

Mr. THORNTON. Do you think it might be appropriate to consider the adoption of that broad sweeping a plan with regard to meeting the problems of our economy? Would not, for example, a plan related to the energy problem help to solve some of the problems of unemployment and help to solve some of the problems of other material shortages, steel and other materials?

Mr. PERKINS. Yes. But that may not nail down this specific problem that we have. We've got to enter into contracts with the people who can do this job, coal liquefaction, coal gasification, on a special basis, and make sure that the Mideast countries don't disrupt them when

they get to about the point of production. Why, they just can't afford to invest that much capital if they think somewhere along the line they're going to get the rug jerked out from under them. That's your oil shale problem now. There's no protection there, really, from the Government, and they know what's going to happen, that they're going to lose money.

But this thing can be perfected in such a way with the know-how that we've already got, if we just provide that protection.

Mr. THORNTON. I think I'm in agreement with the approaches which your bill suggests, and I'm only asking whether this should be considered, together with other approaches, to have a more intensive national approach to the overall problem.

Mr. PERKINS. I would have no objection to that.

Mr. THORNTON. Thank you, Mr. Chairman.

Mr. DAVIS. Mr. Gunter.

Mr. GUNTER. Thank you, Mr. Chairman.

Chairman Perkins, I certainly concur with the principles of the legislation that you've introduced.

I was wondering if you happen to know, with reference to the project that you described, a number of years ago, the extent to which if any, the oil companies at that time had investments in the coal industry.

Mr. PERKINS. They did not have much. They only had investments to a limited extent at that time. But I presume they may have had their minds on the future. I don't know. I judge that from my home where I live. The Kentucky, West Virginia Gas Co. owns the gas on the property where I live. The Elkhorn Coal Corp., which was a rail mine, owns the coal on the property where I live, and I did my darndest, through an attorney, to buy the coal and the oil and gas, because at that time it was about 1956, they were stripping on the other side of the mountain, and I never wanted my home, my farm, stripped over. But I could not. I used every means at my command. There was an adjacent piece of property of about 100 acres in 1956 that a good friend of mine owned, by the name of Gordon L. Martin, an attorney, right at the back of my property, had the coal, oil, and gas on it.

I was going down 1 week to buy it, and the Kentucky, West Virginia guys beat me to it. They bought, not only the surface, but the oil and gas, and then they commenced to buy up the coal on my property, for instance.

Mr. GUNTER. What year was that, Mr. Chairman?

Mr. PERKINS. This was back in 1956 and 1957. That's when they commenced to get into the coal business. In 1957, the coal on my property belonged to the Elkhorn Coal Co. and that's of course, the American Gas & Electric. This was done all over the country, and I think I know a little something about this.

But we cannot look at that angle of it today. The law somehow permitted them to do it. I don't know whether the antitrust laws were enforced, or whether they were not enforced.

But, be that as it may, the private companies can do this job today. The companies can do this job today, and we've got to give them some incentive to do it. I know the Government's not going to undertake to take over all of the private properties here, and if it did we would get

behind 10 or 15 years arguing over it, and this economy would be wrecked by that time.

But we need to start now on these coal-to-oil plants, and let these people who have proposals, you can look at them, and approve them. Just protect them from the Mideast people who can kill off any of our undertakings here at this time, and the Mideast is smart enough. They will do it, just like they've done it to us the last 2 years, unless we give our companies protection, and the Government may have to make an investment.

I just don't really know the economics, but I know enough to know that we've got to make sure that we guarantee them a reasonable profit some way on their investment, or that investment won't be made. But if we'll do this job, we should have some coal-to-oil plants in operation on a crash basis in the next 12 to 18 months in this country. And then let them be updated; let them be updated through our research as time goes on.

Mr. DAVIS. Mr. Brown.

Mr. BROWN. No questions.

Mr. PERKINS. I just hope all of you will go back and read this record in 1953, March, April, and May. It would be very enlightening now to the Members of Congress today.

But all you've got to do is go back and read the record, and the record proves out everything that I've told you here this morning.

Thank you.

Mr. DAVIS. Mr. Chairman, we're deeply indebted to you for your remarks, and we appreciate your appearance very, very much.

Mr. PERKINS. Thank you.

Mr. DAVIS. Dr. Guy Stever, our old, old friend, is back with us this morning. We welcome you, and you may present your statement as you feel proper.

Mr. HECHLER. A young friend.

Mr. DAVIS. Old, in the sense of being a long-time friend; young in age.

[A biographical sketch of Dr. Stever follows:]

DR. H. GUYFORD STEVER

Dr. H. Guyford Stever assumed the post of Director of the National Science Foundation on February 1, 1972. In addition to his duties as NSF Director, he has been named Science Adviser and Chairman of the Federal Council for Science and Technology by the President. He also serves as Chairman of the Energy R&D Advisory Council; Chairman of the Technical Advisory Committee on Research and Development, National Power Survey, Federal Power Commission; U.S. Chairman of the U.S.-U.S.S.R. Joint Commission on Scientific and Technical Cooperation; and Chairman of the Board of Governors of the U.S.-Israel Binational Science Foundation. He serves on a number of additional committees, including National Science Board and the President's Committee on the National Medal of Science.

Born in Corning, New York, in 1916, Dr. Stever received his A.B. from Colgate University in 1938 and his Ph.D. in Physics from California Institute of Technology in 1941. He has received 12 honorary degrees and other honors, including the President's Certificate of Merit in 1948.

Prior to his appointment as NSF Director, Dr. Stever had served as President of Carnegie-Mellon University and, before that, Carnegie Institute of Technology, since 1965. During his presidency, Carnegie Tech merged with Mellon Institute to form Carnegie-Mellon University, with a total endowment of almost $120,000,000. Before going to Carnegie Tech, Dr. Stever served on the MIT faculty

for more than 20 years, including the positions of Head of the Departments of Mechanical Engineering, Naval Architecture, and Marine Engineering. He is an internationally known expert on aeronautical engineering and space technology.

Among other organizations, Dr. Stever is a member of the National Academy of Sciences, National Academy of Engineering, Institute of Aeronautical Sciences, American Physical Society, American Institute of Aeronautics and Astronautics, and Phi Beta Kappa. He is married to the former Louise Risley Floyd and has four children.

STATEMENT OF DR. H. GUYFORD STEVER, SCIENCE ADVISER TO THE PRESIDENT, AND DIRECTOR, NSF; ACCOMPANIED BY DR. DONALD SENICH, DIRECTOR, ADVANCED ENGINEERING RESEARCH & TECHNOLOGY DIVISION, RESEARCH APPLICATIONS DIRECTORATE, NSF

Dr. STEVER. Thank you, Mr. Davis. I appreciate your opening remarks. Each year I appreciate them more.

I appreciate especially the opportunity to discuss with you this bill, H.R. 17400, the Synthetic Liquid Fuel Research and Development Act of 1974, and the efforts now underway by the Federal Government to explore the potential of this energy resource.

Let me first depart from my prepared remarks to say in your presence that Mr. Perkins' statement was one of the best statements I have ever heard to defend the point that R. & D. is a good investment, and that the best stockpile is that of knowledge and know-how, and I just wish that we could have that statement entered in the record when I come up to defend the National Science Foundation budget in front of many of you.

Mr. DAVIS. We'll have it chiseled in marble.

Dr. STEVER. Thank you.

This fiscal year marks the initiation of a major expansion in the Government's energy R. & D. program. Both the legislative and executive branches of the Government have been engaged for some 18 months now in hammering out the priorities of Federal support for energy research and development. Many individuals and groups have participated in developing these priorities, and this effort is still very much in progress. Some of the significant steps that, although late, are significant, according to Mr. Perkins' testimony, are:

The recommendations of Chairman Dixy Lee Ray to the White House in December 1973, just about a year ago, based on the deliberations of many interagency panels with expertise in specific energy R. & D. areas.

Those words cover a lot of blood, sweat, and tears. I was part of that exercise. My team at NSF participated with the others, and, I want to tell you, some of them were working night and day to come out with those reports.

The rapid passage by Congress of the special energy R. & D. appropriation last year;

The Project Independence report, in which 21 task forces participated, and which is now under review by the Energy Resources Council, recently established by Congress; and

The deliberations of the 93d Congress on energy policy and organization and the passage of key legislation in this area—most notably,

Public Law 93–438 establishing ERDA, the significant solar and geothermal energy statutes that originated here in the Science and Astronautics Committee, and the Nonnuclear Energy R. & D. Act of 1974, which is expected to go to the President for signing this week.

The Federal energy R. & D. budget for fiscal 1975 is expected to increase more than 50 percent over the fiscal 1974 level, reaching a total for direct energy R. & D. of about $1.5 billion this year. The budgets for coal and oil shale are tripling. The projections for future years, in the area of synthetic liquid fuels, as in all other energy areas, are under continuous review and revision, based on changing conditions of resource availability, price, technology, private investment, and their complex interrelation.

There is much interest in the potential of synthetic liquid fuels, not only in this country, but worldwide:

You all know that the Canadians have a commercial plant in operation that produces synthetic liquids from the Athabasca tar sands;

A commercial facility in South Africa is producing gasoline and other fuels from coal, using the Fisher Tropsch process developed by the Germans during the Second World War;

There is discussion in Germany of reestablishing their liquids-from-coal program, from which 100,000 barrels a day were provided for their military use in World War II;

Poland is proceeding to construct a pilot liquefaction plant based on American technology; and

Japan hopes to have a plant in operation by the early 1990's for manufacturing syncrude oil from coal. By far the most extensive R. & D. effort in synthetic liquid fuels today is in the United States. Many industrial companies and several Federal agencies are actively engaged in or supporting research and development on the production of synthetic liquids from a variety of sources, including coal, oil shale, and tar sands.

Most of the major oil companies have initiated or participated in investigations for the production of synthetic liquids. You will hear this morning about the work of the Ashland Oil Corp. in this area. The Canadian tar sands plant I mentioned earlier was a development of the Sun Oil Co. The Colony Development Co. has pioneered in surface retorting technology for the production of synthetic liquids from oil shale. Gulf and Exxon both have R. & D. programs in coal liquefaction. The Electric Power Research Institute, a new institutional arrangement on the horizon, has supported the construction and operation of a small pilot plant at Wilsonville, Ala., to produce solvent-refined coal—a product from which much of the sulfur and ash has been removed.

Mr. Chairman and members of the committee, here is some of that liquid fuel, or almost liquid fuel. This is actually in a solid form, but it can be blown into a boiler and burned. It melts at 175 degrees centigrade, and it is a very fine material.

Mr. DAVIS. It has to be blown through a tube?

Dr. STEVER. Yes. It is a fine dust, or small particles, and it can be blown into a tube.

Mr. DAVIS. I was trying to transfer 175 degrees centigrade into fahrenheit.

Dr. STEVER. Nine-fifths times degrees centigrade plus 32—350. I didn't make the calculation. Dr. Senich, who's with me here from RANN, quickly whispered it to me.

Mr. DAVIS. That's more than 150 percent of the boiling point of water.

Dr. STEVER. Yes.

Mr. HECHLER. Who produced this, Guy?

Dr. STEVER. This came from a small pilot plant at Wilsonville, Ala., that was constructed by a subsidiary of Air Products & Chemicals, Inc., with funding from EPRI and Southern Services. I believe it's also associated with our project down there at Auburn University.

Dr. SENICH. Yes.

Mr. SYMINGTON. Would the gentleman yield?

Is the sulfur stacked up in piles?

Dr. STEVER. I don't think they're producing enough to produce large piles yet, but some day that will have to be handled. Is it liquid?

Dr. SENICH. It comes out as a sulfide, sir, and it has H_2S as a gas also. You have to scrub the H_2S with caustic soda in order to take it out.

Mr. HECHLER. Is it true that sulfur now is taken out in all of these various processes that you've mentioned, or in some of these processes? Is there sulfur left?

Dr. STEVER. I'll have to ask Dr. Senich. Certainly, that's one of the objects of it.

Dr. SENICH. Sir, the object of liquefaction is twofold: one is to liquefy the fuel and the other is to get rid of the sulfur. That's what we're trying to do in almost all situations, desulfurize the coal.

Mr. HECHLER. So there really isn't any preference, so far as elimination of a higher degree of sulfur in all these various processes?

Dr. SENICH. It's our desire that—the eastern coals are all high sulfur coals—and the idea is to make them usable coals, to produce low sulfur oil. All the eastern coals are essentially high in sulfur.

Mr. HECHLER. I'd just like to object to that statement. We have a tremendous amount of low sulfur coal.

Dr. SENICH. I'm sorry, sir.

Dr. STEVER. Most of the high sulfur coal is concentrated in the east, but not all the eastern coal is high sulfur coal, is that correct?

Mr. HECHLER. That is correct.

Mr. DAVIS. As a former judge, I'd like to say I'll sustain the objection. [Laughter.]

Mr. MCCORMACK. May I ask a question?

Are the sulfur materials, all noncombustible materials, in the coal taken out of the system?

Dr. STEVER. The product is a very fine product.

This plant, by the way, is part of an overall EPRI program in coal liquefaction that is funded at more than $6 million a year. Wheelabrator-Frye has recently announced plans for a feasibility study of a 1,000-ton-per-day plant that would produce a solvent-refined coal product for use by the Southern Utilities Co. Combustion Engineering has developed a variation of this process that is receiving worldwide attention.

In addition to these efforts by private industry, R. & D. programs in synthetic fuels are underway at the Federal, State, and local levels

of government. The city of Seattle, for example, has a project to produce methanol from municipal waste for use as a substitute fuel by the city's transportation fleet.

Mr. DAVIS. Excuse me. Is that Combustion Engineering a Chattanooga plant?

Dr. STEVER. I'm not sure. Combustion has a plant in Connecticut. Dr. Zahradnik will testify on that later. Where is the research being done?

Dr. ZAHRADNIK. Windsor, Conn.

Dr. STEVER. Windsor, Conn., the Connecticut plant of Combustion Engineering.

In Congressman Perkins' home State of Kentucky, a large State-supported effort is underway to investigate coal gasification and liquefaction, and other States have announced similar plans already noted, the Federal Government commitment to R. & D. on synthetic fuels from coal and oil shale will almost triple this year. This effort is concentrated in the Office of Coal Research and the U.S. Bureau of Mines of the Department of Interior. You will hear about the details of this activity from the Office of Coal Research later this morning. The OCR witness, Dr. Raymond Zahradnik, is one of my best technical experts. He is currently on detail to OCR from the Office of Energy R. & D. Policy at NSF.

Mr. Chairman, let me deviate from my testimony.

I have here in the notes circled, "Plug RANN here," and I want to.

Mr. DAVIS. You could say "RANN plug."

Dr. STEVER. One of the objects of RANN is to do early exploration in fields which, hopefully, will suddenly open up to much wider interests, and here in this field we have done so, and the way we are transferring that to even bigger operations is, in part, transferring people, and Dr. Zahradnik is a prime example of how we are helping out in that way.

By the way, we are about to begin the same process in the field of solar energy and geothermal energy.

I was very pleased yesterday to have the time arrive in which I would write a letter to Bob Seamans congratulating him on his confirmation by the Congress and the Senate, and saying as soon as he was sworn in I would like to have a meeting at which we discuss the most rapid transfer of solar energy and geothermal development. That's a letter I've been looking forward to writing for a long, long time. We promised you we would write it and carry it out, and we're now in the process.

Mr. DAVIS. May I, as a matter of curiosity, ask you how you define solar energy?

Dr. STEVER. Solar energy spreads over a very large array of programs. The large-scale transfer of solar energy fom NSF to ERDA will involve primarily the heating and cooling of buildings. But it will also include some other research in programs that are aimed at central power generation, electrical power generation.

Mr. DAVIS. Would you say temperature gradients in the ocean is solar?

Dr. STEVER. Yes. I suspect that these areas, which are further away from practical application, would stay within NSF for a while, but

solar energy certainly does include them. We would transfer whenever one of those programs came into the development stage, or even to an advanced research stage, when ERDA felt they wanted to take it over.

Mr. DAVIS. Then, of course; there are the atmospheric phenomena that have been associated with solar.

Dr. STEVER. Yes. The wind phenomena. Yes, we have just signed a transfer of funds—the National Science Board approved this within the last week or two—to NASA, for a major wind energy program.

Mr. DAVIS. And you would include that within the concept of solar energy?

Dr. STEVER. Yes, certainly.

Mr. MCCORMACK. Mr. Chairman.

Mr. DAVIS. Mr. McCormack.

Mr. MCCORMACK. I've been sitting here listening to this colloquy with some interest, trying to put myself in your place, Dr. Stever.

Mr. DAVIS. That's not easy.

Mr. MCCORMACK. I recognize the difficulty with the definition of NSF's responsibility and its jurisdiction, and I do want to congratulate you for taking an initiative to provide such transfers that seem appropriate at this time.

I wonder if it would be presumptuous if I would suggest that, if it wouldn't be out of order for you in the very near future, even in January, if you would be prepared to write a letter to us describing how you see the status of these various programs, and in the very indirect monitoring of programs, where you see NFS's role, how far you see it going, where you see it transferring, at what point in the development do you see it transferring, and to whom?

I think this would help us a great deal as we look at the budget and the recommendations for programs' budgets, because we are going to have the problem of defining your budget and their budget, and it would help within this committee if we had that information.

Dr. STEVER. We would be glad to. In fact, we are preparing for that kind of discussion right now and that kind of thinking. It's a very important thing because we would like to know, as well as you, what these lines will be. But we are very determined to help Bob Seamans get off to a flying start with ERDA.

Mr. MCCORMACK. We are very interested in helping both of you. I'm sure you understand that.

Dr. STEVER. Yes; I do. I know that.

Mr. DAVIS. I'd like to make a little comment along that line.

We have to constantly remind ourselves on this committee that we are largely engaged in prenatal care, and as soon as something becomes a shelf item then we hand it to somebody else.

Dr. STEVER. Yes. Prenatal care has features on both sides of the ledger, the positive and the negative side.

Mr. DAVIS. Yes.

Dr. STEVER. Let me speak to the NSF program now in coal liquefaction.

Under the RANN program, we support the work of the Department of Interior. Because we have an extremely good interchange with them, with their people coming to our reviews and our people sitting in on theirs, I think that we, in fact, have put together a joint program

covering as many of the aspects of the job as could properly be covered.

Our effort emphasizes fundamental and innovative aspects of converting coal to synthetic fuels, in an attempt to understand processes that can produce clean burning fuels from coal for use in electrical generating facilities. The fuels thus produced could also be upgraded to gasoline and other transportation fuels through refining. My personal feeling is that there will come a time when this is where we get the fuels for the prime moving vehicles that we use so abundantly.

Support for three university-industry teams accounts for the major part of the Foundation's program in this area, and will account for about a million dollars this year, and, again, let me remind you that another object of RANN is to make sure that university and industrial teams are brought together on important problems of national need, and here are some examples of this:

Pennsylvania State University and Gulf Research and Development Corp. are engaged in a joint research effort on the relation of coal characteristics to liquefaction behavior. The overall objective of this research is to relate the properties of different coal stocks to the yield and composition of the liquid and gaseous products obtained during liquefaction. The results are expected to help in producing optimum yields of synthetic liquids and gases, and will provide valuable information for the siting of commercial coal liquefaction plants.

Auburn University, in Congressman Flowers' home State, is conducting research on solvent refined coal, working in cooperation with Southern Services' pilot plant at Wilsonville, Ala., and with the Electric Power Research Institute, and they're the ones who came up with the sample that we gave you. There is an economic advantage if both sulfur and residual mineral matter can be removed in the same process prior to coal combustion—a technique known as solvent refining. The research on this process is concerned with its chemical and physical aspects, in order to develop basic models for evaluation purposes.

Still another combination, the University of Kentucky and Ashland Oil Corp. are engaged in cooperative research on the production of synthetic oil from coal. This project is concerned with the cost factors in coal liquefaction, including hydrogen production, removal of mineral matter from reacted coal slurry, catalysis of liquefaction, and gasification of coal char. Innovative research in these areas has the potential of providing significant improvements in the economics of large-scale coal liquefaction.

The remainder of the NSF coal liquefaction program involves support for four research projects intended to complement the major university-industry efforts I have described. They include research on catalysis, on the physical separation of ash from liquefied coal by magnetic devices, on sulfur removal in the solvent refining of coal, and on the feasibility of producing liquid coal products by alkylation. This latter technique has the potential of of less severe reaction conditions than under present processes and possible savings in overall hydrogen requirements.

May I now turn to H.R. 17400?

You have gathered so far that I think the reason behind H.R. 17400 and the proposal to get on with the job is an excellent one. However, I would like to bring up a caveat.

H.R. 17400 would amend the NSF act, authorizing the NSF Director to establish an R. & D. program for synthetic liquid fuels. This program would include technical and financial support for research on synthetic liquid fuel production and for demonstration projects, including commercial-size liquid fuel plants. It authorizes such sums as are necessary over the 3-year period from fiscal 1975 through 1977.

As you know, the Energy Reorganization Act of 1974, was signed into law on October 11, 1974, the day after H.R. 17400 was introduced. The ERDA legislation provides for consolidation of the major elements of the Federal effort in energy R. & D. under one agency—the Energy Research and Development Administration. As I have testified on many occasions, I strongly endorse the establishment of this new energy agency. I believe that this centralized coordination and the mandate to move rapidly with an aggressive energy R. & D. program will provide an effective structure for achieving our national energy objectives, including those in synthetic liquid fuels.

The ERDA legislation specifically provides for the transfer of the Office of Coal Research and the fossil fuel energy R. & D. programs of the Bureau of Mines to the new energy Administration. The legislation also specifies that one of the six presidentially appointed Assistant Administrators of ERDA shall be responsible for fossil energy.

In addition, the House of Representatives yesterday approved the Conference Report on S. 1283, the Federal Nonnuclear Energy Research and Development Act. This legislation spells out the responsibilities of the ERDA Administrator for the entire range of nonnuclear energy R. & D. He is specifically directed to "accelerate the commercial demonstration of technologies for producing syncrude and liquid petroleum products from coal," and to "demonstrate the production of syncrude from oil shale by all promising technologies * * *"

In view of the responsibilities assigned to ERDA and the broad authority already vested in NSF for the support of research in all science fields, I do not believe that the provisions of H.R. 17400 are necessary.

In this connection I should like to emphasize once again, as I have on other occasions, that the National Science Foundation Act has unique qualities of breadth and flexibility. This allows the Foundation to place emphasis on high priority research as national requirements dictate. As these priorities change, we have the flexibility to change with them. I believe that we should retain this flexibility. Furthermore, I believe that the authority to support the demonstration of commercial-size liquid fuel plants, as proposed in H.R. 17400, is not an appropriate mission for the Foundation and would create a serious dislocation of its programs. The development and demonstration of synthetic liquid fuels, which is without question a matter of high national priority, is clearly a responsibility of the new Energy Research and Development Agency.

I can say, Mr. Chairman, that the National Science Foundation will help ERDA in every possible way, not only in this field, but in others, and we would look forward to an orderly transfer of the work that we are doing when it approaches development, or when they believe they should be involved in applied research.

I think we have a good combination, in the National Science Foundation and ERDA, and the other mission agencies.

The NSF is constrained to operate with basic research and applied research, but not development. It can move quickly in the fields of basic research and, as they show promise, in applied research. We can carry the bill for a while, and when these programs begin to grow big and important in the everyday affairs of men, we can transfer them to mission agencies and go on to other subjects, and that's the whole philosophy around my attitude toward this bill, a fine objective for the bill, but I really think it belongs to ERDA rather than NSF.

Thank you.

Mr. DAVIS. Thank you very much, Dr. Stever.

One or two thoughts occur to me, and that is I've been applying my mind to the difference between applied research and basic research over a number of years, and I recognize that within the family of NSF there has been some problem area as regards whether or not RANN itself belongs in NSF, and the extreme difficulty you run into when, on the one hand, you are trying to just simply find out something that's not known, and, on the other hand, you are accepting a problem and trying to solve a problem, which I personally regard as the difference between basic and applied research.

I wanted you to comment, if you would, on your view of the degree of acceptance that RANN has found in joining the family of NSF.

Dr. STEVER. I'm glad to.

First of all, the question that you brought up, how you categorize the business of research, both basic and applied, has puzzled people in the field.

There is a very large body of people who approach the search for knowledge, the basic research saying, "Don't attach it to an objective, because you'll make faster progress that way."

There is another group that believes that attaching research to an objective will make faster progress.

My personal feeling is that the National Science Foundation should be prepared to get the best out of both of these kinds of people, and having both an SRPS, Science Research Project Support in one part, and that, by the way, is our largest program, and the RANN program on the other hand I think we can tap both kinds of groups, and I think that you will find that while there are problems because we do operate these two differently, and there are problems inside and outside, I think the country is benefiting by the very fact that we do tap the best from two kinds of different groups of people out there doing research.

Mr. DAVIS. Or two approaches.

Dr. STEVER. Yes. And I don't mind if there are problems within NSF, with one group saying I'm favoring the pure basic research, and the other saying I'm favoring applied research, as long as each is saying that I'm favoring the other, I have a pretty good balance.

Mr. DAVIS. So that there's peace in the family.

Dr. STEVER. Well, peace, like in any good family, has some inside arguments. But I think we're doing something with these two things. I think it's a good thing to have both.

Mr. DAVIS. I'm glad to hear that.

Dr. STEVER. I will also say one other thing. I'm very glad that ERDA is coming along, and we've got a big thing to transfer from RANN,

because that's what we said all along, when applied research got to be development we were going to transfer it to a mission agency, and we're going to, and it's well along the way, and we will give the report that Congressman McCormack asked for, and when we testify before your committee this next year we will show how we are doing.

Mr. McCormack. May I suggest that you submit that also to Congressman Symington?

Dr. Stever. Yes, certainly to Congressman Symington. We will be submitting things to Congressman Symington regularly.

Mr. Davis. Mr. McCormack.

Mr. McCormack. Thank you, Mr. Chairman.

Dr. Stever, you wear two hats. As to the research on oil liquefaction and oil gasification, how about the Office of Energy Policy? Does this fall under your hat as the President's Adviser, or as the Director of NSF?

Dr. Stever. I think it started with me as the President's Adviser, but don't forget that part of the rationale for naming me as Presidential Science Adviser was so that from time to time I could use the broad capabilities of NSF, which I have done, and quite often we will find an Office of Energy Policy group, primarily there for the Science Adviser working with the RANN group or others to help me as Science Adviser.

It's obvious that Dr. Seamans will have some very strong policy people on his staff, and they will be carrying on some major work.

We will probably keep some effort in the field, perhaps not as large as we did, but also pointing, perhaps, at some different areas. For example, the problem of energy, environment, and the economy. There is a kind of a three-way confrontation that I think we will be with as a nation all the rest of our living days.

Mr. McCormack. May I send you my latest speech? That was its title.

Dr. Stever. I think I read it. Maybe I even heard it over at the AIChE. I was there.

Mr. McCormack. Yes, that's right, you were there.

Dr. Stever. But in this confrontation, one fellow will light on one position and the other on another, but there will be lots of studies and thinking about what should be the science policy in the area. I think we can help in NSF on that.

So we're anxious to help Bob Seamans get started in ERDA with his policy analysis and policy work, and we're also anxious to do some work for ourselves. We will work together.

Mr. McCormack. When Dr. Seamans was being confirmed at his confirmation hearings, they asked him if he intended to try to establish a national energy policy within ERDA, and whether he intended to see ERDA as a vehicle for the development of a national energy policy. His answer was somewhat reserved and moderately qualified, but he still seemed to be saying about 95 percent yes.

So I take it that you see your Office Of Energy Policy as working within a relaxed relationship with ERDA in this particular effort. Is this the way you interpret this?

Dr. Stever. Yes; I certainly do. I think that I've learned a long time ago that in Government no one gets a monopoly, and energy policy is

pretty important, and I think at the highest levels of Government, including the Energy Resources Council, they will be involved in writing our energy policy. I think that ERDA will be involved in that, and we'll all be participating together.

I would say that I have a great belief in research and development, and the energy R. & D. policy of 20 years from now is going to be dictated by the successes and failures of the people in research today.

Mr. McCormack. I wish you could make that a banner about 12 feet high and nail it clear across, all the way from the White House to the Capitol so people would understand that fact, that energy policy will be determined by energy R. & D.

Dr. Stever. That's right. Of course, in the long term, I've said that. In the short term I'm not so sure that you want R. & D. people working on all of the problems that we have in energy. But nevertheless, they should participate and be part of the team, and be a strong part of the team, and be a supportive strong part of the team.

Mr. McCormack. Specifically, one question. I don't want to take too much time here.

How do you see NSF and RANN operating in energy R. & D. and related projects? Do you see this on your own volition, or at the request of ERDA, or how do you see it?

Dr. Stever. Personally I think that NSF should have the right and the responsibility to go out on its own violition to explore areas that it feels someone isn't exploring properly, or to take quick advantage of some research that comes out of our basic research program—however, but not in great confrontation to any other agency, but in cooperation with them, which we do all the time. RANN is involved in many cooperative programs. Many of these agencies are delighted that we're participating because we bring a little something different to the program and we can move reasonably rapidly. We have good ways of working with the academic community. Relaxed, I would say RANN should be relaxed, and that we're not trying to get a monopoly on it. We're out there trying to make early explorations; move it along; prove them, whether they're good or bad; pass them on if they turn out to be good.

Mr. McCormack. Thank you, Mr. Chairman.

Mr. Hechler. Mr. Chairman, I would like to say that I strongly endorse what you said, Dr. Stever as to the proper role of RANN and NSF, and I think you defined it as to being in the public interest very intelligently.

You mentioned, not in your prepared testimony, but in your extemporaneous remarks, that the time would come when all forms of transportation are fueled by the kinds of product that we're discussing here.

I realize you're on the research, not the operational side, but can you give us some kind of a general timetable, not in terms of 100 percent, but in terms of when this process will become sufficiently economically and commercially available so that the time will come? When is the time?

Dr. Stever. Mr. Hechler, I think it will probably come earlier than we expect. I'm sure—I'm almost sure—that it will come sometime in the 20- to 40-year period, but if that's the case, we've got to get along on it now.

Mr. HECHLER. Isn't there any way that we can speed that up, because it's a real key question?

Dr. STEVER. I think, that certainly it can begin to contribute at an earlier time, but, as was pointed out by Dr. Senich, the liquefaction programs that we have here have multiple objectives. One is to get the sulfur and the other unpleasant contents of coal out so that we have a nice, clean fuel, that is essentially a substitute for bunker oil, you know, in the boilers, to generate steam for electricity. That, I think, can come early. Now, how much of an impact—our groups have made studies on them—I am always a little bit questioning as to the specifics of a particular year. That will come along earlier. As soon as the nice oil begins to dry up in the world, then we will go on to the next stage, and make nice, high order ethylene and propylene products out of this liquefied coal. When the economics of the situation will dictate change, I am not exactly sure. I'm quite sure it will come, because you just look at the relative supplies of these two and realize the importance of the coal reserves that we have.

What was the prediction of the liquefaction timetable that came out of the studies that you people have made?

Dr. SENICH. Sir, the kinds of times we've talked about are up about between 1990 and 2000 that we can start seeing a contribution. But, again, it's not on transportation fuel as much as it is on bunker fuel.

Mr. HECHLER. Just as this committee, I think, served a very useful purpose in the early days of the space program, when many people were talking in the far, far future, and some thinking that it couldn't possibly happen, and this committee, I believe, took the leadership, not only in space but in science to speed up that timetable.

While I'm just speaking as one member of the committee, and I'm sure the other members of the committee share this, we are going to do everything possible to speed up this timetable that you've indicated.

Mr. SYMINGTON. Would the gentleman yield?

Mr. HECHLER. Go ahead.

Mr. SYMINGTON. As Dr. Stever said, as soon as the oil sources begin to dry up——

Dr. STEVER. Or get too expensive.

Mr. SYMINGTON. Well, you see, that's now. That's here. So why don't we, therefore, liquefy it?

Dr. STEVER. This matter of too expensive to us is a very unusual word, because the fact is that although it's awfully expensive we are buying it, and our economy is suffering from it.

I think that we are talking about a piece of economics that is a little hard to pin down with exact dates, and so on. There will be pressures back and forth. Because if we were to develop this liquid fuel, obviously that would force the price of gasoline down, or at least I think it would, and certainly if no one were buying that oil it would force it down. But perhaps other countries will continue to buy it at the high price.

I don't really think honestly, at this stage, that we have to pin down that year precisely. What we know is that we've got to bring it here as soon as we reasonably can, and reasonably is, I feel, a sense of urgency.

Mr. SYMINGTON. Of course, that's Congressman Perkins' thoughts.

Dr. STEVER. Yes, sir.

Mr. SYMINGTON. We must not allow a timetable to oscillate with the rules of economics with the policies that we have now, and not let it be interrupted by sudden change.

Dr. STEVER. Mr. Symington, I agree. I think that consistency and determination in R. & D. policy is very important, because we have ups and down in the economy.

But, as I said earlier, his statement was a wonderful statement that the best stockpile is R. & D. knowledge and know-how, and had we stockpiled it earlier, according to his tale, we would be benefiting today.

Mr. DAVIS. The inevitable question now. We've used the word "fuel" a whole lot this morning, and the word "energy" a whole lot.

What are we talking about? Just the use for heat?

Dr. STEVER. Well, energy is used in a number of forms. In this case the fuel is the original source of the energy in whatever process we start it through, and the energy is transformed into various things in various ways.

By the way, Congressman McCormack gave a very strong statement of the important future of nuclear power, and I agree with that, and, in fact, it may be that we will be using nuclear power, too, in the conversion of many of these chemicals to useful applications as fuel.

Mr. DAVIS. What I was interested in is just using it as a source of heat.

Dr. STEVER. In the case of the use in the boilers, it would be a source of heat to generate the steam, to generate electricity. In the case of the automobiles, it would be, when we get to that stage, essentially to generate mechanical power.

Mr. DAVIS. And a hydroelectric plant.

Dr. STEVER. In the case of the generation of electricity it would replace the hydropower energy stored in the water.

Mr. DAVIS. Which is essentially a bank?

Dr. STEVER. Well, it's a storage device.

Mr. DAVIS. A storage of energy.

Dr. STEVER. Right, it's a storage of energy.

Mr. HECHLER. Dr. Stever, I have absolutely no parochial interest in this subject, in approving the plant you mentioned in West Virginia. But when you use the phrase "as soon as reasonably possible," if you have to do it unreasonably 3 years earlier, we will defend you.

Dr. STEVER. And I will take full credit, too.

Mr. HECHLER. The average person listening to your discussion of experiments in many other nations: Canada, Poland, Germany, and other nations, and the extent of research which you have going on, and various techniques, in various States, would draw the conclusion that you really aren't in favor of what you call, on page 8, "centralized coordination."

It gives the impression of multiplicity, of using things going on technically in many areas in different ways.

I'd just like to get clear in my own mind how you achieve this centralized coordination, which ERDA's producing and, at the same time, have what Franklin Roosevelt used to describe as "the necessity of having a lot of competing things gonig on," so that he has command of the situation.

Dr. STEVER. I think it would be a mistake if we put all of the Federal money through ERDA into a single company's development, for example. I do believe in the competitive process and tapping the ingenuity of a large number of organizations. In fact, I think that the fact that we do it that way is the main reason we are still leading in technology in the world, and I'm thinking of ERDA as being the flight carrier, the point that gathers all of our strengths together, that makes some judgments about the competition, and doesn't just select one.

I'm not saying "centralization," and I would not want it to be centralized in a single Government laboratory. I think we've got to tap the whole Government and the others.

Mr. HECHLER. Thank you, Mr. Chairman.

Mr. THORNTON. Thank you very much, Dr. Stever, for your testimony.

With regards to your anticipation that in the future all forms of fuel will come from alternate sources, and just looking briefly at the unpleasant alternatives which might be available, do you agree that if you did not provide for an orderly transition in research and development of alternate fuel sources that transportation in the future might well be furnished by hay burners?

Dr. STEVER. Yes; I'm a little worried about that. But I really do believe that our job in R. & D. is to bring along several different forms, and this is right now one of the very important forms. I suspect hay is still an important thing.

Mr. THORNTON. I think that we do have the capacity to avoid that consequence. I think it is a major step that has to be taken by our society now, faced with the limitations, and I'm pleased that you agree with that.

Dr. STEVER. Thank you.

Mr. MCCORMACK. Are there any other questions? Mr. Symington.

Mr. SYMINGTON. Thank you, Mr. Chairman.

Someone suggested—I believe it was Mr. McCormack—that you send a letter spelling out what you think would be the divided responsibility of NSF and ERDA.

I think the chairman mentioned solar energy. Perhaps in all forms of energy you will have some view as to that proportion of basic or midbasic that you retain in NSF.

Dr. STEVER. Yes.

Mr. SYMINGTON. Whatever comes over will be helpful, I think.

Dr. STEVER. In our hearings this spring I would like very much to talk about NSF vis-a-vis the other agencies in the role of basic and applied research, and also in the letter to you.

NATIONAL SCIENCE FOUNDATION,
Washington, D.C., February 26, 1975.

Hon. MIKE MCCORMACK,
Chairman, Subcommittee on Energy, Research, Development, and Demonstration, Committee on Science and Technology, House of Representatives, Washington, D.C.

DEAR MR. MCCORMACK: In response to questions raised by Congressman Symington and you during the hearing last December on H.R. 17400, "The Synthetic Liquid Fuel Research and Development Act of 1974," I would like to take this opportunity to spell out further the Foundation's role in energy research and development and, specifically, its role in relation to the new Energy Research and Development Administration.

As you know, ERDA became operational on January 19, 1975, through Executive Order No. 11834. In my letter to you of January 17, 1975, I informed you that the major part of the Foundation's solar and geothermal energy programs would transfer formally to ERDA as of January 19, 1975.

The purpose of this letter is to discuss the considerations underlying the ERDA transfer and, at the same time, address the questions raised by Congressman Symington and you concerning our anticipated future activities in the energy area.

As I stated in my testimony at the synthetic fuels hearing, the National Science Foundation has, through its enabling legislation, unique qualities of breadth and flexibility. While maintaining a strong program of support for all fields of science, the Foundation is able to emphasize those areas of research that it considers to be of especially high priority. With respect to applied research, this flexibility has been especially helpful in permitting NSF to support projects related to areas of national concern.

It was, in fact, through the exercise of this kind of initiative that NSF first began, early in this decade, to expand its support of research on solar energy for terrestrial use, becoming the major source of Federal support for such research over the last five years.

The Foundation does not, however, have authority to conduct or support the conduct of development and demonstration programs. We have stressed this point on a number of occasions, as you know, both in testimony before the Science and Astronautics Committee and before other committees of the Congress. Thus, for example, my testimony on H.R. 17400 in December stated that NSF was not the appropriate agency to provide support for demonstration projects, including commercial-size liquid fuel plants, in the area of synthetic liquid fuels production. Furthermore, we have never sought such authority. It is our view that the support of large-scale demonstrations of specific technologies would be contrary to the Foundation's primary responsibility for the health of science and scientific research across the entire range of the sciences, and that severe imbalances in the Foundation's programs would be created. We have sought, instead, to retain our flexibility to explore areas where we consider current research efforts are insufficient, where we believe there is a potential for significant results, or where we believe important national interests can be served, either in the long or the shorter run.

In its support of both basic and applied research, the Foundation often works in close cooperation with other Federal agencies, and we regard interagency cooperation as an important aspect of our management responsibilities. Such cooperative endeavors are illustrated by our close ties with the National Aeronautics and Space Administration (NASA) and the Office of Naval Research in lunar planetary and space science endeavors; with NASA and the former Atomic Energy Commission, and the national laboratories of both of these agencies, in energy research; with the Department of the Interior in fossil fuel research; with the Department of Agriculture in pest control and resources research; with the Environmental Protection Agency in environmental research; and with the National Institutes of Health in research in the life sciences. We are working closely with the new Energy Research and Development Administration and I believe we are laying excellent groundwork for future cooperation.

I can assure you that the Foundation has every interest in seeing the potential of its research support realized. We will make every effort to turn over to mission agencies or other user groups research that has reached a point where working-scale systems should be demonstrated and tested.

The recent transfer of a significant portion of our fiscal year 1975 energy program to ERDA is a good example of this approach. Out of $67.3 million allocated to NSF for its fiscal 1975 solar and geothermal energy programs, we have transferred $51.7 million to ERDA as of January 19, 1975. In making this transfer, we are turning over several research programs that have been major elements in the RANN energy program and that may now be considered to be at the advanced proof-of-concept stage. In other words, a sufficient research and technology base is now available to begin development and demonstration of operational systems. These programs include the solar heating and cooling of buildings, wind energy conversion, and geothermal energy development. Included in the transfer are programs in bioconversion to fuels, ocean thermal conversion, and energy storage which have not yet reached the stage of development and demonstration. Nevertheless, research in these areas has progressed satisfactorily and we believe it can be continued most effectively in conjunction with other energy programs under the ERDA umbrella.

Once ERDA reaches full operational status, NSF will continue to play a role in the energy area. This will include support of both basic and applied research, helping to ensure that opportunities in energy research are not missed but are, in fact, exploited for the overall national benefit. The Foundation's research efforts will be focused at the forefront or cutting edge of the research spectrum, thereby preserving its flexibility to pursue promising new leads at the point of discovery. In addition, the Foundation expects to play a role in scientific manpower activities related to energy, drawing on its experience in this general area.

Thus, we plan to continue our support of energy-related general research, not only because of its potential application to energy technologies, but also its application to an improved understanding of problems and processes. We have identified many sub-fields, including interdisciplinary areas, of science as important for the energy problem, and we plan to support and encourage these areas strongly.

In addition, we believe it is desirable for NSF to support energy-related manpower activities in the future because of NSF's long-standing experience in science manpower studies and programs. It wil be ERDA's responsibility to assess energy manpower requirements, but NSF is in a position to relate these to the overall support and demand for science manpower in all fields and recommend possible programs accordingly.

Finally, we plan to continue support of energy-related research in the RANN program when such research has potential significance in addressing national needs and meets RANN's criterion for NSF support—namely, the problem falls between or outside areas of responsibility of other agencies, spans the areas of responsibility of other agencies, or is particularly suited to certain types of multidisciplinary research teams. While RANN is expected to have an active energy program, it will be at a substantially lower level than originally appropriated for this fiscal year—$22 million in fiscal 1976 in contrast to $93.4 million appropriated for RANN for FY 1975. The objectives of the planned RANN activity in solar and geothermal energy for the remainder of FY 1975 and in FY 1976 have been concurred in by ERDA management.

Dr. Alfred J. Eggers, Jr., Assistant Director for Research Applications, NSF, has worked closely with Dr. John M. Teem, Acting Deputy Assistant Administrator for Solar, Geothermal, and Advanced Energy Systems, ERDA, in developing and implementing the transfer. In addition, there has been close coordination of the NSF Director and the ERDA Administrator with each other and with OMB. Most of the NSF personnel who were involved in the solar and geothermal energy programs were also transferred to ERDA. This transfer of personnel should help to ensure continuity in the research projects as well as close working relationships between NSF and ERDA.

In FY 1975, the RANN program will continue to manage a $10 million advanced solar energy research program and a $6 million geothermal energy research program on advanced components, materials, and subsystems. Portions of this effort will be transferred to ERDA in the latter part of FY 1975 and in FY 1976. In addition, the Foundation expects to continue its support of advanced research in fossil fuel production techniques, energy generation and storage, advanced automotive propulsion, energy and fuel transportation, and energy systems studies. In fiscal 1976, RANN's solar and geothermal programs together are budgeted at $10 million (of which $5 million represents funds deferred from fiscal 1975). Efforts in energy conversion, storage, transportation, and systems will be reduced, with ERDA initiating programs in energy conversion and storage and in energy systems. The RANN research programs in fossil fuel, automotive propulsion, and energy transportation will be continued in fiscal 1976 with no comparable activity in ERDA. All of these programs will be managed in close coordination with ERDA.

I want to stress that in the field of energy or any other area where a mission agency has major Federal responsibility, the Foundation's role will be to support research that addresses the longer range aspects of the problem—to examine alternative and innovative approaches that are high risk but that have the potential of eventual payoff. In all of these areas, the Foundation seeks to complement the work of other agencies in the field, filling in where there are gaps in the stream of research and also probing new areas that would probably not otherwise be investigated.

I hope this letter clarifies the status of the National Science Foundation's energy research program and my view of the role the Foundation should play

in relation to other agencies, particularly the Energy Research and Development Administration. I will be happy to provide you with any additional information you may need.

The same letter is being forwarded to Congressman Symington.

With best regards.

Sincerely yours,

H. GUYFORD STEVER, *Director.*

Mr. SYMINGTON. Thank you, Mr. Chairman.

Mr. DAVIS. Dr. Stever, that's all we have this morning. We have two more witnesses.

We want to thank you very much for appearing.

Dr. STEVER. Thank you.

Mr. DAVIS. Our next witness is Mr. William Gammon, administrative vice president of the Ashland Oil Co., and he is accompanied by Charles Brown.

Mr. Symington, would you care to take over at this point?

Mr. SYMINGTON. Only to welcome both Mr. Gammon and Mr. Brown, and to point out that this is Charlie Brown from the seventh district of Missouri, which you so well represented a number of years, so the folks down there can make serious mistakes, and otherwise Congressman Brown would be sitting before us deciding for us what to do, instead of just telling us what we ought to do, and I'm delighted to see him appear before the committee, and I admire his great ability and distinction.

Mr. BROWN. Thank you.

Mr. HECHLER. I would like to join Mr. Symington in welcoming our former colleague, Charlie Brown, and also Mr. Gammon of the Ashland Oil Co. Ashland Oil Co. is a very important company, both in the Nation, and particularly in our area, and we're very proud of the work they're doing in this and other areas.

Mr. GAMMON. Thank you.

Mr. HECHLER. We're pleased to have you gentlemen.

Mr. BROWN. Thank you.

Mr. THORNTON. Mr. Chairman.

Mr. MCCORMACK. Mr. Thornton.

Mr. THORNTON. As to a parochial of my own, at this time I am pleased also to see Mr. Brown here, and we appreciate Mr. Brown's interest in the fourth Congressional District.

Mr. BROWN. Thank you.

Mr. MCCORMACK. Mr. Gammon and Mr. Brown, I've just glanced at your prepared statements, and it's quite obvious that we have run out of time.

Mr. BROWN. Mr. Gammon will do the talking.

Mr. MCCORMACK. If there is no objection, we will insert both of your statements in the record as they've been prepared, and you may submit any comments you would care to make.

Mr. GAMMON. Thank you, Mr. Chairman.

[The prepared statement of Mr. Brown and a biographical sketch of Mr. Gammon follows:]

STATEMENT

Committee on Science and Astronautics

U.S. House of Representatives

by

Charles H. Brown, Senior Vice President

The Oil Shale Corporation

If the dollar drain for foreign oil is serious enough to warrant consideration of unprecedented gasoline taxes or peacetime rationing, it is serious enough for domestic oil shale to be given a fair chance to prove or disprove its economic and environmental feasibility as an energy source for the future. The Soviet Union and China both utilize their oil shale, but our great nation, with the world's largest and richest deposits, does not yet have a single commercial-size oil shale plant in operation or under construction.

No one questions the vastness of our country's oil shale resource. The Project Independence Task Force analysis indicates there are at least 1.8 trillion barrels of oil in the Green River Formation of Colorado, Utah and Wyoming. This is eight times the known oil reserves of the Middle East and sixty times the largest estimate of reserves in Alaska. And it is here in the continental United States--domestic, embargo-proof oil.

The Oil Shale Corporation has spent years and millions of dollars in private effort to get oil shale off the ground. However, we believe this resource is much too important to America's future energy supplies to be left any longer solely to private industry to begin development at its convenience. We suggest that Government and Industry form a contractual partnership, sharing risks and gains to make sure that the first commercial-size oil shale facilities are underway as soon as possible. Without Government's active participation, years may pass without an answer as to the amount of oil we can expect from this unique domestic resource.

The Oil Shale Corporation (TOSCO) is an independent, publicly owned energy company, organized in 1955 for the purpose of developing a commercial technology for the recovery of hydrocarbons from oil shale. Today, TOSCO oil shale processes are recognized as the most mature of the first generation technology and our Company owns and leases extensive acreage of domestic oil shale lands in Colorado and Utah. We are at an advanced stage of development of the TOSCO technology for the recycling of scrap tires, together with the Good Year Tire and Rubber Company; and our research is well underway on the development of a unique coal processing technology. We are also an independent refiner of conventional petroleum, processing some 80,000 barrels of crude per day in our refineries in Arkansas and California.

For more than fifteen years, TOSCO has been a principal force in awakening America to the potential and feasibility of its oil shale. We have evaluated the resource, developed technologies and experimental operations. We have organized venture groups to demonstrate, in semi-works plant operations, the technical, economic and environmental viability of oil shale. We, and our various associates who joined with us, have spent more than $55 million of private capital

-- to mine underground more than 1.2 million tons of oil shale,using and proving conventional underground mining processes and equipment;

-- to prove that the TOSCO II process utilizes 100% of the ore that is mined, and recovers substantially 100% of the assayed hydrocarbon content of the shale, by sustained operations of the demonstration plant at its designed capacity of 1000 tons per day; and

-- to demonstrate advanced environmental control measures for our system encompassing, among other matters, spent shale disposal and surface restoration, air and water quality control, community assistance and planning, and protection of flora and fauna.

In 1974, the Colony Group (comprised of TOSCO, Atlantic Richfield, Ashland Oil Company and Shell Oil Company) participated in the federal prototype oil shale leasing program and was the successful bidder for Colorado Tract B, paying a cash bonus of $117.8 million for approximately 5,000 acres of oil shale lands.

This same Colony Group had hoped to announce the start of construction of the Nation's first commercial oil shale complex in 1974. Final pre-construction engineering plans for a 50,000-barrel-per-day facility on privately owned lands near Parachute Creek, Colorado, have been underway for seventeen months at a cost of more than $10 million. Applications for various government permits have been filed. The Bureau of Land Management has been preparing a project environmental impact statement.

However, the scheduled construction start has been suspended. In the general economic climate of September 1974, the Managing Contractor was unable to obtain responsible bids for major components. Suppliers were reluctant to sign commitments two or three years in advance of delivery; quoted prices were totally out of line with previous quotes; and escalation provisions to cover inflation were unprecedented.

In addition,there was also uncertainty about U.S. long-term energy policy vis-a-vis imports of foreign oil and domestic oil prices. So, construction of the Colony commercial plant had to be suspended, pending clarification of these uncertainties; and, once again, we who believe that the United States has a vast domestic oil supply in its shale deposits and should be doing something now to prove or disprove its viability, have not been able to get a commercial-size oil shale facility underway.

No knowledgeable person in industry questions the technical effectiveness of our first generation technology. The hydrocarbons can be extracted from the shale in commercial quantities by processes already developed. We are continuously improving technology; but what we have now is technically efficient and viable.

The fundamental undertainty which is delaying

commercial-size oil shale demonstration facilities is future crude oil prices. Some Government officials predict that OPEC countries will reduce them. The U.S. Ambassador to Saudi Arabia says that OPEC countries are more apt to increase them. One group of experts predicts $7 crude oil by 1980; another group predicts $20 crude oil. Moreover, uncertainty about future price levels is aggravated by the fear that oil exporting countries might engage in temporary and predatory price cuts designed to undermine the development of new energy sources within the oil consuming countries.

In the meantime, hopes for achieving lower oil prices are being frustrated by the spectacularly rising cost of finding and producing new oil. Indeed, the time may be rapidly approaching when our major concern will be reliable supplies, with the matter of price becoming a relatively less important consideration.

Perhaps it would help this Committee if TOSCO gave you its heretofore unpublished figures on oil shale capital requirements and production costs, based on cost analysis studies at the Colony semi-works plant operations and construction costs estimated by reputable contractors. First, let me emphasize that these figures contemplate the production of hydrotreated shale oil--a no-sulphur, finished fuel which is of premium value for use as is, or which can be further refined into gasoline, propane, lubricating oil and other petroleum products. These costs are not to be confused with costs of "raw" or crude shale oil which have been publicized by other sources.

In 1967, when TOSCO first went to a Managing Contractor to get estimates for an oil shale plant which would process 66,000 tons per operating day of high quality shale yielding 50,000 barrels per day of new shale oil with on-site refinery facilities capable of upgrading the new oil to 43,000 barrels of finished premium fuels per calendar day, the complex was estimated to cost $144 million; direct operating costs were $1.20 per barrel; and the hydrotreated fuel would have to sell at $2.36 per barrel to yield a 12% return on investment.

Since 1967, inflation has brought significant changes in those figures as the following chart

indicates:

Date	Capital Cost	Direct Operating Costs	Price for 12% Return
1967	$144,000,000	$1.20	$2.36
1972	255,000,000	1.82	5.00
1974 (Sept)	653,000,000	4.77	12.50

The 1974 figures are based more on suppliers questimates than on bonafide bids and are viewed as "outside" costs for hydrotreated shale oil which has a premium value. TOSCO estimates that a similar facility producing raw shale oil would cost $510 million in September 1974 dollars with direct operating costs of $3.30 per barrel, necessitating a selling price of $9.50 per barrel.

For comparison purposes, Arabian light crude oil with 1.7 weight percent sulphur content is currently selling for about $12.00 per barrel in Houston, Texas, including transportation costs from Mid-East ports; Indonesian crude with about 0.1 weight percent sulphur content costs $13.00 per barrel landed in West Coast ports. Hydrotreated shale oil is a higher valued raw material than either of these crudes because it yields a more valuable product slate. We believe hydrotreated shale oil, if available today, would be valued at $14 to $15 per barrel.

While hydrotreated shale oil is not a bargain basement form of energy, it is competitive with today's prices of foreign crude, is embargo-proof, and involves no dangerous drain of American dollars to other oil producing countries. Further, it should be emphasized that these are estimates for the first plant utilizing first generation technology, and the first plant is always the most difficult and generally the most costly. There is no reliable way to estimate future cost reductions; but technological improvements will lead to greater efficiencies.

It should also be emphasized that the foregoing cost estimates contemplate a commercial plant which would comply strictly with applicable standards for environmental protection. Unfortunately, much of the controversy surrounding oil shale development is the result of unfounded assumptions regarding the effect upon the environment.

For example, there is a widespread impression that oil shale development involves massive strip-mining. This simply is not true. More than 90 percent of U.S. oil shale has to be mined underground because it is well below the surface. Billions of barrels could be recovered without a single strip mine if strip-mining were considered inconsistent with environmental concerns.

Questions are also raised about the availability of water and the maintenance of air and water quality. We at TOSCO assure you that a 50,000-barrel-per-day oil shale facility utilizing our process can be built and operated today in strict compliance with national environmental protection standards for both air and water.

Duke R. Ligon, Assistant Administrator of the Federal Energy Administration, has stated that "It is now our view that water resource constraints may be less significant than some have indicated. The amount of saline groundwater believed to exist in the Piceance Basin (25 million acre feet) should satisfy initial industrial needs. Our studies indicate no constraints on the development of at least a one-million-barrel-per-day industry."

TOSCO believes the industry could be twice that size without constraint. However, no one really knows. The dialogue on oil shale will be fraught with controversy until sizable commercial complexes are built and evaluated. Some believe that oil shale can be retorted underground economically; others think that in situ production should supplement underground mining of the richer ores. We at TOSCO suggest that the practical solution is to build the first oil shale complexes and see. If the environmental effects become unacceptable, we can either correct the technology or forget oil shale as a viable energy source; but if the environmental effects prove to be manageable and costs economical, the U.S. has a major new source of energy of inestimable value.

Project Independence analysts say that, if U.S. private industry proceeds at a business-as-usual pace and if the price of oil remains at $11 per barrel or above, the Nation can expect to have some 250,000 barrels per day of shale oil from its domestic deposits in 1985. There have been times this year when we at TOSCO would have characterized that estimate as pessi-

mistic. However, the continuing unprecedented inflation and the steady erosion and contraction of capital markets have forced us to revise our expectations. Costs are increasing on the Alaska pipeline, in the North Sea, and for off-shore drilling platforms. The demand for capital for conventional petroleum projects is skyrocketing; and every energy company is cautiously scrutinizing new commitments to new projects. Tar sands projects are being cancelled, other projects delayed. No sizable new refineries are being built. Unfortunately, the production of oil from oil shale or coal is not a high priority item on the essential program list of most energy companies.

It is time for Governemnt to intervene to make sure that synthetic fuels are fairly tested. As we read H.S. 17400, Chairmen Perkins and Teague contemplate such a venture in that the bill provides for Government contracts with private industry for the construction and operation of commercial-size synthetic liquid fuel plants for the demonstration of advanced technology as well as for primary research and development.

This is not plowing new ground. Under the Defense Production Act, Government encouraged the production of copper, manganeses and other critical materials by long-term purchase contracts; and in the case of copper, Government made money. The contract price in 1967 was 38¢ per pound; and electrolytic copper sells today for more than 70¢ per pound.

Such a contractual arrangement for experimental oil shale production should be structured along the lines of the Defense Production Act. There should be a competitive starting price with appropriate escalations for inflation or deflation over the fifteen or twenty year life of the contract. Industry could be protected against downside risk in return for sacrificing upside gains which would go to U.S. taxpayers.

It is even possible to structure a domestic quota system combined with a D.P.A.-type contractual arrangement wherein experimental shale oil would be absorbed in the domestic market on a priority basis in exchange for insured proctection against violent fluctuations in international oil markets.

Price supports for oil shale are also advocated in some quarters; and this method too could perhaps alleviate the uncertainty about future international oil prices. However, we at TOSCO prefer the Government Industry contract program of H.R. 17400 to oil shale price supports as we understand the term.

Oil shale production involves heavy initial capital outlays, recoverable over fifteen to twenty years of production. Price supports would be reviewed by eight or ten different Congresses in the life of a single oil shale complex and support levels could vary with each Congress. Further, price supports would place on the taxpayers only the burden of downside risk. Government would suffer losses if market prices went below support levels but would gain nothing if prices went above. Under a Defense Production Act type of contractual arrangement, Government would have a gain if market prices rose and could pass the gain on to consumers or pass it on to the U.S. Treasury as income.

TOSCO believes there would be a sizable net gain to U.S. taxpayers if Government signed a contract in 1975 for a specific amount of shale oil from TOSCO II plant to be delivered over a period of 15 to 20 years. More and more, oil producing countries can be expected to hoard their precious oil supplies with nationalistic fervor. Given the choice of exporting at a lesser price or keeping their oil in the ground, oil rich exporting countries with minimal needs for imports might well choose to keep their oil in the ground and assure themselves comfortable oil income for a longer period of time. But, of course, no one knows what future oil prices will be; and this is the uncertainty.

Only Government and Industry working together can break through this uncertainty and get oil shale off the ground for fair evaluation; and it should be done soon, because the lead time required to construct an oil shale complex is long--six to seven years from drawing board and resource evaluation to full production, 3-1/2 years even for our Colony plant which is virtually ready for construction start. It is for this reason that we strongly support the objectives and purposes of H.R. 17400 and commend Chairman Teague and Chairman Parkins for introducing a most constructive and timely proposal.

BIOGRAPHICAL DATA

WILLIAM H. GAMMON

William H. Gammon, oil executive, born St. Louis, Missouri, March 8, 1926; son of James Blakely and Floy Mabel Gammon; B.S. Chem. Eng., University of Missouri at Rolla in 1949; United States Marine Corps from 1944 to 1946; married Dorothy L. Scheips, November 25, 1948; children, Nancy S. Dienna, Janice Lynn and William H., Jr. (deceased).

With Ashland Oil, Inc. 1955 to Present; Director, 1966.

1955 - 1960 Development Supervisor at Ashland, Ky.; 1960 Assistant Director Research and Development at Ashland, Ky.; 1963 Manager Research and Development of United Carbon Division at Houston; 1964 Director Research and Development of Ashland Oil at Houston; 1964 - 1968 President of United Carbon Division at Houston; 1966 Vice President of Ashland Oil at Houston; 1968 Senior Vice President of Ashland Chemical Co. of Columbus, Ohio; 1970 Administrative Vice President of Ashland Oil at Ashland, Ky.

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STATEMENT OF WILLIAM H. GAMMON, ADMINISTRATIVE VICE PRESIDENT, ASHLAND OIL, INC.; ACCOMPANIED BY CHARLES H. BROWN, VICE PRESIDENT, OIL SHALE CORPORATION

Mr. GAMMON. My name is William Gammon, administrative vice president for Ashland Oil, Incorporated.

I want to thank the committee for allowing me to appear and present Ashland's views on synthetic fuel production and to speak in favor of legislation which would assist in the development, on a commercial scale, of coal gasification and the production of oil from coal and shale.

Ashland Oil is extensively engaged in oil and gas exploration, production, refining and marketing operations in the United States. In addition, we are placing increased emphasis on the development of new energy resources to supplement our conventional operations. At this time, we are particularly interested in the production of synthetic oil from coal and oil shale and are actively engaged in projects that can lead to substantial production of these materials.

Ashland's commitment to a synthetic oil program has been prompted by many factors. Ashland is an independent refiner with crude oil production sufficient to provide only 15 percent of our refining requirements. Until recently, we have been able to depend upon readily available domestic and foreign crude oil to supply our refining operations. In the last year, however, we have experienced severe shortages in domestic supplies and an unstable foreign situation that have not only affected Ashland's basic position, but also have been a major factor in this country's energy problems. Although these conditions may inprove over the short term, the underlying facts make it obvious that, for the long term, supplies of crude oil produced in the United States will decline. It is also already evident that sole reliance upon imported oil to supplement the supply, without other options, subjects this country to risks and uncertainties it can ill afford to take.

There is no question that alternate sources of energy must be developed and utilized as crude oil becomes less available. There is also no question that future new technologies will provide energy sources totally different from the fossil fuels upon which we now depend. The problem is one of timing. Prior to any significant contribution from exotic energy sources, we must supplement the Nation's dwindling domestic supplies of crude oil with other similar materials which can satisfy our energy requirements during the interim period.

Coal and oil shale, along with effective conservation measures, can provide the margin of safety we need if we proceed with diligence to establish the commercial feasibility of the conversion technology now in hand. Commercial development must begin without further delay. This effort can and should be undertaken by private industry as a major business interest, but the abnormal risks involved are far greater than those acceptable under sound business practice. An all-out commitment to major synthetic oil projects is inhibited, not only by the risk of untested technology, but also by the soaring investments required for commercial facilities, the limited capital available and the uncertainty of the market at such time as synthetic oil plants would come on stream.

Synthetic oils will be competing in markets established by conventional crude oils. Crude oil production as we know it today has been characterized by large initial capital requirements but relatively low operating costs. Synthetic oil production, however, will require both large initial capital commitments and high operating costs. The market for synthetic fuels and the success or failure of these projects will be determined by the price policies which foreign governments, notably the Persian Gulf states, elect to pursue for their crude petroleum production. This factor of late has been subject to change for reasons which have little to do with normal economic factors. Such lack of stability in the market for energy materials, which are the mainstay of our economy, is a prime deterrant to private development of new energy sources. Our national interest requires appropriate governmental action to counter the power which foreign governments presently have in determining the course and direction of the economic future of our country.

To emphasize the problem, we have definitive estimates for a 50,000-barrel-per-day shale oil plant indicating the cost will be in excess of $700 million. Cost of coal liquefaction and gasification plants have not yet been precisely estimated, but you can be assured they will be equally expensive. Investment in just one such 50,000-barrel-per-day plant would double the plant and equipment assets of Ashland Oil. My company as well as most others would find it extremely difficult today to finance any venture of this size, and especially one that involves the risks associated with a new industry.

Beyond the investment, we are faced with equally formidable and adverse economics. According to our best estimates, in order to realize a barely adequate return on the investment indicated above, the initial price of shale oil when the plant comes on stream in 1978 will considerably exceed the current price of Persian Gulf crude oil delivered to U.S. ports. Of course, there is always the hope that further technological developments may significantly reduce these costs.

We cannot predict the cost of foreign crude to U.S. refiners in 1978, but it is evident that production costs of private firms in the Middle East are substantially below the estimates of costs of oil from coal or shale. The production costs of the national oil companies of the OPEC nations are, of course, much lower than those of the private firms in those areas. On this basis, OPEC pricing policy has the flexibility to impede and even kill these projects outright. Commercial synthetic oil ventures simply cannot withstand an economic attack from that quarter and must have the cooperation of the Government to counter potentially depressed international markets.

In this context, Ashland is convinced that the production of synthetic oil from coal and shale urgently requires a strong cooperation between the Federal Government and private industry. The urgency is evident since, although we feel confident of the technical feasibility, the experience of commercial operation is absolutely necssary to properly assess the contribution these synthetic oils will make. By starting now, we can possibly avoid the inevitable crash program which may later be required and undertaken with little regard for any adverse effects which must result.

In this respect, while industry is ready to begin, we must have the support of the Federal Government against financial disaster in this

pioneering effort. H.R. 17400, pending before the committee, while certainly a constructive step, does not offer the necessary incentives as do the provisions such as are contained in H.R. 15107 previously introduced by Congressman Carl Perkins. In our opinion, H.R. 15107 is a well-considered attempt to provide adequate support. We are therefore primarily addressing that bill in this statement. We believe legislation generally along those lines would answer the needs of those companies who are willing to undertake the task of developing these new industries.

Provision for Government price supports or purchase agreements to assure a market for the output of synthetic fuel facilities on a reasonable profit basis is of crucial importance for the protection of the new industry against price manipulation by foreign governments.

The availability of capital through federally guaranteed or direct loans and the provision for price supports will certainly encourage and facilitate commitments by industry to undertake the large expenditures required for synthetic oil plans. Just as important, performance guarantees coupled with purchase agreements will serve to interest private investors in financing these projects.

We fully recognize the need to adequately consider and balance the environmental consequences of synthetic oil and gas against the social and economic benefits to be derived from maintaining adequate energy supplies. Although this is the intent of the National Environmental Policy Act, based upon past experience, we are concerned that a NEPA section 102 review may be used as a mechanism for unreasonable delay by narrowing its perspective to consideration of only the natural environment.

In order to avoid confusion and unnecessary delay, we feel congressional attention should be focused upon this problem and new avenues be designed if necessary so that adequate and timely development of energy resources will not be impeded.

Authorizing the leasing of Federal lands to provide coal reserves and plant sites would be of particular importance to the small or independent operators. Many companies currently involved in the development of coal conversion technology do not have the reserve base to support a commercial operation, and would find it difficult to to secure adequate reserves from private interests. Much the same considerations apply in the case of shale oil production.

Legislation should also contain provisions authorizing the leasing of Federal lands for these projects on some basis other than the conventional auction with the heavy front money requirements which will add greatly to the investment costs and in all likelihood deter development. We would suggest special provisions for leasing of Federal lands on a royalty basis for the purpose of extracting minerals for gasification or liquefaction. The royalties could be based upon either the raw material value or value of the finished product. Rates should, of course, be adjusted to recognize the costs incurred by the lessee in processing the raw material and the price achievable in the marketplace in case the royalties are based upon finished-product values. Making Federal lands available on a royalty basis would allow the independent segment of the oil industry to compete effectively with the integrated major oil companies in the development of a synthetic oil program.

Furthermore, a program such as this will have significant impact upon those geographical areas where commercial plants are located. Policies governing the leasing of Government land for plant sites can influence the industry to locate in areas where unemployment is high or otherwise economically depressed. In cases where the new installations impose additional burdens on public facilities, such as schools, hospitals, police, and fire protection, the legislation should provide for a major Federal contribution to the costs of such additional facilities. Under present conditions, these high costs must be borne almost entirely by private industries, substantially increasing capital outlays required.

In conclusion, Ashland endorses legislation along the lines discussed in this statement and as exemplified in H.R. 15107. We believe such legislation would provide essential support for the timely and orderly development of a synthetic oil industry. Ashland is in a position to participate in a series of coal and shale conversion projects which can be of considerable help in moving this Nation toward self-sufficiency in energy. However, we can assure you that it will be difficult, if not impossible, to proceed with these projects unless supporting legislation is adopted.

I thank you for the opportunity to express our thoughts on this matter. We will be pleased to provide any additional information that you may request.

Mr. McCormack. Thank you, Mr. Gammon, for that presentation, and I particularly appreciate the fact that we must have a realistic, pragmatic approach to the needs of the country if we're going to accomplish anything in this particular area. Of course, we have developed this in discussions and questions that have been asked, and I would like to ask a couple of questions of you in relation directly to your closing statements.

Do you believe that you would require direct Federal loans for capital for construction of this sort of facility, or would you need insurance for loans, or would you need interest, would you need to have Federal coverage for interest of loans, or would you think it would be appropriate to have the Federal Government guarantee to purchase synthetic fuels over a period of 10 years, or over a specified period, and also at a lower price up to a certain amount, a certain number of gallons per day?

How would you approach this?

Mr. Gammon. That's a difficult question to answer absolutely.

Each and every one of the suggested support measures would have an impact. Any one of them, if sufficiently firm, would be an incentive for private industry to continue.

I guess I feel that the price support, to guarantee that a product could be marketed at a price sufficient to justify the investment, would be the single most important support that could be forthcoming. Assistance in financing would also be a help. I think we are all aware of the rather chaotic capital markets, both in this country and throughout the world. So assistance in that area would certainly also be an incentive.

But my own personal belief is that the price support, the guarantee that the product would not suffer from the vagaries of the political

climate internationally with respect to crude oil values, would be the single most important thing.

Mr. BROWN. I think the formula in the Defense Production Act is a good one. When the Nation set out to assure supplies of essential commodities, such as copper, the Federal Government found it wise to establish in the national interest a program where the Federal Government could procure the product at a specified price, and it also employed the loans, guarantees of loans, for the production of that product, and even production advances in capital form. That has worked very well, and I had the added advantage that the consumer gets a break on the price.

There's no question but what a Government guaranteed loan reduces the capital cost to private industry and reduces the cost of the ultimate product.

The U.S. Government made money on its copper, and I think if the Government is going in business with us, I think both Mr. Gammon and I would agree, that the Government and the people of this country have a right to share in the lower price, and I think that formula works very well.

Mr. MCCORMACK. Let me ask you the other side of the question.

Let's suppose that the Federal Government provides financial support for the work—and, we know they haven't, but let us suppose it—and let us suppose that it would allow you to produce synthetic fuel competitively on the market today.

How long would it take for you, if given this guarantee today, to get a production plant on the line, and how much would it produce?

Mr. GAMMON. The plant we have currently undertaken, along with TOSCO, and two other organizations, Arco and Shell, could be in operation in 1978 if we could start today.

Mr. MCCORMACK. This is to make synthetic liquid fuel from coal?

Mr. GAMMON. No. From oil shale.

Our original plan was that we as a group would commit to the construction of this facility in April, 1975.

Mr. MCCORMACK. What would its production be?

Mr. GAMMON. 50,000 barrels a day.

Mr. MCCORMACK. Are you satisfied that you would meet environmental EPA requirements?

Mr. GAMMON. Yes, sir.

Mr. MCCORMACK. And water supply requirements?

Mr. GAMMON. Yes, sir.

Mr. MCCORMACK. Can you make any such estimate for coal liquefaction?

Mr. GAMMON. No, I can't. As was mentioned here a little earlier in Congressman Perkins' testimony, we are involved with a group of other private companies in OCR in designing right now a demonstration plant based upon some private technology. That plant would probably be in construction in late 1975, early 1976. We anticipate about 3 years' overall operation of that plant to shake down all the technological and design factors so that a commercial-sized facility could then be definitively estimated, designed, and constructed. So you're talking about a time frame there, I guess, sir, of about 6 years.

Mr. HECHLER. Is that the Catlettsburg plant?

Mr. GAMMON. Right, sir.

Mr. DAVIS. Thank you.

Mr. Hechler.

Mr. HECHLER. I should note for Mr. Symington's benefit that he was born in St. Louis, Mo.

Mr. GAMMON. Yes, sir. I was about to say, "I'm a 'show me' guy too."

Mr. HECHLER. He's also a guy who's got a degree from the University of Missouri at Rolla.

Mr. GAMMON. Right, sir.

Mr. HECHLER. I gather, that your answers to Chairman McCormack's questions indicate that you're further along in the synthetic fuel from shale oil than from coal. Is that correct, sir?

Mr. GAMMON. Yes, sir.

Mr. HECHLER. You also answered Chairman McCormack that you saw no difficulties with the National Environmental Policy Act, yet your testimony on page 6 indicated, "We are concerned that a NEPA section 102 review may be used as a mechanism * * *."

Mr. GAMMON. We're referring there, Congressman, to the fact that we have an environmental impact statement which has been prepared. What we're really talking about is making sure that such a review is not a deterrent, or it doesn't impede the progress, that we don't get bogged down in delay, that the necessary permits are forthcoming expeditiously. This is what we are fearful of, that it takes so much time to get the wheels going in many of these areas. We need Interior's help, and everybody's help, in seeing that those things are accomplished expeditiously.

Mr. HECHLER. Tell me a little bit about this Catlettsburg plant, its location in the Big Sandy Ohio River area.

Does that indicate the use of the river water in connection with it?

Mr. GAMMON. It could, from the standpoint just, as you know, we now operate, we transfer a number of our liquid products from that refining area by water. The coal would come in by transportation such as it now does into the plant there at Louisa, Ky., by rail, and so on.

I might add, incidentally, that is one big problem that Congressman Perkins alluded to. In expanding our production of coal significantly, the availability of transportation facilities, rail cars, and also the ability of the necessary mining engineers and technologies to greatly expand. Our mining engineering graduates have virtually disappeared annually for the past decade or so. I don't know the numbers absolutely, but I would say that it's something around less than 200 mining engineers were graduated last year, for example.

Mr. HECHLER. One of the sections of the surface mining bill that's before the President now could give some assistance in this connection. I'm not advising you personally to do that, but I merely point this out.

Mr. GAMMON. I understand.

Mr. HECHLER. What about the byproducts of both of these processes, synthetic fuel and synthetic fuel production, are they useful? Are they damaging? Are they a nuisance? Just what attention has been given that?

Mr. GAMMON. The byproducts are primarily char, cokelike materials, and, of course, sulfur and nitrogen compounds removed from the original raw material. We remove sulfur now in refining operations, in the area of elemental sulfur. There's no partcular difficulty with disposal. Sulfur is used, of course, in some of our chemical industries. As we take all the sulfur out of oil, and out of coal, and so on, we're going to have an excess of sulfur, and then I don't know what we'll do with it, but the sulfur in itself is not a problem; no.

Mr. MCCORMACK. Mr. Thornton.

Mr. THORNTON. Thank you, Mr. Chairman.

With regard to the byproducts question, the byproduct of this shale process, I believe, is very likely dry powder?

Mr. GAMMON. Yes. It's really just the shale which has been deoiled.

Mr. THORNTON. And do I also understand that that displaces a larger volume as a powder than it did before processing?

Mr. GAMMON. It would; yes, because it's not aggregated.

Mr. BROWN. Excuse me.

The best way to explain that is when the shirts come home from the laundry you can generally get them in the same drawer, but after they've been worn it's difficult to get them all back in.

Mr. THORNTON. Is this a problem that has to be solved if consideration is going to be given to the successful development of the shale processing, for the larger displacement of the byproduct?

Mr. BROWN. Yes. I think the dream of everyone who's ever dealt with shale is to some way get this resource in liquid form underground without mining. But so far it is not a practical dream, and we keep working on the technology. But we haven't found the process yet that will really get the hydrocarbon out of the resource without mining now.

There, may I just say a word about the need for commercial-sized plants? There are various stages of research, as everyone knows, especially in this committee: The bench model, the pilot plant, the semi-works and the commercial-size.

Unfortunately, the bankers and the investment community will not believe the credibility of research at the bench level, the pilot level or the semi-works until it has been demonstrated in the commercial-size operation.

Now there seems to be a feeling in this country that we can do this research and have it ready on the shelf, and that when these cheaper forms of energy are exhausted that it will be there for us to expand immediately into those less economical forms. That is not true. It takes 7 years, from drawing board to production, to bring a shale plant on stream with present technology, and with anything we see on the horizon.

We could come to 1985 without commercial-size plants, and we would not know any more about the feasibility, environmentally and economically, of oil shale than we know today, if we don't do something of a commercial-size venture.

Mr. THORNTON. I appreciate very much your expression of that point.

Following it very quickly, to illustrate, if you would, the state to which research and development has proceeded, do you have something planned, on the line?

Mr. BROWN. We do. Of the TOSCO II technology, we have demonstrated at the bench level, the pilot plant, the semiworks, and we are now ready for the commercial-size plant, and that was the one we had hoped to commit in April of 1975, and all these uncertainties have appeared, which make it impossible for us to commit to the construction.

Mr. THORNTON. What was the volume production of the commercial plant?

Mr. BROWN. 1,000 barrels a day.

Mr. THORNTON. Thank you. I have no further questions.

Mr. MCCORMACK. Mr. Symington.

Mr. SYMINGTON. Thank you, Mr. Chairman.

To add to Mr. Hechler's comments in view of the witness' background, I see he's very intelligent also.

I gave a commencement address at Rolla the day before yesterday to say I looked greedily at those 400 newly graduated engineers—some of them were mining engineers—and told them to hurry up because we need them.

At that time I did talk to Dr. Ray Bisplinghoff, former associate director of the NSF, and Mr. Chancellor of the university, and he pointed out that in Missouri there is a great deal of sand in oil, that they're experimenting with methods of bringing that oil, sending something down to shoot it up, and even bringing it all up in some open form, or just the oil, and he seemed to feel that there was a breakthrough of some kind that they were making.

Mr. GAMMON. I'm not familiar with the progress they are making. I knew they were working on it, but I haven't had a detailed report.

Mr. SYMINGTON. I want to thank both of you gentlemen for the high contribution you have made to our understanding of the prospects of synthetic fuel oil production, and the facts. Thank you very much.

Mr. GAMMON. I wonder if I might make one other comment?

As I have listened to the prior testimony and the questions that the committee has raised, I sense that perhaps there's been an impression left that the urgency for the development of synthetics in this country, synthetic oils, hydrocarbons, is totally oriented and dependent upon fuel for energy.

I would like to just submit for your consideration that we are a hydrocarbon based society, and that we need all the hydrocarbon that we are currently consuming if we are to maintain or enhance our standard of living, and where we have a deficiency of such hydrocarbons from crude oil and gas in this country, and are having to import substantial amounts from outside the continental limits of the United States, and, as I think you're all aware, we're having some problems with our neighbors to the north, and they've been supplementing our supply considerably, I really feel that it's imperative that we develop these synthetic oils as quickly as possible because, recognizing that we not only have fuels for transportation that are based solely on hydrocarbon, our entire petrochemical industry; our entire synthetics in-

dustry, are based upon such hydrocarbons; our pharmaceutical industry is based upon such hydrocarbons; our entire fertilizer industry.

I just wanted to be sure there wasn't an impression left that the sole reason for developing synthetic oils is energy.

Mr. SYMINGTON. Mr. Chairman, on that point might I ask an additional question?

Mr. MCCORMACK. Go ahead.

Mr. SYMINGTON. Somehow we're going to have to finance the introduction of new energy sources and the development of new liquid fuels. I think the American people would respond to any appropriate request by the Federal Government. I understand that the tax on gasoline today is about $1 billion.

Do you favor a tax of that kind and putting it into a trust fund, some of it, to be used for developing energy sources, and, if so, how high would you go?

Mr. GAMMON. Wow. That's a tough one.

Mr. SYMINGTON. Because the Government, if it's going to get into this business of financing, has got to get the money somewhere. It just can't furnish it.

Mr. GAMMON. Sure, it's got to have a source of revenue.

I guess I feel that I don't know that a tax, or additional tax, on gasoline will actually be a deterrent, a great deterrent, maybe because I'm living in an area where we're solely dependent upon—we don't have any other public transportation, and the tax would only be particularly onerous to the guy who can least afford it.

Coming back to your question, though, where do the funds come from to provide this source, then I have to jump over and take the other side of the cart and say, yes, perhaps some tax, some other form of assessment—and, Charlie, I guess I'm not that much of an expert. Maybe you could talk to that.

Mr. BROWN. I want to suggest that there's a tax in existence right now that should be utilized for this purpose. We place an import levy now of about 15 cents a barrel on the import licenses which are sold, and that's going up to 20 cents a barrel.

Now, if you do the mathematics on it, you will see that there could be in this country as much as 500,000 barrels a day of oil from experimental sources that could be financed by exemptions from that import levy. In other words, you could keep the whole cost within the distribution system by just adjusting the amount, the number, of free import licenses distributed to refiners by refining capacity, because 500,000 barrels a day of crude, if it costs $3 or $4 a barrel more than imported oil, could, in the total crude mix, add about 10 to 11 cents per barrel to the total cost.

There are all different kinds of ways to do it, but I, for one, if Government's going to get into it, I think Government should stand a chance to gain from the program on behalf of the taxpayers, and I think there should be a self-financing provision because there's no such thing as available tax money for this sort of development.

Mr. SYMINGTON. Thank you, gentlemen.

Mr. MCCORMACK. Could I ask a question?

Mr. Brown, this is a fairly complicated point you just made, and many of us are not familiar with the background of it, and I wonder

if you would willing to submit for the record, or in a letter to me, a more detailed exposition of this subject that you have just raised.

Mr. BROWN. I will, indeed.

Mr. DAVIS. We would appreciate that very much.

[The information to be provided is as follows:]

Under the terms of the April 18, 1973 Proclamation by the President of the United States of America, modifying Proclamation 3279, relating to imports of petroleum and petroleum products in their relation to the national security, and under section 232 of the Trade Expansion Act of 1962 as amended, the Secretary of the Interior is authorized to establish, by regulation, a system of fees for licenses issued under allocations of imports of crude oil, unfinished oils, and finished products, above certain levels specified in the Proclamation. The fee schedule set by the Proclamation is:

FEE SCHEDULE

[Cents per barrel]

	May 1, 1973	Nov. 1, 1973	May 1, 1974	Nov. 1, 1974	May 1, 1975	Nov. 1, 1975
Crude	10½	13	15½	18	21	21
Motor gasoline	52	54½	57	59½	63	63
All other finished products and unfinished oils (except ethane, propane and butanes)	15	20	30	42	52	63

According to published information in trade journals, the U.S. is now importing daily about 4 million barrels of crude; some 200,000 barrels of motor gasoline; and roughly 2.3 million barrels of other finished products and unfinished oils. The scheduled fees will not apply to all imports until 1980, however.

Currently, there are liberal exemptions from the scheduled fees, described as "maximum levels of imports to which license fees shall not be applicable," with a gradual phase-down of such exemptions each year until all exemptions are abolished in 1980. Careful distinction should be made between the present level of revenue from this source and what it will be as exemptions are phased out.

If the U.S. is still importing crude and petroleum products at present levels in 1980, and if import license fees remain intact, as scheduled, there would be some $900 million per year in revenues from this source. Under provisions of the April 18, 1973 Proclamation by the President, these monies, "shall be held by the Secretary of the Interior in a suspense account and may be drawn upon by the Secretary for the payment of any refunds or refundable license fees and for payments to Puerto Rico of sums collected by way of license fees for imports into Puerto Rico. Balances remaining in such suspense account not required for payment hereinabove provided shall be deposited at the end of each fiscal year in the Treasury of the United States and credited to miscellaneous receipts."

TOSCO suggests that, if import license fees are to continue, the revenues therefrom should be earmarked for expediting the development of New Source Domestic Liquid Fuels, such as synthetics from oil shale and coal. Since the funds from this source should be substantial in four to six years (about the time that new synthetic plants could get in operation), these revenues could fund "premium" incentives for New Source domestic oil.

For example, $2.3 million per day from import license fees could provide a $3.00 per barrel incentive "premium" for more than 700,000 barrels per day of New Source domestic synthetic crude with no additional cost to U.S. consumers and no additional taxes on crude or petroleum products.

In TOSCO's opinion, such a "premium" would stimulate serious development of synthetic fuels. Existing first generation technology could be proved in commercial-size plant operations, and improved technology and operational efficiencies could be expected.

Further, the 700,000 barrels per day production itself would be of measurable value to the Nation. Replacing imported oil of like quality, these 700,000 barrels could reduce the dollar drain to OPEC countries by some $11 billion per year or more.

It is TOSCO's opinion that, if inflation settles down to historical levels, synthetic crude from oil shale can be produced at costs competitive with conventional oil, long term. The primary need for incentive "premiums" is for the first facilities which are generally more difficult and most expensive.

In short, presently scheduled import license fees on foreign oil, if earmarked for expediting development of New Source Domestic Crude, should be sufficient to provide an effective "premium" incentive program for advancing U.S. synthetic fuels from pilot plants or semi-works plants experimental development to a new more credible commercial-size plant phase which could demonstrate the economic and environmental feasibility of these vast new domestic energy sources without new taxes on petroleum products.

Mr. DAVIS. Mr. Hechler, do you have any questions?

Mr. HECHLER. I'm sure the railroads, the airlines, and the truckers would have been very pleased if you'd come in with a user tax. I wouldn't have expected you to abrogate that, Mr. Gammon.

I was very fascinated, however, by the statement that you made on page 7—and I think it's necessary to bring this out—the effect on public facilities, schools, hospitals, water and sewer systems, and the necessity of providing some means of helping construction of public facilities.

I was out in Gillette, Wyo., for example, about a month ago, where there's this big boom. The development by Amex Corp. of the tremendously thick fields of coal out there has made a boom town, with trailers, alcoholism, psychiatrists running all over the place, and it really is the kind of thing I think we're going to have to give some attention to.

I'm glad that you flagged this and raised the question.

For example, Kaiser coming into Wavits had to help fill the school, and I have no doubt that Ashland Oil helped with the Paul Blazer High School in Ashland, Ky., and many other public progress.

We're just going to have to concentrate with a lot more thinking on this subject. I'm glad you brought the question up.

Thank you, Mr. Chairman.

Mr. MCCORMACK. Thank you very much, Mr. Hechler.

We thank you, Mr. Gammon, and I want to say that we do appreciate, not only your remarks, but we agree with you very much in what you said about the needs for hydrocarbon in the petrochemical industry and in synthetics, and so forth, and we've always felt that oil shale was a source for fuel, and that it's there, and, hopefully, is a practical source for petrochemicals.

Thank you very much for testifying, gentlemen.

Mr. GAMMON. Thank you, sir.

Mr. BROWN. Thank you, sir.

Mr. DAVIS. Dr. Zahradnik, would you be willing to give us a luncheon break, and come back at 2 today?

Dr. ZAHRADNIK. Certainly.

Mr. DAVIS. Would the other members of the committee approve of this procedure?

[No response.]

Mr. DAVIS. There being no objection, we will adjourn at this time until 2 p.m., at which time we'll take the testimony of Dr. Zahradnik.

[Whereupon, the subcommittee was in recess from 11:58 a.m., until 2 p.m., on the same date.]

AFTERNOON SESSION

Mr. MCCORMACK. The meeting will come to order.

We are reconvening our hearing that was recessed at noon today on H.R. 17400, the Synthetic Liquid Fuel Research and Development Act of 1974, sponsored by the Honorable Carl Perkins, and others.

Earlier today we had testimony by Congressman Perkins, by Dr. Guy Stever, Science Adviser to the President, and Mr. William Gammon of Ashland Oil Co.

This afternoon our witness will be Dr. Raymond Zahradnik, Acting Associate Director for Technical Operations, Office of Coal Research.

Dr. Zahradnik, welcome, and please feel free to proceed as you would like.

Dr. ZAHRADNIK. Thank you very much, Mr. Chairman.

May I take the opportunity to introduce my assistant, Miss Cathy Preston, who will be assisting me this afternoon with the slides?

Mr. MCCORMACK. Welcome, Miss Preston, and please feel free to join Dr. Zahradnik at the witness table, if you wish.

Miss PRESTON. Thank you.

Mr. MCCORMACK. Dr. Zahradnik, please proceed as you wish.

Dr. ZAHRADNIK. Thank you, Mr. Chairman.

[A biographical sketch of Dr. Zahradnik follows:]

DR. RAYMOND L. ZAHRADNIK

Dr. Raymond L. Zahradnik, an official of the National Science Foundation, has been named Acting Associate Director for Technical Operations of the Office of Coal Research, U.S. Department of the Interior.

In this capacity, Acting OCR Director S. William Gouse said, Zahradnik will function as a deputy for technical operations in areas of coal conversion. He has been energy policy analyst for the Office of Energy Research and Development Policy of the National Science Foundation (NSF) for the past year.

The 37-year-old Zahradnik, a native of Ford City, Pennsylvania, holds a bachelor's, master's, and doctor's degree from the Carnegie Institute of Technology. He was a fellow engineer at Westinghouse Electric Company in 1963–66, a professor of chemical engineering at Carnegie-Mellon University in 1966–72, and served as program manager of the NSF's RANN program in 1972–73.

Dr. Zahradnik is married to the former Margana Ruston of Cadogen, Pennsylvania, and they have three children. The family resides at 5302 Waneta Road, Washington, D.C. 20550.

STATEMENT OF DR. RAYMOND L. ZAHRADNIK, ACTING ASSOCIATE DIRECTOR FOR TECHNICAL OPERATIONS FOR THE OFFICE OF COAL RESEARCH, DEPARTMENT OF THE INTERIOR

Dr. ZAHRADNIK. I am pleased this morning to provide testimony for the Office of Coal Research on the proposed legislation.

Mr. MCCORMACK. Excuse me.

Would you like to present your entire testimony, and have it inserted in the record?

Dr. ZAHRADNIK. I'm going to excerpt it, Mr. Chairman, for about a 15-minute presentation.

Mr. MCCORMACK. All right. We'll put the entire statement in the record, if you would like. We'll give your statement to the stenographer.

Dr. ZAHRADNIK. All right. I have no objection whatsoever.

[The prepared statement of Dr. Zahradnik follows:]

STATEMENT
ON
H.R. 17400, "THE SYNTHETIC LIQUID FUEL
RESEARCH AND DEVELOPMENT ACT OF 1974"
TO
SCIENCE RESEARCH AND DEVELOPMENT ENERGY SUBCOMMITTEES
COMMITTEE ON SCIENCE AND ASTRONAUTICS
U.S. HOUSE OF REPRESENTATIVES
BY
RAYMOND L. ZAHRADNIK
ACTING ASSOCIATE DIRECTOR FOR TECHNICAL OPERATIONS
FOR THE
OFFICE OF COAL RESEARCH
DEPARTMENT OF THE INTERIOR
DECEMBER 17, 1974

I am pleased this morning to provide testimony for the Office of Coal Research on H.R. 17400.

As the Committee realizes, neither the production of synthetic liquid fuels nor Federal action in the Demonstration Plant area are new to this proposed legislation.

Nearly fifty years ago the first commercial synthetic liquid fuel plant was built at the Leuna works in central Germany. This plant continued in operation through the second world war, during which time it produced from coal over 15,000 barrels per day of aviation and motor gasoline.

In the United States passage of Public Law 290 in April 1944, permitted expansion of the U.S. Bureau of Mines program into the synthetic fuels area. A demonstration plant for the production of 200 barrels of oil per day was erected at Louisiana, Missouri and began operation in 1949. During the next four years, six American coals were processed into gasoline and other fuels. Cost studies showed that the process was not competitive with gasoline from petroleum and operations were terminated in June 1953.

Recollection of past activities is neither the subject of my testimony, nor the topic of this hearing. But the half century struggle by the scientific community to develop synthetic liquid fuel technology should alert us to the enormity of the technical job, and the fact that today, over 30 years after passage of Public Law 290, we are considering similar legislation, speaks with equal eloquence to the magnitude of the marketing job.

In previous testimony, Dr. Stever, Director of the National Science Foundation, described the activities of other nations as well as American industry in the synthetic fuels area. We are in good contact with all of these projects, both at home and abroad, and have developed our program

plans with full cognizance of the work of others. In the synthetic liquids area as across our entire program we seek to develop national research and development plans which integrate Federal activity with that of the private sector and other nations.

In my comments this morning, I would like to address both points from the perspective of the program we have developed in the Department of the Interior Fossil Energy Program. This program, developed under the direction of the Department's Office of Research and Development, includes substantial activity in the Bureau of Mines as well as in the Office of Coal Research.

Since this is an initial appearance of the Office of Coal Research before these Subcommittees, may I introduce the OCR to you with a brief description of its history and program. This will provide you with insight into the Federal synthetic-liquid-fuel-from-coal program; the production of synthetic liquid fuels from other sources will not be discussed.

HISTORY OF THE OFFICE OF COAL RESEARCH

The Office of Coal Research was established by the Secretary of the Interior in 1961, pursuant to the Coal Research Act of July 1960, (H.R. 3375). Its charter is to develop technology for new and more efficient methods of mining, preparing and utilizing coal to ensure abundant supplies of clean energy.

The OCR began its contract research program with an initial budget of $1 million. For the next 12 years, the OCR budget grew slowly, reaching $17 million in 1971 (Figure 1).

The energy shortage catapulted the OCR into a program of top priority; the OCR budget was increased to over $43 million in FY 1973, $123 million in FY 1974 and $261 million in FY 1975.

The OCR is entirely a contract research office. The OCR procures through solicitation in the form of requests for proposals, as well as unsolicited proposals. Its major pilot and demonstration plant projects require substantial cost sharing on the part of the industrial participants. As of June 30, 1974, the OCR had awarded 160 contracts totalling $421 million. The OCR contractors represent a major cross section of the energy research and development community ranging from universities to government and non-profit laboratories to major industrial firms. The latter include major architectural and engineering firms, manufacturing firms and major energy companies. These contractors have cost shared $80 million of the $421 million.

As of today, the OCR has obligated over $100 million of its FY 1975 funds. This includes both new starts as well as some continuations of existing contracts. This successful expansion has been the result of the dedicated efforts of the OCR to respond effectively to the energy research needs through efficient procurement procedures and good program planning.

The staff of OCR has increased this year from about 45 persons in January to over 200 at the present time. The Office was reorganized in January of this year and again in May to the structure shown in Figure 2. There are 5 technical directorates and 3 support directorates, each headed by an Assistant Director. Selections have been made for all positions. Six of these positions have been permanently filled.

Current OCR Program

The means by which coal can be converted and utilized are varied and versatile. The OCR program is structured to address these various approaches in a creative and flexible fashion. The OCR program strategy is to pursue those technologies which have specific and significant potential contributions to increasing the usable supply of energy. Different energy requirements are satisfied by different forms of the coal and coal-derived products.

The program is structured along the lines of the OCR organization (Figure 3). It includes High and Low Btu Gasification, Power and Combustion, and Liquefaction. Through our Supporting Science and Technology element, we sponsor front-end type studies in these areas; through our Demonstration Plant activity, we are looking to encourage the construction of large coal conversion facilities - one step removed from commercialization.

I would like to take just a moment to describe the overall program of the Office of Coal Research. There are two reasons for this. The first is that the overview will put into better context my more detailed remarks on coal liquefaction. The second reason is that any specific coal conversion technology, such as coal liquefaction, involves many unit operations common to other conversion technologies. Progress in the development of a synthetic fuels industry is accelerated by having an integrated program in which synergisms are encouraged to develop among various program elements.

High Btu Gasification

The specific objective of the High Btu Gasification program is to provide the technology for the manufacture of pipeline gas from coal. We are seeking improvements which conserve coal as they permit greater efficiency and decrease the cost of manufacture of gas compared to present technology. There are two pilot plants in operation and one in the late stages of construction. A fourth pilot plant, constructed by the U.S. Bureau of Mines, is nearing start-up.

The OCR efforts in this area have been encouraged by the American Gas Association, which in August 1971, entered into a cost sharing agreement with the Department of Interior to accelerate the coal gasification program. The funds allocated in this area in FY 1975 are $37.8 million.

Low Btu Gasification

The objective of the low Btu gasification program is to develop one or more gasifier systems that can economically convert coal into gas suitable for power generation and industrial use. Several feasible concepts are being studied concurrently, and pilot plants are planned.

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We are receiving substantial cost sharing by private industry and the Electric Power Research Institute in this area. The FY 1975 OCR budget for low Btu gasification is $49 million.

Direct Boiler Combustion

The Direct Coal Combustion program is geared to develop both atmospheric and pressurized fluidized-bed combustor systems capable of burning high-sulfur coals, and to improve the reliability and efficiency of present boilers. A 30-megawatt atmospheric fluidized-bed boiler is being installed in a generating station at Rivesville, West Virginia, and an RFP has been issued for the design, construction and operation of a 20-megawatt pressurized fluidized-bed boiler-combined cycle plant. The FY 1975 funds allocated in this area are $34 million.

Advanced Power Systems

A budget allocation of $17.7 million was made in FY 1975 for projects in advanced power systems. Increased efficiency of coal burning electrical power generation is the goal here and the program focuses largely on developing advanced gas turbines capable of operating on coal-derived fuels and on developing magnetohydrodynamic systems which utilize coal directly.

Advanced Research and Supporting Technology

Supporting all the program areas of the office, including specific component research, research in advanced conversion concepts, basic coal science, and development of an active, productive university research program in coal is the responsibility of this program element. A byproduct of this activity will be the training of technologists required by this new synthetic fuels industry. Here, also, a significant materials research program is being developed to support the entire coal conversion fields. This activity has an FY 1975 allocation of $19.1 million.

Coal Liquefaction

The OCR program element of most relevancy to H. R. 17400 is coal liquefaction. A budget of $79.6 million has been allocated in this area for FY 1975. The objective here is to develop an efficient and economical technology to convert a variety of coals into clean liquid fuel products. Generally speaking, liquefaction occurs upon the addition of hydrogen to coal under suitable processing conditions.

A small addition of hydrogen will yield a heavy oil suitable for burning in electric power generating boilers. Further hydrogen addition, distillation and refinement will produce a spectrum of petroleum-like products.

There are four time-honored methods for liquefying coal: pyrolysis, solvent extraction, direct catalytic hydrogenation and indirect synthesis variations.

Coal pyrolysis or carbonization is a form of destructive distillation of coal which yields liquid products and a byproduct char.

In solvent extraction, a coal-derived liquid solvent acts as an agent for transferring hydrogen to coal to extend the degree of liquefaction.

Direct catalytic hydrogenation is similar to solvent refining except that the presence of a catalyst facilitates hydrogen transfer to coal and thereby yields a more hydrogenated product i.e., a lighter liquid.

Indirect synthesis variations involve an initial gasification of coal into a synthesis gas (hydrogen and carbon monoxide) followed by conversion of the gases into liquid fuels by use of appropriate catalysts.

The OCR program consists of projects utilizing each of these four methods. Because the products which are produced by each variation differ and because data is lacking to make exact economic comparisons at this time, such a parallel approach is highly desirable.

Our strategy is to explore selected process and unit operations options through large bench and pilot plant stages in order to develop a broad technological base. From this base, we can synthesize the most efficient and economical process or combination of processes to produce clean liquid fuels.

Pyrolysis

The major project in this area is the COED Pilot Plant at Princeton, New Jersey, developed in cooperation with FMC, which has successfully tested a variety of coals, and for which a commercial design is being prepared. This process consists of a number of pyrolysis vessels in which coal is subjected to a series of stages of increasingly severe conditions. Coal-derived liquids and unconverted coal (char) are produced. The liquid products from this process have been tested in a number of applications, including destroyer tests by the U.S. Navy. The char byproduct has been successfully burned in a commercial boiler and gasification tests in a Koppers-Totzek gasifier are planned for early in 1975.

Solvent Extraction

A major pilot plant has been built by OCR at Fort Lewis, Tacoma, Washington, to establish the economic and operating parameters associated with the solvent refining of coal. The product from this plant is a heavy oil which although not a liquid at room temperature, could be fired as a liquid into boilers. Much of the ash and sulfur originally present in the coal are removed by this process and a product of remarkably uniform quality is produced from a variety of coals. This plant is currently in start-up operation and we expect to begin collecting meaningful data very soon. This plant represents about a factor of ten scale up in size over a similar facility constructed at Wilsonville, Alabama, under sponsorship of EPRI and Southern Services, Inc. These two plants will not only serve to determine the commercial and technical viability of this process, but also provide valuable information on the scale-up of coal conversion plants.

Catalytic Hydrogenation

The use of a catalyst to accelerate the hydrogenation reactions of coal has been studied for the greater part of this century. Engineering of a reactor to provide appropriate contact between coal, catalyst, hydrogen, and solvent remains however, a complicated problem. Two reactor configurations seem attractive. One, using an ebulating bed is the basis of the H-Coal process. In September, a contract was awarded for the detailed design and engineering for a pilot plant to test the H-Coal process. In a recent announcement, the Secretary of the Interior disclosed that this plant would be located at the Ashland Oil site in Catlettsburg, Kentucky. The product of an H-Coal plant can be either a synthetic crude oil similar to petroleum or a heavier liquid suitable for use as a boiler fuel.

A second reactor configuration using a fixed bed of catalyst is the basis of the Synthoil process, developed by the U.S. Bureau of Mines. A pilot plant is also planned to test this concept. Product distribution is expected to be similar to that of an H-Coal plant.

Indirect Synthesis Variations

Our program here is exploratory and there are no plans at the moment to construct a major pilot plant. However, a number of interesting variations are being explored and if successful, could be considered for testing at a larger scale.

I hope that this brief description of the OCR program - particularly its liquefaction activity - provides a perspective on the synthetic liquid fuels program at OCR. I realize it is difficult in a short time to cover the topic adequately, but even my brief description highlights the basic points.

1. Coal conversion is a complex technology
2. The optimum route to liquids from coal is at yet undetermined.

We would be pleased to arrange more extensive briefings on the entire Fossil Energy Program.

Because of the complexity of the technology a broad-based, integrated program is essential to success. Each of the processes I have described involves coal feeders, solid-liquid separation systems, cyclones, filters, pumps, valves, heat exchangers, and so forth, all of which need development within the coal handling context. The operability and reliability of these components are crucial to process success, and problems in development must be solved in an integrated way. One of the first facilities constructed by the Office of Coal Research was at Cresap, West Virginia, where a process to convert coal to gasoline was studied. This facility is now being operated as a component test facility where process equipment can be developed and tested under realistic conditions.

The multiplicity of approaches is likewise essential in a synthetic liquids program. The ultimate commercialization of a synthetic fuels process depends very heavily upon process efficiency and cost. Small increases

in process efficiency result in huge annual savings because of the large throughput of product. Ultimately, the country needs the best conversion schemes possible. However, it must be pointed out that coal itself varies widely in its properties, and an optimum process for eastern coal may not be suited to western coal. Thus, a parallel approach, not only in liquefaction but in coal conversion generally, is not a luxury but a necessity.

It is necessary to keep the program tracking constantly towards optimum process configurations. The Office of Coal Research supports several evaluation contractors whose responsibility is to provide continuing comparative evaluations of the process alternatives being considered. These studies are necessary for program guidance as well as development of realistic plans for demonstration plant projects.

The program plans, budget and personnel of the Office of Coal Research are now merging with similar resources from the U.S. Bureau of Mines in anticipation of joining the Energy Research and Development Administration. The Acting Director of OCR is Chairman of this activity. The experience of OCR in managing contract research programs will meld with the extensive in-house R&D capability of the U.S. Bureau of Mines energy centers to provide a unique fossil energy capability witin the Federal Government. We believe this capability will be the best instrument to carry out the intentions of this Subcommittee as expressed in H.R. 17400.

The intentions of the proposed legislation to encourage not only studies in the production of liquid fuels but demonstration projects as well, are likewise our intentions. In July of this year we issued a request for proposals for a demonstration plant to produce a clean boiler fuel from coal. The emphasis on boiler fuel was to provide a coal based fuel which could displace oil and gas from utility applications into residential and commercial uses. In this way coal can effectively stretch out supplies of oil and gas.

We received three proposals in response to this RFP, two of which we consider to be responsive. Contract negotiations are underway with one of these proposers and we could sign a contract for the initial phases of the project soon. The second contract could be signed early next year.

Each of the projects produces pipeline gas as a coproduct. The boiler fuel product will be tested by utilities and commercial users. The gas coproduct will be evaluated by gas utilities and their customers.

The final selection of the plant to be built will be made upon completion of the detailed plant designs and cost evaluations. We expect to have at least 50% cost sharing of the construction and operating costs of the selected facility which we expect will be only one step removed from commercialization. Our industrial partner will be completely involved in this venture. By this arrangement, we hope to ensure as efficient and cost effective a process as is possible. Coupled with the product testing I mentioned we hope not only to build a plant but to develop a sound basis for a synthetic fuels industry from mine to customer.

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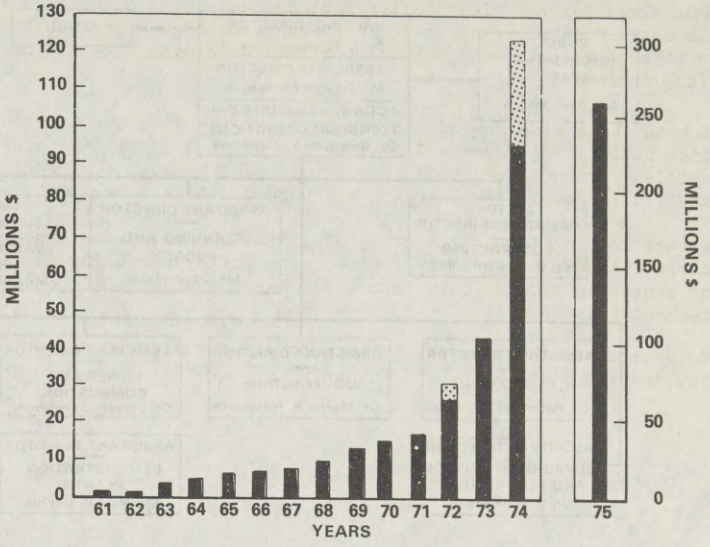
Our plans for the clean boiler fuel demonstration plant call for an 18 month design period, a 30 month construction period and at least 42 months to operate with several coals to determine reliable operating (and economic) data.

I cite these time periods to you this morning in order to illustrate the time scale involved in a demonstration plant program. Careful planning, skilled personnel and long term committment by both the Federal Government and its industrial partner are all needed.

We are looking forward to ERDA to provide the means for assembling all of these ingredients not only for a demonstration plant for the production of synthetic liquid fuels from coal, but for other coal conversion technologies as well.

We appreciate the opportunity to describe our program and our plans to you and are pleased to have provided our comments on H.R. 17400.

OFFICE OF COAL RESEARCH APPROPRIATIONS



TETRA TECH, INC.

FIGURE 1

OFFICE OF COAL RESEARCH

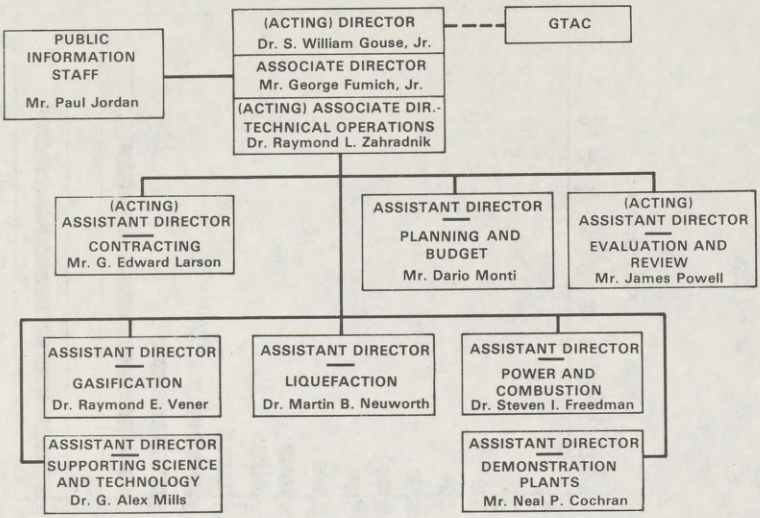


FIGURE 2

OFFICE OF COAL RESEARCH
FY 73 BUDGET AUTHORIZATIONS

PROGRAM	MILLIONS
LIQUEFACTION	$ 79.6
DEMONSTRATION PLANT	(24.0)
HIGH-BTU GASIFICATION	37.8
LOW-BTU GASIFICATION	49.0
DIRECT COMBUSTION	34.0
ADVANCED POWER SYSTEMS MHD	17.7
ADVANCED RESEARCH AND SUPPORT TECH.	19.1
SYSTEM STUDIES	2.5
PIONEER PLANTS	15.0
TOTAL R&D CONTRACTS PROGRAM	254.7
ADMINISTRATION	6.5
	261.2

FIGURE 3

Dr. ZAHRADNIK. As you on the committee realize, neither the production of synthetic liquid fuels nor Federal action in the demonstration plant area are new to this proposed legislation.

Nearly 50 years ago the first commercial synthetic liquid fuel plant was built at the Leuna works in Central Germany. This plant continued in operation through the Second World War, during which time it produced from coal over 15,000 barrels per day of aviation and motor gasoline.

As Congressman Perkins noted in his opening statement today, in the United States, passage of Public Law 290 in April 1944, permitted expansion of the U.S. Bureau of Mines program into the synthetic fuels area. A demonstration plant for the production of 200 barrels of oil per day was erected at Louisiana, Missouri, and began operation in 1949. During the next 4 years, six American coals were processed into gasoline and other fuels. Cost studies showed that the process was not competitive with gasoline from petroleum, and operations were terminated in June 1953.

Recollection of these past activities is neither the subject of my testimony, nor the topic of this hearing. But the half-century struggle by the scientific community to develop synthetic liquid fuel technology should alert us to the monumental size of the technical job, and the fact that today, over 30 years after passage of Public Law 290, we are considering similar legislation, speaks with equal eloquence to the magnitude of the marketing job.

In answer to a question that Congressman Hechler raised this morning, I would like to note that, and as Dr. Stever noted as well, there are activities of other nations as well as American industry in the synthetic fuels area. We in the Office of Coal Research are in good contact with all of these projects, both at home and abroad, and have developed our program plans with full cognizance of the work of others. In the synthetic liquids area, as across our entire program, we seek to develop national research and development plans which integrate Federal activity with that of the private sector and other nations.

Since this is an initial appearance of the Office of Coal Research before these subcommittees, may I introduce the OCR to you with a brief description of its history and program?

The Office of Coal Research was established by the Secretary of the Interior in 1971, pursuant to the Coal Research Act of July 1960, H.R. 3375. Its charter is to develop technology for new and more efficient methods of mining, preparing, and utilizing coal to insure abundant supplies of clean energy.

This particular slide, I think, is illustrative, Mr. Chairman, and simply shows the history of the Office of Coal Research, and the fact that it began its contract research program with an initial budget in 1961 of $1 million, and that budget grew slowly, reaching a total of $17 million in fiscal 1971.

However, the budget was increased to over $43 million in fiscal 1973, $125 million in fiscal 1974, and $261 million in fiscal 1975.

The Office of Coal Research is entirely a contract research office. The OCR procures through solicitation in the form of requests for proposals, as well as responses to unsolicited proposals. Its major pilot

and demonstration plant projects require substantial cost sharing on the part of the industrial participants. As of June 30, 1974, the OCR had awarded 160 contracts totaling $421 million. Of this total contractors have cost shared $80 million.

As of today, the OCR has obligated over $100 million of its fiscal year 1975 budget. This includes both new starts, as well as some continuations of existing contracts. This successful expansion has been the result of the dedicated efforts of the OCR to respond effectively to the energy research needs of the country through efficient procurement procedures and good program planning.

Mr. McCormack. Do you have any breakdown of who was receiving the grants, and how much the participants provided?

Dr. Zahradnik. A fairly substantial number of contracts have been written, Mr. Chairman. I would provide the breakdown for the record, which I would be pleased to do.

Mr. McCormack. I would be pleased to receive that and incorporate that in the record.

[The information to be provided is as follows:]

CURRENT LIST OF OFFICE OF COAL RESEARCH CONTRACTS

DECEMBER 20, 1974

CONTRACTS AWARDED BY THE OFFICE OF COAL RESEARCH

Date of Award	Estimated Total Cost	Contractor	Purpose
June 11, 1964 (125 months)	26,866,622 OCR-21,236,622 AGA- 5,630,000	Consolidation Coal Company Pittsburgh, Pennsylvania	The "CO_2 Acceptor Process" bench-scale research has been successfully completed and a pilot plant has been constructed to complete proof of the process. The pilot plant, completed in February 1972, is undergoing "shakedown" operations. Technical information and data based on operations will begin to accumulate during 1972. Assuming successful operations, a commercial plant producing pipeline gas from lignite could be in operation early in the 1980's. CONTRACT NO. 14-01-0001-415
May 11, 1965 (116 months 19 days)	426,960	Iowa State University of Science and Technology Ames, Iowa	Processes to be developed include use of electric energy as input to a fluidized bed of char to provide the heat necessary for the steam carbon reaction. The primary purpose of this work is production of hydrogen. Similar reactions can be postulated for high quality, low ash char for reaction with ammonia, sulfur, and with hydrogen to produce a number of chemical products. These alternates will be explored as well. CONTRACT NO. 14-01-0001-479
Sept. 26, 1966 (96 months)	2,629,463 OCR-2,386,131 Pa.- 243,332	The Pennsylvania State University University Park, Pa.	Work is jointly sponsored by the Pennsylvania State University, the Commonwealth of Pennsylvania, and OCR. For the purpose of identifying coal types and constituents which are best suited for conversion to liquids, gases, for use in sewage treatment, and for other special products which OCR is attempting to develop under its contract research program. The work also includes study of preparation of finely ground anthracite and to develop new markets and new uses for this material. CONTRACT NO. 14-01-0001-390
Oct. 10, 1966 (114 months)	41,943,466	The Pittsburg & Midway Coal Mining Co. Kansas City, Missouri	The research and development phases of the "Solvent Refined Coal Process" were completed under a contract with the Spencer Chemical Co. The Pittsburg & Midway Coal Mining Co., a subsidiary of Gulf Oil Co. (purchaser of Spencer Chemical Co.), was awarded a contract to design, construct, and operate a pilot plant to prove the process. The plant construction design is completed and negotiations for a construction contract are underway. The plant is scheduled for completion during 1973 and a 2-year operating period is projected. Construction of a commercial plant could be started during 1975. The solvent refined product will contain only minute quantities of sulfur and traces of ash, and will provide a substitute for coal to relieve pollution and meet combustion requirements. CONTRACT NO. 14-01-0001-496
Nov. 15, 1966 (103 months)	503,873 OCR- 487,808 WVU- 16,065	West Virginia University College of Engineering Morgantown, W.Va.	To investigate mathematical optimization of processes that can be applied to OCR's coal gasification projects. CONTRACT NO. 14-01-0001-497
Oct. 2, 1969 (63 months)	1,857,161 OCR- 1,583,727 Utah- 273,434	University of Utah Salt Lake City, Utah	Intermediate coal hydrogen process to produce synthetic crude oil, solid char fuel, and fuel gases. CONTRACT NO. 14-32-0001-1200
April 15, 1971 (62 months)	1,095,274	STD Research Corporation Pasadena, California	Realistic modeling and performance prediction of MHD generator channels. CONTRACT NO. 14-32-0001-1211
May 21, 1971 (40 months	729,091	Massachusetts Institute of Technology Cambridge, Mass.	To assist in the direction and performance evaluation of a coal-fired magnetohydrodynamic (MHD) electric generation research and development program. CONTRACT NO. 14-32-0001-1209
June 1, 1971 (42 months)	232,300	National Academy of Sciences Washington, D.C.	Independent engineering study and technical evaluation of current research and development efforts of coal gasification directed toward conversion of pipeline-quality gas, and an assessment of their promise for commercialization. CONTRACT NO. 14-32-0001-1216
June 18, 1971 (41 months 13 days)	6,226,500 OCR-3,773,000 Util. & Avco-2,453,500	Avco Everett Research Laboratory Everett, Massachusetts	Intensive research and development work directed toward the development of power generation by magnetohydrodynamics (MHD) by demonstrating long-duration (MHD) generator operation with the extraction of practical power levels from coal-fired, open-cycle (MHD) generators. CONTRACT NO. 14-32-0001-1208

CONTRACTS AWARDED BY THE OFFICE OF COAL RESEARCH

Date of Award	Estimated Total Cost	Contractor	Purpose
Aug. 2, 1971 (41 months)	1,494,199 OCR-1,314,199 TVA & U of T- 180,000	University of Tennessee Space Institute Tullahoma, Tennessee	Research and development work performed to determine properties of plasmas produced by the combustion of coal, char, and carbon monoxide. The plasmas will be needed to enable study of the electrical properties of plasmas and their interaction with a magnetic field to produce power in an MHD generator. Support of U.S./USSR MHD Cooperative Program. CONTRACT NO. 14-32-0001-1213
Aug. 3, 1971 (96 months)	120,000,000 OCR- 80,000,000 AGA- 40,000,000	Department of the Interior/ American Gas Association	Cooperative Coal Gasification Research Program.
Aug. 18, 1971 (40 months)	10,045,466	FMC Corporation Princeton, New Jersey	To conduct continuing research and development work on the COED Process (conducted previously under OCR Contract No. 14-01-0001-235 and Contract No. 14-01-0001-498, and their amendments), a process to convert coal by a multi-stage fluidized bed pyrolysis and subsequent hydrotreating of the pyrolysis-derived oil into a synthetic crude oil, a residue char, and pyrolysis off-gases. CONTRACT NO. 14-32-0001-1212
Aug. 19, 1971 (72 months)	66,000,000 OCR- 44,000,000 AGA- 22,000,000	Bituminous Coal Research, Inc. Monroeville, Pennsylvania	Intensive research performed leading to development of commercially economic equipment for gasifying of coal. Work under this contract is an extension of gasification research and development performed by the Contractor under Contract No. 14-01-0001-324, as amended. Such R & D work has indicated a sufficient degree of success for commercial operation. A pilot plant program to provide data for the commercial plant above is expected to start during FY-1972. CONTRACT NO. 14-32-0001-1207
Feb. 4, 1972 (53 months)	1,148,890 OCR-1,121,290 WVU- 27,600	West Virginia University School of Mines Morgantown, West Virginia	To expand the work effort performed under Contract No. 14-01-0001-488 to attempt to find practical uses for any and all of the waste products resulting from the mining, processing and utilization of coal. CONTRACT NO. 14-32-0001-1218
Mar. 10, 1972 (36 months)	$6.561 million OCR- 4.636 million USSEC- 1.925 million	USS Engineers and Consultants, Inc. Pittsburgh, Pennsylvania	Work will be conducted at Contractor's Applied Research Laboratory, Monroeville, Pa., Contractor will expedite design of a pilot plant to incorporate the Clean Coke Process for converting coal to a high-grade nonpolluting metallurgical coke, chemicals, and clean fuels. The processing scheme includes a new coke-making technique for steel industry which will reduce atmospheric pollution associated with conventional coke production. CONTRACT NO. 14-32-0001-1220
Mar. 24, 1972 (36 months)	323,960 OCR-282,646 CSM & State- 41,314	Colorado School of Mines University of Mineral Resources Golden, Colo.	To investigate the removal of sulfur from coal by hydrogen. Contractor will conduct a large number of statistically controlled experiments to determine the effect of many variables on sulfur removal from coal, the objective being development of a commercially feasible, nonpolluting energy source. CONTRACT NO. 14-32-0001-1225
Mar. 28, 1972 (60 months)	3,356,600	University of North Dakota College of Engineering Grand Forks, North Dakota	To develop one or more processes to upgrade Northern Great Plains lignite into clean fuel gas, liquid fuels, chemicals, and related products. Contractor will perform bench-scale and process development unit R & D to determine technology and practical economic yields of useful products. The project will culminate in design of a pilot plant. CONTRACT NO. 14-32-0001-1224
July 1, 1972 (48 months)	2,030,723 OCR-1,180,930 NSF- 849,793	Leland Stanford Junior Univ. Stanford, California	To investigate magnetohydrodynamic (MHD) phenomena at high magnetic fields to correlate the performance analyses and to provide a basis for extrapolation to other generator sizes and operating conditions, including the use of coal or coal-derived gas as a fuel. CONTRACT NO. 14-32-0001-1227
July 1, 1972 (48 months)	620,000	National Bureau of Standards U.S. Dept. of Commerce Washington, D.C.	This Interdepartmental Agreement requires research on MHD-related high-temperature materials. CONTRACT NO. 14-32-0001-1230

CONTRACTS AWARDED BY THE OFFICE OF COAL RESEARCH

Date of Award	Estimated Total Cost	Contractor	Purpose
Aug. 9, 1972 (26 months 22 days)	215,376	National Research Development Corporation London, England	To perform research to establish the effect on performance of operating at bed temperatures higher than have been investigated previously in pressurized fluidized combustion. CONTRACT NO. 14-32-0001-1511
Aug. 9, 1972 (108 months)	9,277,379 OCR-6,494,165 (Ind. (Team-2,783,214	Westinghouse Electric Corp. Heat Transfer Division Philadelphia, Pa.	The work on this contract will reduce to practice information that has been generated on fluidized-bed gasification systems. It will further apply the fluidized-bed gasification system to a combined-cycle electric generation system, providing an integrated gasification/combined-cycle generating system which will be of a commercial size and located on an electric utility generating system to provide verification of the technology and economics of this system functioning under actual commercial conditions. CONTRACT NO. 14-32-0001-1514
Aug. 21, 1972 * (19 months)	Letter Contract	Pittsburg & Midway Coal Mining Co. Merriam, Kansas	The objective of this program is to develop, design, construct, and operate a pilot plant to produce clean low-B.t.u. fuel gas from coal. The pilot plant gasifier will be an air-blown, pressurized, two-stage entrained flow gasifier, designed to gasify approximately 50 tons of coal per hour. The low-B.t.u. gas will be used as a fuel in an existing steam power generating unit. In addition, the gasification system will be connected to a combined-cycle electric generating system providing an integrated gasification combined-cycle generating system. CONTRACT NO. 14-32-0001-1521
Aug. 25, 1972 (29 months)	548,364	Air Products & Chemicals Allentown, Pa.	The objective of this program is to develop, demonstrate, and commercialize a novel technology for the removal of sulfur from producer gas in a fixed bed of lime or calcined dolomite at producer temperature and pressure. CONTRACT NO. 14-32-0001-1510
Sep. 1, 1972 (34 months)	4,331,043 OCR- 2,887,362 AGA- 1,443,681	C F Braun & Co Alhambra, Calif.	Evaluation of certain coal gasification processes and other work. CONTRACT NO. 14-32-0001-1235
Sep. 1, 1972 (34 months)	16,500,000 OCR-11,000,000 AGA- 5,500,000	Institute of Gas Technology Chicago, Ill.	The work under this contract is directed toward the continuation and expansion of the work previously performed under Contract No. 14-01-0001-381. CONTRACT NO. 14-32-0001-1221
Oct. 5, 1972 (48 months)	14,300,000	Pope, Evans and Robbins, Inc. New York, N.Y.	To design, construct, and test a multicell fluidized-bed boiler as a pollution-free method of burning high-sulfur coal or burning highly corrosive coals without excessive maintenance problems. This will be accomplished by designing, building, and operating a multicell fluidized-bed boiler under practical electric utility conditions. The work was initiated under Contracts No. 14-01-0001-478 and 14-32-0001-1229. CONTRACT NO. 14-32-0001-1237
Oct. 6, 1972 (35 months)	362,570	Battelle Memorial Institute Pacific Northwest Labs. Richland, Washington	The objective of this research is to develop a fused salt scrubber system for removal of flyash and sulfur compounds from low-B.t.u. fuel gas at high temperatures (1400° F. to 1700° F.) at ambient pressure. CONTRACT NO. 14-32-0001-1519
Oct. 31, 1972 (48 months)	1,601,930 OCR- 1,372,367 Par.- 229,563	Ralph M. Parsons Los Angeles, Calif.	To provide technical evaluation services to OCR to develop practical processes for producing liquid and/or solid fuels from coal. CONTRACT NO. 14-32-0001-1234
Nov. 7, 1972 (72 months)	1,365,000	Gilbert Associates Reading, Pa.	To provide technical and engineering services directed to the development of commercially attractive processes for converting coal to electric power. CONTRACT NO. 14-32-0001-1236
Nov. 15, 1972 (24 months)	145,175	M. W. Kellogg Houston, Texas	The objective of this contract is to complete technical, experimental, and economic studies of the Kellogg Molten Salt Gasification Process, used as a method for manufacturing carbon monoxide from carbon dioxide and char. CONTRACT NO. 14-32-0001-1233

CONTRACTS AWARDED BY THE OFFICE OF COAL RESEARCH

Date of Award	Estimated Total Cost	Contractor	Purpose
Jan. 2, 1973 (30 months)	1,885,794 OCR- 1,257,196 AGA- 628,598	Chem Systems, Inc. New York, New York	To develop a practical and useful process for converting coal-derived synthesis gases (largely carbon monoxide and hydrogen) to methane as the major constituent of synthetic natural gas, using liquid fluidized beds. CONTRACT NO. 14-32-0001-1505
Jan. 2, 1973 (30 months)	4,100,000 OCR- 2,733,333 AGA- 1,366,667	Battelle Columbus Laboratories Columbus, Ohio	Development of the Two-Stage Agglomerating Fluidized-Bed Process as a practical and economical method of producing hydrogen or synthesis gas (a mixture of hydrogen and carbon monoxide) from coal. The developed process is to be useful as part of a synthetic pipeline-gas producing system, as a fuel gas system, or for other purposes. CONTRACT NO. 14-32-0001-1513
Feb 16, 1973 (19 months)	133,850	Foster Associates Washington, D.C.	Objective: to measure in depth the potential regional markets for coal-conversion products over the period 1977 to 1985. CONTRACT NO. 14-32-0001-1509
May 1, 1973 (26 months)	18,160,062 OCR-12,106,708 AGA- 6,053,354	Institute of Gas Technology Chicago, Illinois	Objective: to provide for the design, construction, and operation of a pilot plant that will operate on char from the HYGAS Pilot Plant. It uses steam and iron oxide to produce hydrogen which is returned to the HYGAS reactor to increase its methane output. This makes possible a more complete utilization of the coal fed to the HYGAS plant. CONTRACT NO. 14-32-0001-1518
June 11, 1973 (30 months)	658,377	Hittman Associates, Inc. Columbia, Maryland	To investigate and evaluate the environmental and ecological problems associated with large-scale mining and coal-conversion processes, as well as the sociological impacts of such complexes. Recommendations for long-range end-use regional planning will be developed. CONTRACT NO. 14-32-0001-1508
June 29, 1973 (18 months)	1,422,953	Combustion Power Company, Inc. Menlo Park, California	Energy conversion from coal utilizing CPU-400 technology. (Letter contract) CONTRACT NO. 14-32-0001-1536
Aug 1, 1973 (42 months)	2,307,887	Fluor Utah, Inc. San Mateo, California	To determine and define the unique problems of producing coal in large quantities under varied physical, geographic, geologic, and climatic conditions to supply coal conversion complexes and to develop improved mining concepts and systems designed to produce coal at optimum cost, safety, continuity of supply, conservation of resources, and minimum environmental damage. CONTRACT NO. 14-32-0001-1520
Aug 3, 1973 (50 months)	2,575,000	Bituminous Coal Research, Inc. Monroeville, Pa.	To develop processes to gasify coal to produce fuel gas. Work was initiated under Contract No. 14-01-0001-324 and continued under Contract No. 14-32-0001-1207. CONTRACT NO. 14-32-0001-1527
Aug 6, 1973 (77 months)	300,000	Central Indiana County Water Authority	Agreement to supply water to OCR's Homer City, Pennsylvania, site. CONTRACT NO. 14-32-0001-1530
Sep 3, 1973 (16 months)	10,911	U.S. Atomic Energy Commission Argonne, Illinois	To support the U.S./USSR Cooperative Program in MHD Power Generation. CONTRACT NO. 14-32-0001-1727
Sep 13, 1973 (24 months)	211,144	University of Denver Research Institute Denver, Colorado	To perform study on the social, economic, and land use impacts of a Fort Union coal processing complex, including environmental impacts related to industrial and economic development. CONTRACT NO. 14-32-0001-1526

CONTRACTS AWARDED BY THE OFFICE OF COAL RESEARCH

Date of Award	Estimated Total Cost	Contractor	Purpose
Oct 1, 1973 (14 months)	232,677 OCR- 99,299 GE- 133,378	General Electric Co. Space Sciences Laboratory Philadelphia, Pennsylvania	Erection of a low-B.t.u. coal gas-fired, ceramic, regenerative heat exchanger as well as the integration of the fluid flow and diagnostic control and timing systems. Following construction, the heat exchanger will be operated by alternately passing hot combustion products and the inert working fluid through to determine contamination of the working fluid. CONTRACT NO. 14-32-0001-1533
Oct 15, 1973 (24 months)	1,035,781	Westinghouse Electric Corp. Pittsburgh, Pennsylvania	The work under this contract is a continuation of Contract No. 14-32-0001-1223, which will provide more extensive and detailed information in systems study and evaluation in magnetohydrodynamic (MHD) generators. CONTRACT NO. 14-32-0001-1540
Oct 29, 1973 (36 months)	3,450,000	U.S. Department of the Air Force Arnold Engineering Dev. Center Arnold AFS, Tennessee	Objective: to proceed with the detailed design, procurement, and fabrication of the equipment required to demonstrate the attainment of high MHD efficiency, and then to make the demonstration. The performance goal shall be a 20 percent enthalpy extraction at 60 to 70 percent isentropic efficiency and a 6.75 pressure ratio. The Contractor's existing equipment in the LORHO Pilot Facility will be utilized. CONTRACT NO. 14-32-0001-1542
Dec 1, 1973 (24 months)	10,200	Leland Stanford Jr. Univ. Stanford, California	To support the U.S./USSR Cooperative Program in MHD Power Generation. CONTRACT NO. 14-32-0001-1739
Dec 3, 1973 (14 months)	360,000	U.S. Atomic Energy Commission (AEC) Argonne, Illinois	The objective of this agreement is to utilize Argonne National Laboratory's instrumented and sophisticated 5-inch-diameter pressurized fluidized-bed combustor and professional staff to investigate basic research in fluid bed combustion. This basic research will include the development of advanced pressurized fluidized-bed combustor technology and investigate methods for reducing levels of such pollutants as SO_2 and NO_x. AEC, acting through its Argonne National Laboratory (ANL), shall also develop conceptual designs of future generation powerplants utilizing this technology. CONTRACT NO. 14-32-0001-1543
Dec 7, 1973 * (9 months)	99,801	McDowell Wellman Engineering Company Cleveland, Ohio	Engineering study to determine feasibility of constructing a large-diameter fixed-bed gasifier and to establish a preliminary design and cost estimate for such unit. CONTRACT NO. 14-32-0001-1524
Dec 10, 1973 (36 months)	537,600 OCR- 456,600 VPI- 81,000	Virginia Polytechnic Institute & State University Blacksburg, Virginia	To expand and further develop techniques for evaluating the engineering and safety factors involved in mining coal by underground methods so as to assure maximum conservation and recovery of the coal resource. These considerations must include all environmental impacts of the mining systems considered as well as the health and safety related directly to underground coal mining. CONTRACT NO. 14-32-0001-1231
Dec 21, 1973 (Unlimited)	-	Pennsylvania Electric Co. Johnstown, Pennsylvania	Right-of-way agreement to install a transmission line and power station at OCR's Homer City, Pennsylvania, site. CONTRACT NO. 14-32-0001-1547
Jan 2, 1974 (16 months)	201,023 OCR- 153,023 Cospon- 48,000	Stanford Research Institute Menlo Park, California	To determine the economic feasibility of a coal conversion facility in southcentral Alaska utilizing the large Beluga coal reserves. The current economic status of such a venture and also the potential economics for 1985 shall be examined. Technological advances shall be taken into account to ensure maximum economic incentives for commercial development. CONTRACT NO. 14-32-0001-1516

CONTRACTS AWARDED BY THE OFFICE OF COAL RESEARCH

Date of Award	Estimated Total Cost	Contractor	Purpose
Apr 4, 1974 (12 months)	300,000	State of Oklahoma	To determine technical as well as economic potential for the use of a high-temperature gas-cooled nuclear reactor as a source of process heat for the solution-gasification of coal. CONTRACT NO. 14-32-0001-1219
Apr 16, 1974 (24 months)	247,828	Dow Chemical Company Midland, Michigan	To estimate preliminary capital investment and operating costs for a commercial plant which would utilize coal liquefaction products for production of useful aliphatic and aromatic components. CONTRACT NO. 14-32-0001-1534
Apr 18, 1974 (24 months)	207,710	Eyring Research Institute Provo, Utah	To further investigate and develop a novel, high-rate, high-temperature gasification process--Fast Pyrolytic Gasification (FPG) Process--to produce in high efficiency (on a B.t.u. basis) an intermediate (300-400) B.t.u. gas from coal. CONTRACT NO. 14-32-0001-1548
May 1, 1974 (30 months)	2,250,000	Department of Housing & Urban Development	To develop one or more coal-fired power-plants for decentralized generation of electric power for M.I.U.S. CONTRACT NO. 14-32-0001-1742
May 16, 1974 (12 months)	1,000,000	Bureau of Mines Washington, D.C.	Design and construct a PDU to test the Synthoil Process for converting coal to low-sulfur fuel oil. CONTRACT NO. 14-32-0001-1729
May 17, 1974 (36 months)	13,582,000 OCR- 11,389,000 Fluor- 193,000 Allegheny- 2,000,000	Fluor Engineers and Constructors, Inc. Los Angeles, California	Development and testing of multiprocess equipment components of coal-to-liquid processes at Cresap which is to be restructured to handle this work. CONTRACT NO. 14-32-0001-1517
May 23, 1974 (12 months 2 weeks)	2,200	National Academy of Sciences Washington, D.C.	Partial support of Conference on Thermodynamics and National Energy Problems. CONTRACT NO. 14-32-0001-1741
May 29, 1974 (16 months)	413,205	Bechtel Corporation San Francisco, Calif.	To provide a means of evaluating the relative transportation economics of delivering energy from coal and/or conversion output products by various modes from the energy demand center. CONTRACT NO. 14-32-0001-1552
Jun 19, 1974 (9-1/2 months)	500,000	U.S. Department of Commerce Washington, D.C.	C T A B Panel on Project Independence Blueprint. Interagency Agreement 14-32-0001-1758
Jun 27, 1974 (36 months)	216,653 OCR- 191,996 VPI- 24,657	Virginia Polytechnic Institute and State University Blacksburg, Virginia	To investigate a novel stirred-tank reactor extractive coal hydrogenation process. The data obtained from this work, if promising, will serve as the basis for design of a process development unit for scaleup of the process. CONTRACT NO. 14-32-0001-1550
Jun 27, 1974 (36 months)	1,508,000	Atomic Energy Commission Germantown, Maryland	Interagency agreement concerning coal conversion programs: technical and scientific services; R & D and engineering services to provide information and data on conversion processes materials components and equipment; investigation and resolution of practical problems relating to economical system designs and operations; assistance in developing cost estimates of conversion processes and general laboratory services; and preparation and documentation of comparative conceptual designs for various coal conversion projects and processes encompassing pilot plant scale through commercial scale. AGREEMENT NO. 14-32-0001-1740

CONTRACTS AWARDED BY THE OFFICE OF COAL RESEARCH

Date of Award	Estimated Total Cost	Contractor	Purpose
June 28, 1974 (36 months)	264,062	IIT Research Institute Chicago, Illinois	To develop an economical process for the conversion of a coal-to-clean-fuel conversion (CCP) carbonaceous waste or byproduct to benzene carboxylic acids, preferably tetra- to hexacarboxylic acid mixes, for use in detergents and/or other applications. CONTRACT NO. 14-32-0001-1724
July 1, 1974 (36 months)	1,750,000 OCR- 875,000 NBS- 875,000	National Bureau of Standards Washington, D.C.	Utilization of contractor's capabilities to provide technical and scientific services to OCR for its coal conversion programs, including such tasks as evaluation of proposals received by OCR, and R & D and standards services to provide information and data on construction materials for conversion processes and on process chemistry. CONTRACT NO. 14-32-0001-1749
Aug 20, 1974 (15 months)	750,000	National Aeronautics and Space Administration (NASA) Washington, D.C.	For the conduct of a research study project related to coal energy conversion technology. NASA shall undertake an energy conversion alternative study (ECAS) to make an assessment of energy conversion systems on a common basis with respect to its impact on (a) economics, (b) natural resources, (c) environment, and (d) performance. CONTRACT NO. 14-32-0001-1751
Sep 4, 1974 (23 months)	8,132,596 OCR- 5,421,731 * - 2,710,865 *Contributors & Participants	Hydrocarbon Research, Inc. Washington, D.C.	Originally executed as a letter contract, December 1973. Definitive contract was executed September 1974 for pilot plant design as well as bench-scale operations for H-Coal Liquefaction Process. CONTRACT NO. 14-32-0001-1544
Sep 4, 1974 (150 days)	96,935	The Mitre Corporation McLean, Virginia	Planning assistance to OCR on advanced power cycles based on the use of coal to include advanced gas turbines, combine Brayton-Rankine cycles, MHD cycles, high temperature binary cycles, low temperature Rankine bottoming cycles, direct energy conversion, alkali metal systems, and fuel cells. CONTRACT NO. 14-32-0001-1746
Sep 4, 1974 (150 days)	99,095	The Mitre Corporation McLean, Virginia	Planning assistance for OCR on atmospheric and pulverized coal-fired, fluidized-bed combustion systems. CONTRACT NO. 14-32-0001-1748
Sep 7, 1974 (51 months 24 days)	156,000	Borough of Indiana (Pennsylvania)	The Borough will provide for disposal of waste effluent from OCR's coal gasification pilot plant at Homer City, Pennsylvania. CONTRACT NO. 14-32-0001-1538
Sep 15, 1974 (4-1/2 months)	24,620	Arthur D. Little, Inc. Cambridge, Massachusetts	Study to evaluate the benefit/cost methodology and application to advanced power cycles technology. CONTRACT NO. 14-32-0001-1756
Oct 1, 1974 (48 months)	3,607,660 OCR-13,739,389 C.E.- 6,869,695	Combustion Engineering, Inc. Windsor, Connecticut	A research and development effort relating to an entrained coal gasifier system with sulfur removal, to produce an environmentally clean low-B.t.u. gas from coal suitable for use in central station electric power generating plants. CONTRACT NO. 14-32-0001-1545
Oct 29, 1974 (12 months)	30,596	U.S. Department of the Navy Office of Naval Research	Government-sponsored research and development in the nonpropulsive power field. CONTRACT NO. 14-32-0001-1763
Oct 31, 1974 (12 months)	247,600	Institute of Gas Technology Chicago, Illinois	Preparation of a coal conversion systems technical data book. CONTRACT NO. 14-32-0001-1730

CONTRACTS AWARDED BY THE OFFICE OF COAL RESEARCH

Date of Award	Estimated Total Cost	Contractor	Purpose
Oct 31, 1974 (7 months)	36,460	University of Scranton Scranton, Pennsylvania	To arrange, convene, and conduct an advanced anthracite technology research conference. CONTRACT NO. 14-32-0001-1774
Nov 8, 1974 (12 months)	95,694	Systems Consultants, Inc. Washington, D.C.	This project is for the design and implementation of a project management and planning system for the demonstration plant program. CONTRACT NO. 14-32-0001-1771
Nov 25, 1974 (1 month)	99,770	TRW Systems Group TRW, Inc. Redondo Beach, California	Planning Assistance for the Office of Coal Research Liquefaction Program. CONTRACT NO. 14-32-0001-1755
Nov 25, 1974 (36 months)	2,990,892	The Ralph M. Parsons Company Pasadena, California	The objective of this contract is to provide technical evaluation services to the Office of Coal Research, U.S. Department of the Interior, to develop practical processes for producing liquid and/or solid fuels from coal. CONTRACT NO. 14-32-0001-1775
Nov 25, 1974 (21 months)	2,002,300	U.S. Atomic Energy Commission Argonne, Illinois	Continuation of a Development Program on Pressurized Fluidized-Bed Coal Combustion CONTRACT NO. 14-32-0001-1780
Nov 27, 1974 (7 months)	3,607,660 OCR-2,405,107 AGA-1,202,553	CONOCO Coal Development Co. Library, Pennsylvania	Test and evaluation of CO_2 Acceptor Process for production of pipeline-quality gas. CONTRACT NO. 14-32-0001-1734
Nov 29, 1974 (24 months)	111,946	Brigham Young University Provo, Utah	Study of the influence of mixing on kinetic processes in entrained coal gasifiers. CONTRACT NO. 14-32-0001-1767
Dec 3, 1974 (4-1/2 months)	44,425	Arthur D. Little, Inc. Cambridge, Massachusetts	A study to implement a multiyear project plan for OCR. CONTRACT NO. 14-32-0001-1750
Dec 3, 1974 (6 months) 1/	98,400	Tetra Tech, Inc. Arlington, Virginia	Technical support services for the Office of Coal Research. CONTRACT NO. 14-32-0001-1768
Dec 11, 1974 (12 months)	320,572	Fluidyne Engineering Corp. Minneapolis, Minnesota	Preliminary Design of a Single Air Heater Segment Suitable for a Coal-Fired, Open-Cycle Magnetohydrodynamic System. CONTRACT NO. 14-32-0001-1537
Dec 12, 1974 (40 months)	6,913,293	Atomics International Division Rockwell International Corporation Canoga Park, California	To perform intensive research leading to the development of commercially economic equipment for gasifying coal. CONTRACT NO. 14-32-0001-1529
Dec 12, 1974 (12 months)	195,140	Hudson Institute, Inc. New York, N.Y.	Research study of issues relative to the development and commercialization of a coal-derived synthetic liquids industry. CONTRACT NO. 14-32-0001-1752
Dec 12, 1974 (14-1/2 months)	568,000	Arthur D. Little, Inc. Cambridge, Massachusetts	Experimental study of an extractive coking process to produce low-sulfur liquid fuels from bituminous coal. CONTRACT NO. 14-32-0001-1754

1/ Awarded 12-3-74; however, work began 6-17-74 for completion 12-31-74.

CONTRACTS AWARDED BY THE OFFICE OF COAL RESEARCH

Date of Award	Estimated Total Cost	Contractor	Purpose
Dec 15, 1974 (1/2 month)	2,400	Walter Lobo, P.C. New Canaan, Connecticut	The Contractor shall provide necessary technical review of a contractor program. CONTRACT NO. 14-32-0001-1714.
Dec 23, 1974 (12 months)	270,000	Bureau of Mines Washington, D.C.	Extractive coking of bituminous coals to produce low-sulfur liquid fuels. CONTRACT NO. 14-32-0001-1753
1/	8,150,792	University of Tennessee University of Tennessee Space Institute Tullahoma, Tennessee	Development program for MHD direct coal-fired power generation test facility. CONTRACT NO. 14-32-0001-1760

1/ No effective date, no period of performance.

COMPLETE LIST OF OFFICE OF COAL RESEARCH

CONTRACTS SINCE OCR INCEPTION

DECEMBER 20, 1974

12-19-74

CONTRACTS AWARDED BY THE OFFICE OF COAL RESEARCH

	Date of Award	Estimated Total Cost	Contractor	Purpose
1.	Aug. 4, 1961 * (9 months)	$ 139,600	Booz, Allen & Hamilton, Inc. Chicago, Illinois	To identify new products, which are economically and technically marketable, that would expand present coal markets and generate new ones. The study has been completed. CONTRACT NO. 14-01-0001-223
2.	Oct. 5, 1961 * (24 months)	170,000	Bituminous Coal Research, Inc., Monroeville, Pa.	To study the preparation, transportation and utilization of superfine pulverized coal. Specific objectives are (1) to develop systems for preparing pulverized coal with the removal of sulfur and ash content, (2) to devise continuous transportation systems from mine to factory, and (3) to design and operate boilers to burn superfine coal in continuous sequence with transportation systems. CONTRACT NO. 14-01-0001-226
3.	Feb. 26, 1962 * (60 months)	164,185	Pope, Evans and Robbins New York, New York	To design and develop a new, completely integrated, coal-fired industrial heating plant of intermediate-size range requiring minimum attendance and space, and with initial and operating costs considerably more favorable than existing coal-fired equipment. CONTRACT NO. 14-01-0001-242
4.	March 29, 1962 * (30 months)	750,000	General Electric Company Schenectady, New York	To study the conversion of coal to gas liquid fuels and chemicals using electrical corona as the catalyst. CONTRACT NO. 14-01-0001-237
5.	March 29, 1962 * (27 months)	147,000	Virginia Polytechnic Inst. Blacksburg, Virginia	To develop scientific engineering methods and formulae for determining the most favorable combination of various elements in underground mining which can be controlled by the mine operator to insure lowest cost production under the physical conditions existing in his coal-producing sections or face areas. CONTRACT NO. 14-01-0001-243
6.	March 29, 1962 * (12 months)	24,000	Georgia Tech Research Inst., Atlanta, Georgia	To study the reactions which occur between pulverized coal and various gases at high temperatures, and to identify the products or compounds formed. CONTRACT NO. 14-01-0001-228
7.	May 16, 1962 * (53 months)	1,598,990	FMC Corporation (formerly Food Machinery & Chemical Corp.) Princeton, New Jersey	To determine the possibility of deriving from coal a synthetic crude oil of a kind that, mixed with the residue (char), can be transported by pipeline. CONTRACT NO. 14-01-0001-235
8.	May 16, 1962 * (90 months)	354,000	The Ralph M. Parsons Co. Los Angeles, California	To analyze the engineering and economic feasibility of a process owned by the Consolidation Coal Co., Pittsburgh, Pa., to convert coal into gasoline and to act as design consultants to OCR during pilot plant construction, operation and evaluation. CONTRACT NO. 14-01-0001-255
9.	Aug. 14, 1962 * (30 months)	139,140	Board of Governors of West Virginia University Morgantown, West Virginia	To determine and evaluate the economics of processing marginal by-product materials closely associated with mineable coal. CONTRACT NO. 14-01-0001-269
10.	Aug. 22, 1962 * (30 months)	1,240,000	Spencer Chemical Division Gulf Oil Corporation Kansas City, Missouri	To produce low-ash and low-sulfur coal through solvation techniques. CONTRACT NO. 14-01-0001-275
11.	Aug. 24, 1962 * (88 months)	(Co-Sponsored) OCR-$476,000 State of Utah $351,114	University of Utah Salt Lake City, Utah	Bench-scale testing of the response of powdered coal in an electric arc, by flash photolysis, and in other reactions, toward recommending a final process for converting Western coals into gaseous and liquid fuels. CONTRACT NO. 14-01-0001-271

* Completed.

CONTRACTS AWARDED BY THE OFFICE OF COAL RESEARCH

	Date of Award	Estimated Total Cost	Contractor	Purpose
12.	Aug. 24, 1962 * (16 months)	26,000	Endowment & Research Foundation, Montana State College, Bozeman, Montana	To determine the yield and composition of liquid and gaseous products from bituminous coals. CONTRACT NO. 14-01-0001-274
13.	Nov. 7, 1962 * (12 months)	86,000	Robert R. Nathan Associates, Inc., Washington, D. C.	To study the coal export potential, identify the impediments to the full achievement of that potential, and recommend actions by Government and industry for expanding coal exports. CONTRACT NO. 14-01-0001-258
14.	Dec. 6, 1962 * (92 months)	3,866,899	Westinghouse Electric Corp. Pittsburgh, Pennsylvania	To develop a fuel cell that can be incorporated into a coal reactor system, thus delivering an overall potential efficiency of 60 percent or more. The end result is to be construction of a thin film solid electrolyte system with a total output of about 100 watts. CONTRACT NO. 14-01-0001-303
15.	Aug. 30, 1963 * (108 months)	20,377,000	Consolidation Coal Company Pittsburgh, Pennsylvania	Laboratory research, pilot plant construction, and pilot plant operation were continued through March 1970. The pilot plant information indicated a verification of the laboratory results. Mechanical problems causing interruption to process runs and data collection precluded proof of the process. Currently planning is underway to modify the Project "Gasoline" pilot plant, Cresap, West Virginia, for evaluation and development of a process to produce low-sulfur fuel oil from coal to support and relieve the Nation's atmospheric pollution problem. CONTRACT NO. 14-01-0001-310
16.	Nov. 12, 1963 * (23 months)	200,895	Rand Development Corporation Cleveland, Ohio	This contract will explore methods for utilizing coal in the treatment of sewage and industrial wastes. An attempt will be made to develop integrated processes utilizing fine-size coal. The use of coal as an adsorbent, settling agent, flocculent, and filter aid will be explored for the purpose of facilitating removal of sewage and industrial wastes from water and subsequent use of the heating values of the coal in treatment and removal of solids for incineration heat or steam generation. CONTRACT NO. 14-01-0001-348
17.	Dec. 20, 1963 * (92 months)	4,000,000	Bituminous Coal Research, Inc., Monroeville, Pa.	This work seeks to evaluate alternate coal gasification methods and recommend one or more for larger scale work. The scale of effort on this contract is not expected to exceed process development scale in size. Such a unit will be designed, built, and operated to determine data needed for design of larger units, if the process appears promising. CONTRACT NO. 14-01-0001-324
18.	May 12, 1964 * (2 months)	8,500	Babcock & Wilcox Company Alliance, Ohio	Contractor is performing a variety of tests to ascertain combustion characteristics of low-ash coal under a variety of burning conditions. CONTRACT NO. 14-01-0001-418
19.	May 12, 1964 * (5 months)	5,180	Combustion Engineering, Inc. Windsor, Connecticut	Contractor is performing a variety of tests to ascertain combustion characteristics of low-ash coal under a variety of burning conditions. CONTRACT NO. 14-01-0001-417
20.	June 9, 1964 * (114 months)	583,164	Virginia Polytechnic Inst. Blacksburg, Virginia	The contractor has developed computer programs to solve in advance of mining complex engineering problems relative to mine power, ventilation, haulage and drainage systems. These are being field tested and improved. A program is now underway for the determination of safe and efficient pillar dimensions, subsidence requirements, room and entry dimensions, and anticipated requirements for adequate strata, pillar, and ground support. CONTRACT NO. 14-01-0001-410

* Completed.

CONTRACTS AWARDED BY THE OFFICE OF COAL RESEARCH

	Date of Award	Estimated Total Cost	Contractor	Purpose
21.	June 11, 1964 (125 months)	26,866,622 OCR-21,236,622 AGA- 5,630,000	Consolidation Coal Company Pittsburgh, Pennsylvania	The "CO_2 Acceptor Process" bench-scale research has been successfully completed and a pilot plant has been constructed to complete proof of the process. The pilot plant, completed in February 1972, is undergoing "shakedown" operations. Technical information and data based on operations will begin to accumulate during 1972. Assuming successful operations, a commercial plant producing pipeline gas from lignite could be in operation early in the 1980's. CONTRACT NO. 14-01-0001-415
22.	June 11, 1964 ** (60 months)	1,709,860	M. W. Kellogg Company New Market, New Jersey	For further development of a new coal-gasification process originated by Kellogg and based on a method of injecting steam and coal into a molten salt under pressure to produce a synthesis gas. By controlling the conditions of the reaction, gas can be "tailor made" for further processing into useful products. Major objectives are to produce pipeline gas (essentially methane) and hydrogen at competitive prices. A cost-saving feature of the process is that oxygen is not required. CONTRACT NO. 14-01-0001-380
23.	June 30, 1964 * (6 months)	24,750	Battelle Memorial Institute Columbus, Ohio	Market survey for low-ash coal. CONTRACT NO. 14-01-0001-471
24.	July 29, 1964 * (99 months)	18,481,230 OCR-16,506,230 AGA- 1,975,000	Institute of Gas Technology Chicago, Illinois	The IGT "HYGAS Process", jointly supported by the American Gas Association and OCR, has successfully completed both the research and pilot plant construction phases of the work. Startup operations have been underway during 1971, and operation to provide commercial plant design information is expected to become available during 1972 and 1973. If this work is completed on schedule, a first commercial pipeline-gas-from-coal plant can be completed before 1980. CONTRACT NO. 14-01-0001-381
25.	Aug. 10, 1964 * (66 months)	968,000	Atlantic Refining Company Philadelphia, Pennsylvania	A new process based on a method of feeding bituminous coal, together with crude oil residuum, into a fluid coking operation is now underway. The coal in "topped" and volatiles are removed for further processing into gasoline and other liquid fuels. If successful, there could be a substantial increase in coal usage in the many locations where oil refinery and coal-fired electric generating plants are located in relatively close proximity to one another. CONTRACT NO. 14-01-0001-473
26.	Oct. 12, 1964 * (25 months)	257,028	Robert R. Nathan Associates, Inc., Washington, D. C.	To make a study appraising intensively the potential markets for United States coal, including lignite, produced in the States west of the Mississippi River, including Alaska, and the constructive steps that may be taken toward achieving that potential. Analyze and project the potential market for Western coals, including lignite, to the year 1980 by major producing area, by major market area and end uses. CONTRACT NO. 14-01-0001-475
27.	Dec. 3, 1964 * (13 mos. 17 days)	59,000	Battelle Memorial Institute Columbus, Ohio	To survey the current and future cost and market potential for low-Btu industrial fuel gas and for hydrogen. CONTRACT NO. 14-01-0001-474

* Completed.
** Terminated 9/18/67.

CONTRACTS AWARDED BY THE OFFICE OF COAL RESEARCH

	Date of Award	Estimated Total Cost	Contractor	Purpose
28.	Feb. 4, 1965 ** (36 months)	2,063,750	Hydrocarbon Research, Inc. Washington, D. C. and Trenton, New Jersey	The contract will seek to develop a process for converting various coals to liquid products ranging from heavy fuel oils to high-octane gasoline, with minimum production of byproducts. The primary purpose of the work is to investigate the application to coal processing technology of improved methods for hydrogenation, gasification, and the manufacture of oxygen. CONTRACT NO. 14-01-0001-477
29.	Feb. 4, 1965 * (11 months)	113,000	Westinghouse Electric Corp. Pittsburgh, Pennsylvania	A preliminary study of the feasibility of magnetohydrodynamic (MHD) power generation using coal as fuel, and passing a hot ionized, and electrically conductive, gas through a magnetic field. CONTRACT NO. 14-01-0001-476
30.	Feb. 20, 1965 * (85 months)	956,550	Pope, Evans and Robbins New York, New York	An atmospheric pressure fluidized-bed process-development-scale boiler has been built and operated successfully over sustained periods. Ability to meet the most rigorous air pollution standards while burning high-sulfur coals has been demonstrated. Ash fouling and slagging problems common to other types of boiler have been eliminated. This work offers promise of improved efficiency and cleanliness when burning chars, anthracite, or coal in its conventional form and eliminates the need for pulverization of the coal feed. CONTRACT NO. 14-01-0001-478
31.	April 14, 1965 * (12 months)	92,000	W. B. Saunders & Company Washington, D. C.	The study is to analyze the coal distribution system for shipments of bituminous coal and anthracite from several ports on the Atlantic seaboard to Germany, Italy, and Japan, as well as the related inland routes, and to identify alternative techniques which offer the greatest potential for lowering the delivered cost of export coal. CONTRACT NO. 14-01-0001-480
32.	May 11, 1965 (116 months 19 days)	426,960	Iowa State University of Science and Technology Ames, Iowa	Processes to be developed include use of electric energy as input to a fluidized bed of char to provide the heat necessary for the steam carbon reaction. The primary purpose of this work is production of hydrogen. Similar reactions can be postulated for high quality, low ash char for reaction with ammonia, sulfur, and with hydrogen to produce a number of chemical products. These alternates will be explored as well. CONTRACT NO. 14-01-0001-479
33.	May 26, 1965 * (26 months)	364,000	Melpar, Inc. Falls Church, Virginia	The process that Melpar will investigate is a potentially improved method for manufacturing acetylene by converting the carbon in coal to a vapor phase carbide. The carbide, when reacted with water, produces the acetylene. CONTRACT NO. 14-01-0001-472
34.	June 25, 1965 * (15 months)	108,963	The M. W. Kellogg Company New Market, New Jersey	Research work directed to establishing feasibility and costs of water desalination plants combined with electric generating plants. CONTRACT NO. 14-01-0001-481
35.	Aug. 25, 1965 * (59 months)	1,686,798	Rand Development Corporation Cleveland, Ohio	Construction and operation of a pilot plant for coal-sewage treatment processing employing filtration-adsorption process. CONTRACT NO. 14-01-0001-483
36.	Nov. 12, 1965 * (14 months)	109,000	Booz, Allen & Hamilton Washington, D. C.	To analyze and project the potential industrial coal market in the eastern half of the United States to the year 1975 for each pertinent industry, taking into consideration (a) the rate of output-growth in the over-all economy, (b) the rate of output-growth in major coal-consuming industries, (c) shifts in industry location and production mix, (d) basic fossil fuel supply trends, (e) fuel transportation developments and costs, and (f) developments in basic energy technology. CONTRACT NO. 14-01-0001-486

* Completed.
** Terminated 9/18/67.

CONTRACTS AWARDED BY THE OFFICE OF COAL RESEARCH

	Date of Award	Estimated Total Cost	Contractor	Purpose
37.	November 24, 1965 * (34 months)	406,000	Combustion Engineering, Inc. Windsor, Connecticut	A study of causes of corrosion of the exterior surfaces of high temperature electric utility boiler tubes, and practical methods of preventing such corrosion. The work will attempt to pinpoint the reactions responsible for the corrosion and the elements or compounds in the coal which make them possible, attempt to determine simple low-cost modifications to eliminate the undesirable materials or to neutralize them with other minerals or materials available at the mine site. CONTRACT NO. 14-01-0001-485
38.	Dec. 6, 1965 * (74 months)	811,950	West Virginia University Morgantown, West Virginia	Construction and operation of a pilot plant in the Morgantown area to produce high-quality structural building materials using flyash and bottom ash to provide the necessary background and design information for the construction of commercial plants by private industry. CONTRACT NO. 14-01-0001-488
39.	Dec. 30, 1965 * (10 months)	91,845	Arthur D. Little, Inc. Cambridge, Massachusetts	To analyze (1) factors affecting the requirements for fuels in New England States to 1980, including existing or developing plans for expansion of system capacity electric generation, anticipated technological, economic, and regulatory changes; (2) the present and projected costs for delivering coal to New England locations; (3) the delivered prices coal will have to achieve in that market; and (4) opportunities for reducing the cost of transportation, storage, and handling of coal delivered to that market, including power transmission. CONTRACT NO. 14-01-0001-489
40.	April 22, 1966 * (6 weeks)	24,500	Blaw-Knox Company Pittsburgh, Pennsylvania	Feasibility Study - Project COED (Char-Oil-Energy Development) - Contract No. 14-01-0001-235. CONTRACT NO. 14-01-0001-155
41.	May 10, 1966 ** (48 months)	1,200,000	Gourdine Systems, Inc. Livingston, New Jersey	To develop a practical process for generating commercial electric power by means of a coal-fired Electro-gasdynamic (EGD) generator. The work under the contract is directed primarily toward a system producing 375,000 volts direct current, although alternating current may be demonstrated by modulating the corona discharge. If DC generation is successful, this contract could result in the precursor of direct-current systems. CONTRACT NO. 14-01-0001-495
42.	May 10, 1966 * (32 months 21 days)	229,350	Howard University Washington, D. C.	To develop practical and economic diesel-cycle internal combustion engines employing coal as a primary fuel. CONTRACT NO. 14-01-0001-491
43.	May 11, 1966 * (69 months)	1,821,000	Avco Corporation Lowell, Massachusetts	For the development of processes for the electric-arc treatment of coal. During the first phase of the work, the Contractor will build a small scale unit and operate it with a wide range of United States coals to determine the practicality of the process, including necessary operating conditions and yields of products. The second phase will concentrate on the development of practical electrical and mechanical designs and operating methods necessary for commercial application. CONTRACT NO. 14-01-0001-493
44.	June 28, 1966 * (32 months)	203,442	The Franklin Institute Philadelphia, Pennsylvania	For the development of the Szikla-Rozinek combustion system to gasify coal. The first phase will be a study of the behavior of coal particles under a wide range of conditions simulating those possible in the Szikla-Rozinek combustor. If this work is encouraging, the second phase will include the construction and test operation of an experimental unit with a capacity of 100 pounds of coal an hour and conclude with an evaluation of possible commercial applications. The study of a liquid ammonia cycle bottoming steam plant will also be included. CONTRACT NO. 14-01-0001-494

* Completed.
** Terminated 9/25/68.

CONTRACTS AWARDED BY THE OFFICE OF COAL RESEARCH

	Date of Award	Estimated Total Cost	Contractor	Purpose
45.	Aug. 26, 1966 * (32 months)	386,100 OCR- 289,575 C/PA.- 96,525	Dorr-Oliver, Inc./ Commonwealth of Pa. Stamford, Connecticut/ Harrisburg, Pa.	Contract co-funded with the Commonwealth of Pennsylvania is directed toward determining economic and technical feasibility of using Pennsylvania anthracite culm bank material as a base for making brick and other construction material using the OCR-West Virginia University process. CONTRACT NO. 14-01-0001-492
46.	Aug. 26, 1966 * (60 days)	15,000	United Engineers & Constructors, Inc. Jackson & Moreland Div.	Complete technical and economic review, and independent evaluation made of "Project Fuel Cell" being performed by Westinghouse Electric Corporation - Contract No. 14-01-0001-303, and of the achievements made to date under the contract. CONTRACT NO. 14-01-0001-500
47.	Sept. 9, 1966 ** (36 months)	16,800	West Virginia Institute of Technology Montgomery, West Virginia	To develop the economic feasibility of converting low-temperature carbonization products into antioxidants used in the manufacture of rubber products. CONTRACT NO. 14-01-0001-487
48.	Sept. 26, 1966 (96 months)	2,629,463 OCR-2,386,131 Pa.- 243,332	The Pennsylvania State University University Park, Pa.	Work is jointly sponsored by the Pennsylvania State University, the Commonwealth of Pennsylvania, and OCR. For the purpose of identifying coal types and constituents which are best suited for conversion to liquids, gases, for use in sewage treatment, and for other special products which OCR is attempting to develop under its contract research program. The work also includes study of preparation of finely ground anthracite and to develop new markets and new uses for this material. CONTRACT NO. 14-01-0001-390
49.	Sept. 29, 1966 * (59 mos. 2 days)	11,200,000	FMC Corporation Princeton, New Jersey	Intensive research and development work directed toward the continuation of Project COED (Char-Oil-Energy-Device), a process for converting coal by multistage pyrolysis into useful liquid and char (which can be transported in a common pipeline) and gases. CONTRACT NO. 14-01-0001-498
50.	Oct. 10, 1966 (114 months)	41,943,466	The Pittsburg & Midway Coal Mining Co. Kansas City, Missouri	The research and development phases of the "Solvent Refined Coal Process" were completed under a contract with the Spencer Chemical Co. The Pittsburg & Midway Coal Mining Co., a subsidiary of Gulf Oil Co. (purchaser of Spencer Chemical Co.), was awarded a contract to design, construct, and operate a pilot plant to prove the process. The plant construction design is completed and negotiations for a construction contract are underway. The plant is scheduled for completion during 1973 and a 2-year operating period is projected. Construction of a commercial plant could be started during 1975. The solvent refined product will contain only minute quantities of sulfur and traces of ash, and will provide a substitute for coal to relieve pollution and meet combustion requirements. CONTRACT NO. 14-01-0001-496
51.	Nov. 15, 1966 (103 months)	503,873 OCR- 487,808 WVU- 16,065	West Virginia University College of Engineering Morgantown, W.Va.	To investigate mathematical optimization of processes that can be applied to OCR's coal gasification projects. CONTRACT NO. 14-01-0001-497
52.	Jan. 4, 1967 * (18 months)	176,000	Stanford Research Institute Menlo Park, California	The Institute will seek to develop a process for treating coal in a high-temperature gas stream (plasma) to produce useful gaseous, liquid, and chemical products. CONTRACT NO. 14-01-0001-490
53.	April 13, 1967 * (4 months)	22,500	American Oil Company Whiting, Indiana	To make a complete technical and economic review and independent evaluation of "Project H-Coal" being performed by Hydrocarbon Research, Inc. (HRI), Division of Dynalectron, Inc.; under Contract No. 14-01-0001-477, and of the achievement under that contract, including an evaluation of the technical feasibility of the project as to coal liquefaction processes and suitability of the crude products for further conversion into saleable products. CONTRACT NO. 14-01-0001-1188

* Completed.
** Terminated 1/9/69.

CONTRACTS AWARDED BY THE OFFICE OF COAL RESEARCH

	Date of Award	Estimated Total Cost	Contractor	Purpose
54.	April 24, 1967 * (24 months)	241,798	Consolidated Controls Corp. Bethel, Connecticut	The work under this contract is directed toward design, construction, and testing of thermionic generators as prototypes of units capable of producing commercially usable alternating-current electric power by direct radiation of thermal energy from pulverized coal flame in standard central station steam-generator furnaces. CONTRACT NO. 14-01-0001-499
55.	June 12, 1967 * (3 months)	25,000	Dynatech Corporation Cambridge, Massachusetts	To provide an independent evaluation of OCR's program covering coal-fired electrogasdynamic (EGD) system of extra high voltage direct current power generation being performed by Gourdine Systems, Inc., under Contract No. 14-01-0001-495, and achievements made to date, and as to the feasibility of future plans of Gourdine. Also to make an independent evaluation and report on: OCR's Proposal Nos. 411 - "Gas Flywheel Heat-Electric Power Converter"; 412 "Periodic Pulse Generator for Suppressed Gas Ionization," and 432 "Development of an Electrogasdynamic Generator with Controlled Motion of Charges." CONTRACT NO. 14-01-0001-1191
56.	June 12, 1967 * (15 months)	53,400	Battelle Memorial Inst. Columbus, Ohio	The work to be performed under this contract is directed toward identification of sizeable and promising markets, both combustion and non-combustion, for solid low-volatile residue ("char") deriving from OCR-developed projects aimed at the production of liquid gaseous hydrocarbon products. CONTRACT NO. 14-01-0001-1190
57.	Aug. 16, 1967 * (15 months)	61,495	Skeist Labs., Inc. Newark, New Jersey	A survey of the potential markets for commercial by-product chemicals resulting from OCR projects for conversion of coal to liquids and gases. CONTRACT NO. 14-01-0001-1192
58.	March 29, 1968 * (17 months)	63,197	R. L. Banks & Associates, Inc. Washington, D. C.	To assess the marketing opportunities for U. S. coal in Canada-Phase I, and to re-examine the transportation factors and recommend opportunities to achieve lower transportation costs through changes in transportation practices and technology. CONTRACT NO. 14-01-0001-1189
59.	June 18, 1968 * (6 weeks)	2,400	Iowa State University Ames, Iowa	Evaluation study of the EGD Process CONTRACT NO. 14-01-0001-1193
60.	June 18, 1968 * (6 weeks)	2,200	Dynatech Corporation Cambridge, Massachusetts	Evaluation study of the EGD Process CONTRACT NO. 14-01-0001-1194
61.	June 18, 1968 * (6 weeks)	2,500	Illinois Institute of Tech. Chicago, Illinois	Evaluation study of the EGD Process CONTRACT NO. 14-01-0001-1195
62.	Oct. 18, 1968 * (3 months)	2,400	Westinghouse Elec. Corp. Pittsburgh, Pennsylvania	MHD Study CONTRACT NO. 14-01-0001-1197
63.	Nov. 27, 1968 * (63 months)	613,720	University of Wyoming Laramie, Wyoming	The work to be performed under this contract is directed toward the development of a process for the direct reaction of either coal and steam, or char and steam, in a fluidized bed to produce hydro-carbons and oxygenated products using a multiple catalyst system. CONTRACT NO. 14-01-0001-1196
64.	Dec. 11, 1968 * (13 months)	3,500	Dr. Wilburn Schroeder Schroeder Associates College Park, Maryland	Evaluation of Project Gasoline
65.	Dec. 19, 1968 * (13 months)	1,900	American Oil Company Whiting, Indiana	Evaluation of Project Gasoline

* Completed.

CONTRACTS AWARDED BY THE OFFICE OF COAL RESEARCH

	Date of Award	Estimated Total Cost	Contractor	Purpose
66.	June 30, 1969 * (7 months)	1,800	Westinghouse Electric Corp. Pittsburgh, Pennsylvania	MHD Study CONTRACT NO. 14-01-0001-1199
67.	July 2, 1969 * (9 months)	49,987 OCR-24,994 OSW-24,993	Office of Saline Water & Sanderson & Porter, Inc. New York, New York	A cost study of the steam supply for desalination using coal-fired boilers. CONTRACT NO. 14-01-0001-2187
68.	Aug. 14, 1969 * (6 weeks)	2,450	University of Maryland College Park, Maryland	Evaluation study of the EGD process
69.	Oct. 2, 1969 (63 months)	1,857,161 OCR- 1,583,727 Utah- 273,434	University of Utah Salt Lake City, Utah	Intermediate coal hydrogen process to produce synthetic crude oil, solid char fuel, and fuel gases. CONTRACT NO. 14-32-0001-1200
70.	Nov. 24, 1969 * (3 months)	2,500	Avco Everett Research Lab. Everett, Massachusetts	To study a Char-burning MHD Power System CONTRACT NO. 14-32-0001-1201
71.	March 23, 1970 * (7 months)	13,150	National Academy of Engineering Washington, D. C.	Engineering Evaluation of Project Gasoline CONTRACT NO. 14-32-0001-1202
72.	April 24, 1970 * (120 days)	80,375	Foster Wheeler Corporation Livingston, New Jersey	Complete independent engineering evaluation made of "Project Gasoline," a pilot plant research project being performed by Consolidation Coal Company under Contract No. 14-01-0001-310, and of the achievements made to date under that contract. CONTRACT NO. 14-32-0001-1203
73.	June 15, 1970 * (3 months)	50,000	Air Products and Chemicals Inc. Allentown, Pennsylvania	Complete independent engineering study and technical evaluation made of the "Two stage Super Pressure Gasification Process" being performed by Bituminous Coal Research, Inc., under Contract No. 14-01-0001-324 and of the achievements made to date under that contract. CONTRACT NO. 14-32-0001-1204
74.	June 25, 1970 * (345 days)	31,500	Sverdrup & Parcel and Associates, Inc. St. Louis, Missouri	Complete independent engineering study and technical evaluation made of the "Coal Sewage-Treatment Pilot Plant" being performed by Rand Development Corporation, under Contract No. 14-01-0001-483, and of the achievements made to date under that contract. CONTRACT NO. 14-32-0001-1205
75.	Nov. 16, 1970 * (4 weeks)	7,500	Hydrocarbon Research, Inc. Trenton, New Jersey	Survey of Project Gasoline Pilot Plant, Cresap, West Virginia, to obtain information needed to prepare a cost estimate for converting OCR's Cresap Pilot Plant to the H-Coal Process to produce low sulfur fuel oil.
76.	Dec. 4, 1970 * (90 days)	11,300	Air Products & Chemicals, Inc. Allentown, Pa.	Provide an evaluation, design and construction drawings of the coal transfer system described in Proposal No. 549.
77.	Dec. 14, 1970 * (5 mos. 30 days)	25,000	Massachusetts Institute of Technology Cambridge, Mass.	To provide expert assistance to the overall effort by examining and evaluating present state-of-the-art, ongoing work, proposed work and recommending an overall MHD program.
78.	Feb. 1, 1971 * (4 mos. 30 days)	20,000	University of Tennessee Space Institute Tullahoma, Tenn.	To determine properties of plasmas produced by the combustion of char and carbon monoxide.
79.	April 15, 1971 (62 months)	1,095,274	STD Research Corporation Pasadena, California	Realistic modeling and performance prediction of MHD generator channels. CONTRACT NO. 14-32-0001-1211
80.	April 28, 1971 * (120 days)	35,000	American Oil Company Whiting, Indiana	Review available data on the COED process and processes for gasification of char. CONTRACT NO. 14-32-0001-1210

* Completed.

CONTRACTS AWARDED BY THE OFFICE OF COAL RESEARCH

	Date of Award	Estimated Total Cost	Contractor	Purpose
81.	May 21, 1971 (40 months	729,091	Massachusetts Institute of Technology Cambridge, Mass.	To assist in the direction and performance evaluation of a coal-fired magnetohydrodynamic (MHD) electric generation research and development program. CONTRACT NO. 14-32-0001-1209
82.	June 1, 1971 (42 months)	232,300	National Academy of Sciences Washington, D.C.	Independent engineering study and technical evaluation of current research and development efforts of coal gasification directed toward conversion of pipeline-quality gas, and an assessment of their promise for commercialization. CONTRACT NO. 14-32-0001-1216
83.	June 18, 1971 (41 months 13 days)	6,226,500 OCR-3,773,000 Util. & Avco-2,453,500	Avco Everett Research Laboratory Everett, Massachusetts	Intensive research and development work directed toward the development of power generation by magnetohydrodynamics (MHD) by demonstrating long-duration (MHD) generator operation with the extraction of practical power levels from coal-fired, open-cycle (MHD) generators. CONTRACT NO. 14-32-0001-1208
84.	Aug. 2, 1971 (150 days) *	37,070	Blaw-Knox Chemical Plants, Inc. Pittsburgh, Pennsylvania	A complete technical review and independent evaluation of the Arc Process for Acetylene from Coal being performed by the Avco Corp., under Contract No. 14-01-0001-493, and the achievements made to date under that contract. CONTRACT NO. 14-32-0001-1215
85.	Aug. 2, 1971 (41 months)	1,494,199 OCR-1,314,199 TVA & U of T- 180,000	University of Tennessee Space Institute Tullahoma, Tennessee	Research and development work performed to determine properties of plasmas produced by the combustion of coal, char, and carbon monoxide. The plasmas will be needed to enable study of the electrical properties of plasmas and their interaction with a magnetic field to produce power in an MHD generator. Support of U.S./ USSR MHD Cooperative Program. CONTRACT NO. 14-32-0001-1213
86.	Aug. 3, 1971 (96 months)	120,000,000 OCR- 80,000,000 AGA- 40,000,000	Department of the Interior/ American Gas Association	Cooperative Coal Gasification Research Program.
87.	Aug. 18, 1971 (40 months)	10,045,466	FMC Corporation Princeton, New Jersey	To conduct continuing research and development work on the COED Process (conducted previously under OCR Contract No. 14-01-0001-235 and Contract No. 14-01-0001-498, and their amendments), a process to convert coal by a multi-stage fluidized bed pyrolysis and subsequent hydrotreating of the pyrolysis-derived oil into a synthetic crude oil, a residue char, and pyrolysis off-gases. CONTRACT NO. 14-32-0001-1212
88.	Aug. 19, 1971 (72 months)	66,000,000 OCR- 44,000,000 AGA- 22,000,000	Bituminous Coal Research, Inc. Monroeville, Pennsylvania	Intensive research performed leading to development of commercially economic equipment for gasifying of coal. Work under this contract is an extension of gasification research and development performed by the Contractor under Contract No. 14-01-0001-324, as amended. Such R & D work has indicated a sufficient degree of success for commercial operation. A pilot plant program to provide data for the commercial plant above is expected to start during FY-1972. CONTRACT NO. 14-32-0001-1207
89.	Oct. 7, 1971 (120 days) *	39,650	Foster Wheeler Corporation Livingston, New Jersey	Technical review, and an engineering review and evaluation of the process data and information of the Consol Synthetic Liquid Fuel (CSLF) Process being performed by Consolidation Coal Company under Contract No. 14-01-0001-310 and achievements of the process for production of low-sulfur fuels. CONTRACT NO. 14-32-0001-1217
90.	Jan. 3, 1972 (90 days) *	2,200	Jackson & Moreland Division United Engineers & Constructors, Inc. Boston, Massachusetts	Examine OCR Proposal #586 and its supporting documents as well as the state-of-the-art of present and potentially advanced methods of electric power generation, and prepare a report. The report shall state the Contractor's opinion of the feasibility of the work proposed, its potential for success, and its value if successful CONTRACT NO. 14-32-0001-1226

* Completed.

CONTRACTS AWARDED BY THE OFFICE OF COAL RESEARCH

Date of Award	Estimated Total Cost	Contractor	Purpose
91. Feb. 4, 1972 (53 months)	1,148,890 OCR-1,121,290 WVU- 27,600	West Virginia University School of Mines Morgantown, West Virginia	To expand the work effort performed under Contract No. 14-01-0001-488 to attempt to find practical uses for any and all of the waste products resulting from the mining, processing and utilization of coal. CONTRACT NO. 14-32-0001-1218
92. Mar. 7, 1972 (36 months)	2,320,000 OCR- 1,600,000 MBM- 720,000	U.S. Bureau of Mines Bruceton, Pennsylvania	The work to be performed by the Bureau of Mines under the terms of the interagency agreement requires the construction of a three-stage, high-temperature coal combustion system intended to produce a hot, ash-free gas. The system shall have a capacity of approximately 1,000 pounds per hour of wet coal feed and operate at air preheat temperature up to 2100° F. with provision for flue gas recycle, ash recycle and slag removal. Various stages of the work will involve investigation of slag removal, heat losses, refractory wall design, gasification and combustion efficiency, slag vaporization and flow, burning rate, etc.
93. Mar. 10, 1972 * (13 months)	99,190	Department of the Air Force Headquarters, Arnold Engineering Development Center (AFSC) Arnold Air Force Station, Tennessee	This contract is to develop design criteria, including cost estimates, for a short-term, highpowered, magnetohydrodynamic (MHD) electric generator, based upon maximum use of existing facilities and equipment at AEDC. The operating conditions for such a generator shall consist of such important characteristics as combustion pressure, temperature, working fluid, mass flow, as well as channel/magnet combination and configuration. CONTRACT NO. 14-32-0001-1228
94. Mar. 10, 1972 (36 months)	$6.561 million OCR- 4.636 million USSEC- 1.925 million	USS Engineers and Consultants, Inc. Pittsburgh, Pennsylvania	Work will be conducted at Contractor's Applied Research Laboratory, Monroeville, Pa., Contractor will expedite design of a pilot plant to incorporate the Clean Coke Process for converting coal to a high-grade nonpolluting metallurgical coke, chemicals, and clean fuels. The processing scheme includes a new coke-making technique for steel industry which will reduce atmospheric pollution associated with conventional coke production. CONTRACT NO. 14-32-0001-1220
95. Mar. 24, 1972 (36 months)	323,960 OCR-282,646 CSM & State- 41,314	Colorado School of Mines University of Mineral Resources Golden, Colo.	To investigate the removal of sulfur from coal by hydrogen. Contractor will conduct a large number of statistically controlled experiments to determine the effect of many variables on sulfur removal from coal, the objective being development of a commercially feasible, nonpolluting energy source. CONTRACT NO. 14-32-0001-1225
96. Mar. 28, 1972 (60 months)	3,356,600	University of North Dakota College of Engineering Grand Forks, North Dakota	To develop one or more processes to upgrade Northern Great Plains lignite into clean fuel gas, liquid fuels, chemicals, and related products. Contractor will perform bench-scale and process development unit R & D to determine technology and practical economic yields of useful products. The project will culminate in design of a pilot plant. CONTRACT NO. 14-32-0001-1224
97. May 12, 1972 * (6 months)	42,595 (not to exceed)	Pope, Evans and Robbins, Inc. Alexandria, Virginia	The objective of this Purchase Order (A-5088) is to conduct research directed toward verifying and demonstrating small-scale experimental work performed under Contract 14-32-0001-1229 wherein it was found that addition of small quantities of common salt to a fluidized bed of coal and limestone served to retain sulfur in the fly-ash, reduce sulfur oxide emissions from the burning of high-sulfur coal to levels well below existing and proposed Federal and local regulations. CONTRACT NO. 14-32-0001-1229

* Completed.

CONTRACTS AWARDED BY THE OFFICE OF COAL RESEARCH

	Date of Award	Estimated Total Cost	Contractor	Purpose
98.	June 30, 1972 ** (36 months)	5,719,590 OCR-5,394,450 W. - 325,140	Westinghouse Electric Corp. Pittsburgh, Pa.	The work on this contract is to provide more extensive and detailed information in systems study and evaluation in power generation devices, magnetohydrodynamic generators, fuel cells, and gas turbines; in fuel gas cleaning by cyclones and precipitators; in H_2 generation for coal gasification and/or gaseous and liquid fuel coproduct production; and in superconductive d.c. transmission. CONTRACT NO. 14-32-0001-1223
99.	July 1, 1972 (48 months)	2,030,723 OCR-1,180,930 NSF- 849,793	Leland Stanford Junior Univ. Stanford, California	To investigate magnetohydrodynamic (MHD) phenomena at high magnetic fields to correlate the performance analyses and to provide a basis for extrapolation to other generator sizes and operating conditions, including the use of coal or coal-derived gas as a fuel. CONTRACT NO. 14-32-0001-1227
100.	July 1, 1972 (48 months)	620,000	National Bureau of Standards U.S. Dept. of Commerce Washington, D.C.	This Interdepartmental Agreement requires research on MHD-related high-temperature materials. CONTRACT NO. 14-32-0001-1230
101.	Aug. 9, 1972 * (18 months)	305,446 OCR- 152,723 (ConEd & Comb- 152,723	Combustion Engineering, Inc. Windsor, Conn.	The objective of the work under this contract is to make a design study of entrainment coal gasifier and sulfur-removal systems to provide fuel gas suitable for economic and environmentally acceptable electric power generating systems located at mine mouth and in metropolitan areas. CONTRACT NO. 14-32-0001-1512
102.	Aug. 9, 1972 (26 months 22 days)	215,376	National Research Development Corporation London, England	To perform research to establish the effect on performance of operating at bed temperatures higher than have been investigated previously in pressurized fluidized combustion. CONTRACT NO. 14-32-0001-1511
103.	Aug. 9, 1972 (108 months)	9,277,379 OCR-6,494,165 (Ind. (Team-2,783,214	Westinghouse Electric Corp. Heat Transfer Division Philadelphia, Pa.	The work on this contract will reduce to practice information that has been generated on fluidized-bed gasification systems. It will further apply the fluidized-bed gasification system to a combined-cycle electric generation system, providing an integrated gasification/combined-cycle generating system which will be of a commercial size and located on an electric utility generating system to provide verification of the technology and economics of this system functioning under actual commercial conditions. CONTRACT NO. 14-32-0001-1514
104.	Aug. 21, 1972 * (19 months)	Letter Contract	Pittsburg & Midway Coal Mining Co. Merriam, Kansas	The objective of this program is to develop, design, construct, and operate a pilot plant to produce clean low-B.t.u. fuel gas from coal. The pilot plant gasifier will be an air-blown, pressurized, two-stage entrained flow gasifier, designed to gasify approximately 50 tons of coal per hour. The low-B.t.u. gas will be used as a fuel in an existing steam power generating unit. In addition, the gasification system will be connected to a combined-cycle electric generating system providing an integrated gasification combined-cycle generating system. CONTRACT NO. 14-32-0001-1521
105.	Aug. 25, 1972 (29 months)	548,364	Air Products & Chemicals Allentown, Pa.	The objective of this program is to develop, demonstrate, and commercialize a novel technology for the removal of sulfur from producer gas in a fixed bed of lime or calcined dolomite at producer temperature and pressure. CONTRACT NO. 14-32-0001-1510

* Completed.

** As of January 22, 1973, all tasks were terminated except MHD, and the MHD task was completed October 14, 1973.

CONTRACTS AWARDED BY THE OFFICE OF COAL RESEARCH

Date of Award	Estimated Total Cost	Contractor	Purpose
106. Sep. 1, 1972 (34 months)	4,331,043 OCR- 2,887,362 AGA- 1,443,681	C F Braun & Co Alhambra, Calif.	Evaluation of certain coal gasification processes and other work. CONTRACT NO. 14-32-0001-1235
107. Sep. 1, 1972 (34 months)	16,500,000 OCR-11,000,000 AGA- 5,500,000	Institute of Gas Technology Chicago, Ill.	The work under this contract is directed toward the continuation and expansion of the work previously performed under Contract No. 14-01-0001-381. CONTRACT NO. 14-32-0001-1221
108. Oct. 5, 1972 (48 months)	14,300,000	Pope, Evans and Robbins, Inc. New York, N.Y.	To design, construct, and test a multicell fluidized-bed boiler as a pollution-free method of burning high-sulfur coal or burning highly corrosive coals without excessive maintenance problems. This will be accomplished by designing, building, and operating a multicell fluidized-bed boiler under practical electric utility conditions. The work was initiated under Contracts No. 14-01-0001-478 and 14-32-0001-1229. CONTRACT NO. 14-32-0001-1237
109. Oct. 6, 1972 (35 months)	362,570	Battelle Memorial Institute Pacific Northwest Labs. Richland, Washington	The objective of this research is to develop a fused salt scrubber system for removal of flyash and sulfur compounds from low-B.t.u. fuel gas at high temperatures (1400° F. to 1700° F.) at ambient pressure. CONTRACT NO. 14-32-0001-1519
110. Oct. 31, 1972 (48 months)	1,601,930 OCR- 1,372,367 Par.- 229,563	Ralph M. Parsons Los Angeles, Calif.	To provide technical evaluation services to OCR to develop practical processes for producing liquid and/or solid fuels from coal. CONTRACT NO. 14-32-0001-1234
111. Nov. 7, 1972 (72 months)	1,365,000	Gilbert Associates Reading, Pa.	To provide technical and engineering services directed to the development of commercially attractive processes for converting coal to electric power. CONTRACT NO. 14-32-0001-1236
112. Nov. 15, 1972 (24 months)	145,175	M. W. Kellogg Houston, Texas	The objective of this contract is to complete technical, experimental, and economic studies of the Kellogg Molten Salt Gasification Process, used as a method for manufacturing carbon monoxide from carbon dioxide and char. CONTRACT NO. 14-32-0001-1233
113. Jan. 2, 1973 (30 months)	1,885,794 OCR- 1,257,196 AGA- 628,598	Chem Systems, Inc. New York, New York	To develop a practical and useful process for converting coal-derived synthesis gases (largely carbon monoxide and hydrogen) to methane as the major constituent of synthetic natural gas, using liquid fluidized beds. CONTRACT NO. 14-32-0001-1505
114. Jan. 2, 1973 (30 months)	4,100,000 OCR- 2,733,333 AGA- 1,366,667	Battelle Columbus Laboratories Columbus, Ohio	Development of the Two-Stage Agglomerating Fluidized-Bed Process as a practical and economical method of producing hydrogen or synthesis gas (a mixture of hydrogen and carbon monoxide) from coal. The developed process is to be useful as part of a synthetic pipeline-gas producing system, as a fuel gas system, or for other purposes. CONTRACT NO. 14-32-0001-1513
115. Jan 3, 1973 * (17 months)	119,000	Consolidation Coal Co. Library, Pennsylvania	Technical maintenance and security service at Cresap, West Virginia, pilot plant. CONTRACT NO. 14-32-0001-1522
116. Feb 5, 1973 (24 months)	267,180	Bonner & Moore Associates, Inc. Houston, Texas	Objective: to provide an economic evaluation of coal-based synthetic crude, with analysis of related current energy industry uncertainties. CONTRACT NO. 14-32-0001-1506

*Completed.

CONTRACTS AWARDED BY THE OFFICE OF COAL RESEARCH

	Date of Award	Estimated Total Cost	Contractor	Purpose
117.	Feb 16, 1973 * (19 months)	133,850	Foster Associates Washington, D.C.	Objective: to measure in depth the potential regional markets for coal-conversion products over the period 1977 to 1985. CONTRACT NO. 14-32-0001-1509
118.	Mar 23, 1973 * (9 months)	20,000	Office of Aeronautics & Space Technology NASA Headquarters Washington, D.C.	A joint NASA/OCR study of alkali metal topping cycles for stationary power application by the General Electric Company CONTRACT NO. 14-32-0001-1525
119.	Apr 17, 1973 * (12 months)	26,070	U.S. Atomic Energy Commission Argonne, Illinois	AEC, acting through its Argonne National Laboratory facility, and subject to Stanford University functional requirements, will perform as Project Manager for the design study of the magnet system required under Contract No. 14-32-0001-1227. CONTRACT NO. 14-32-0001-1523
120.	May 1, 1973 (26 months)	18,160,062 OCR-12,106,708 AGA- 6,053,354	Institute of Gas Technology Chicago, Illinois	Objective: to provide for the design, construction, and operation of a pilot plant that will operate on char from the HYGAS Pilot Plant. It uses steam and iron oxide to produce hydrogen which is returned to the HYGAS reactor to increase its methane output. This makes possible a more complete utilization of the coal fed to the HYGAS plant. CONTRACT NO. 14-32-0001-1518
121.	June 11, 1973 (30 months)	658,377	Hittman Associates, Inc. Columbia, Maryland	To investigate and evaluate the environmental and ecological problems associated with large-scale mining and coal-conversion processes, as well as the sociological impacts of such complexes. Recommendations for long-range end-use regional planning will be developed. CONTRACT NO. 14-32-0001-1508
122.	June 29, 1973 (18 months)	1,422,953	Combustion Power Company, Inc. Menlo Park, California	Energy conversion from coal utilizing CPU-400 technology. (Letter contract) CONTRACT NO. 14-32-0001-1536
123.	Aug 1, 1973 (42 months)	2,307,887	Fluor Utah, Inc. San Mateo, California	To determine and define the unique problems of producing coal in large quantities under varied physical, geographic, geologic, and climatic conditions to supply coal conversion complexes and to develop improved mining concepts and systems designed to produce coal at optimum cost, safety, continuity of supply, conservation of resources, and minimum environmental damage. CONTRACT NO. 14-32-0001-1520
124.	Aug 3, 1973 (50 months)	2,575,000	Bituminous Coal Research, Inc. Monroeville, Pa.	To develop processes to gasify coal to produce fuel gas. Work was initiated under Contract No. 14-01-0001-324 and continued under Contract No. 14-32-0001-1207. CONTRACT NO. 14-32-0001-1527
125.	Aug 6, 1973 (77 months)	300,000	Central Indiana County Water Authority	Agreement to supply water to OCR's Homer City, Pennsylvania, site. CONTRACT NO. 14-32-0001-1530
126.	Sep 3, 1973 (16 months)	10,911	U.S. Atomic Energy Commission Argonne, Illinois	To support the U.S./USSR Cooperative Program in MHD Power Generation. CONTRACT NO. 14-32-0001-1727
127.	Sep 4, 1973 * (10 months)	17,845	Modern Electric Power Products and Service Company (MEPPSCO) Malden, Mass.	To support the U.S./USSR Cooperative Program in MHD Power Generation. CONTRACT NO. 14-32-0001-1541

* Completed.

CONTRACTS AWARDED BY THE OFFICE OF COAL RESEARCH

Date of Award	Estimated Total Cost	Contractor	Purpose
128. Sep 4, 1973 * (10 months)	18,780	Magnetic Corporation of America Waltham, Massachusetts	To support the U.S./USSR Cooperative Program in MHD Power Generation. CONTRACT NO. 14-32-0001-1551
129. Sep 13, 1973 (24 months)	211,144	University of Denver Research Institute Denver, Colorado	To perform study on the social, economic, and land use impacts of a Fort Union coal processing complex, including environmental impacts related to industrial and economic development. CONTRACT NO. 14-32-0001-1526
130. Sep 20, 1973 * (to 3/29/74)	200,000	NASA, Headquarters, Washington, D.C.	A follow-on effort to Contract No. 14-32-0001-1525, this phase consisting of the selection of a potassium binary system for preliminary engineering design. CONTRACT NO. 14-32-0001-1539
131. Sep 21, 1973 * (10 months)	12,500	Magnetic Engineering Associates Cambridge, Massachusetts	To support the U.S./USSR Cooperative Program in MHD Power Generation. CONTRACT NO. 14-32-0001-1553
132. Oct 1, 1973 (14 months)	232,677 OCR- 99,299 GE- 133,378	General Electric Co. Space Sciences Laboratory Philadelphia, Pennsylvania	Erection of a low-B.t.u. coal gas-fired, ceramic, regenerative heat exchanger as well as the integration of the fluid flow and diagnostic control and timing systems. Following construction, the heat exchanger will be operated by alternately passing hot combustion products and the inert working fluid through to determine contamination of the working fluid. CONTRACT NO. 14-32-0001-1533
133. Oct 15, 1973 (24 months)	1,035,781	Westinghouse Electric Corp. Pittsburgh, Pennsylvania	The work under this contract is a continuation of Contract No. 14-32-0001-1223, which will provide more extensive and detailed information in systems study and evaluation in magnetohydrodynamic (MHD) generators. CONTRACT NO. 14-32-0001-1540
134. Oct 29, 1973 (36 months)	3,450,000	U.S. Department of the Air Force Arnold Engineering Dev. Center Arnold AFS, Tennessee	Objective: to proceed with the detailed design, procurement, and fabrication of the equipment required to demonstrate the attainment of high MHD efficiency, and then to make the demonstration. The performance goal shall be a 20 percent enthalpy extraction at 60 to 70 percent isentropic efficiency and a 6.75 pressure ratio. The Contractor's existing equipment in the LORHO Pilot Facility will be utilized. CONTRACT NO. 14-32-0001-1542
135. Nov 11, 1973 * (3 months)	23,500	Hudson Institute, Inc. Croton-on-Hudson, N.Y.	This study is aimed at the increased usage of coal of which there are large identified resources. CONTRACT NO. 14-32-0001-1528

* Completed.

CONTRACTS AWARDED BY THE OFFICE OF COAL RESEARCH

Date of Award	Estimated Total Cost	Contractor	Purpose
136. Nov 23, 1973 * (90 days)	5,600	Stanford Sobel Associates New York, N.Y.	The Contractor shall write a production script for a 16-mm motion picture film--intended for the general public--describing the coal conversion program of the Office of Coal Research and the objectives of the program as they relate to the Nation's current energy shortage. CONTRACT NO. 14-32-0001-1535
137. Dec 1, 1973 (24 months)	10,200	Leland Stanford Jr. Univ. Stanford, California	To support the U.S./USSR Cooperative Program in MHD Power Generation. CONTRACT NO. 14-32-0001-1739
138. Dec 3, 1973 (14 months)	360,000	U.S. Atomic Energy Commission (AEC) Argonne, Illinois	The objective of this agreement is to utilize Argonne National Laboratory's instrumented and sophisticated 5-inch-diameter pressurized fluidized-bed combustor and professional staff to investigate basic research in fluid bed combustion. This basic research will include the development of advanced pressurized fluidized-bed combustor technology and investigate methods for reducing levels of such pollutants as SO_2 and NO_x. AEC, acting through its Argonne National Laboratory (ANL), shall also develop conceptual designs of future generation powerplants utilizing this technology. CONTRACT NO. 14-32-0001-1543
139. Dec 7, 1973 * (9 months)	99,801	McDowell Wellman Engineering Company Cleveland, Ohio	Engineering study to determine feasibility of constructing a large-diameter fixed-bed gasifier and to establish a preliminary design and cost estimate for such unit. CONTRACT NO. 14-32-0001-1524
140. Dec 10, 1973 (36 months)	537,600 OCR- 456,600 VPI- 81,000	Virginia Polytechnic Institute & State University Blacksburg, Virginia	To expand and further develop techniques for evaluating the engineering and safety factors involved in mining coal by underground methods so as to assure maximum conservation and recovery of the coal resource. These considerations must include all environmental impacts of the mining systems considered as well as the health and safety related directly to underground coal mining. CONTRACT NO. 14-32-0001-1231
141. Dec 21, 1973 (Unlimited)	-	Pennsylvania Electric Co. Johnstown, Pennsylvania	Right-of-way agreement to install a transmission line and power station at OCR's Homer City, Pennsylvania, site. CONTRACT NO. 14-32-0001-1547
142. Jan 2, 1974 (16 months)	201,023 OCR- 153,023 Cospon- 48,000	Stanford Research Institute Menlo Park, California	To determine the economic feasibility of a coal conversion facility in southcentral Alaska utilizing the large Beluga coal reserves. The current economic status of such a venture and also the potential economics for 1985 shall be examined. Technological advances shall be taken into account to ensure maximum economic incentives for commercial development. CONTRACT NO. 14-32-0001-1516
143. Jan 28, 1974 * (4 months)	12, 914	Geodyne, Inc. Washington, D.C.	Services to design, develop, and implement a mechanized technical proposal information system. CONTRACT NO. 14-32-0001-1549

* Completed.

CONTRACTS AWARDED BY THE OFFICE OF COAL RESEARCH

Date of Award	Estimated Total Cost	Contractor	Purpose
144. Feb 1, 1974 * (5 months)	41,149	Avco Everett Research Laboratory Avco Corporation Everett, Massachusetts	To support the U.S./USSR Cooperative Program in MHD Power Generation. CONTRACT NO. 14-32-0001-1728
145. Feb 5, 1974 * (60 days)	17,699	W. C. Schroeder & Associates College Park, Maryland	An investigation with an Ad Hoc Committee for 4 members to assist the U.S. Department of the Interior, Office of Coal Research, in the evaluation of the BI-GAS, ATGAS, and Steam-Iron processes. CONTRACT NO. 14-32-0001-1725
146. Feb 19, 1974 * (6 months)	23,731	Arthur D. Little, Inc. Cambridge, Massachusetts	Evaluation of Advanced Power Cycle Program. CONTRACT NO. 14-32-0001-1722
147. Mar 22, 1974 * (6 months)	200,000 OCR- 150,000 TVA- 50,000	Tennessee Valley Authority Chattanooga, Tennessee	A joint program for development of commercial technology to produce a clean fuel gas for generating electric power. CONTRACT NO. 14-32-0001-1731
148. Apr 2, 1974 * (5 months)	30,400	Flight Systems, Inc. Arlington, Virginia	Services to develop a comprehensive program plan for research. The contractor shall perform an analysis of present OCR programs and projects to develop a comprehensive coal research plan. This plan will consist of a 3-year near-term coal research plan, a 5-year mid-term objectives plan, and a 10-year long-term program plan. CONTRACT NO. 14-32-0001-1732
149. Apr 4, 1974 (12 months)	300,000	State of Oklahoma	To determine technical as well as economic potential for the use of a high-temperature gas-cooled nuclear reactor as a source of process heat for the solution-gasification of coal. CONTRACT NO. 14-32-0001-1219
150. Apr 16, 1974 (24 months)	247,828	Dow Chemical Company Midland, Michigan	To estimate preliminary capital investment and operating costs for a commercial plant which would utilize coal liquefaction products for production of useful aliphatic and aromatic components. CONTRACT NO. 14-32-0001-1534
151. Apr 18, 1974 (24 months)	207,710	Eyring Research Institute Provo, Utah	To further investigate and develop a novel, high-rate, high-temperature gasification process--Fast Pyrolytic Gasification (FPG) Process--to produce in high efficiency (on a B.t.u. basis) an intermediate (300-400) B.t.u. gas from coal. CONTRACT NO. 14-32-0001-1548
152. May 1, 1974 (30 months)	2,250,000	Department of Housing & Urban Development	To develop one or more coal-fired powerplants for decentralized generation of electric power for M.I.U.S. CONTRACT NO. 14-32-0001-1742
153. May 16, 1974 (12 months)	1,000,000	Bureau of Mines Washington, D.C.	Design and construct a PDU to test the Synthoil Process for converting coal to low-sulfur fuel oil. CONTRACT NO. 14-32-0001-1729
154. May 17, 1974 (36 months)	13,582,000 OCR- 11,389,000 Fluor- 193,000 Allegheny- 2,000,000	Fluor Engineers and Constructors, Inc. Los Angeles, California	Development and testing of multiprocess equipment components of coal-to-liquid processes at Cresap which is to be restructured to handle this work. CONTRACT NO. 14-32-0001-1517

* Completed.

CONTRACTS AWARDED BY THE OFFICE OF COAL RESEARCH

	Date of Award	Estimated Total Cost	Contractor	Purpose
155.	May 23, 1974 (12 months 2 weeks)	2,200	National Academy of Sciences Washington, D.C.	Partial support of Conference on Thermodynamics and National Energy Problems. CONTRACT NO. 14-32-0001-1741
156.	May 29, 1974 (16 months)	413,205	Bechtel Corporation San Francisco, Calif.	To provide a means of evaluating the relative transportation economics of delivering energy from coal and/or conversion output products by various modes from the energy demand center. CONTRACT NO. 14-32-0001-1552
157.	Jun 19, 1974 (9-1/2 months)	500,000	U.S. Department of Commerce Washington, D.C.	C T A B Panel on Project Independence Blueprint. Interagency Agreement 14-32-0001-1758
158.	Jun 27, 1974 (36 months)	216,653 OCR- 191,996 VPI- 24,657	Virginia Polytechnic Institute and State University Blacksburg, Virginia	To investigate a novel stirred-tank reactor extractive coal hydrogenation process. The data obtained from this work, if promising, will serve as the basis for design of a process development unit for scaleup of the process. CONTRACT NO. 14-32-0001-1550
159.	Jun 27, 1974 (36 months)	1,508,000	Atomic Energy Commission Germantown, Maryland	Interagency agreement concerning coal conversion programs: technical and scientific services; R & D and engineering services to provide information and data on conversion processes materials components and equipment; investigation and resolution of practical problems relating to economical system designs and operations; assistance in developing cost estimates of conversion processes and general laboratory services; and preparation and documentation of comparative conceptual designs for various coal conversion projects and processes encompassing pilot plant scale through commercial scale. AGREEMENT NO. 14-32-0001-1740
160.	June 28, 1974 (36 months)	264,062	IIT Research Institute Chicago, Illinois	To develop an economical process for the conversion of a coal-to-clean-fuel conversion (CCP) carbonaceous waste or byproduct to benzene carboxylic acids, preferably tetra- to hexacarboxylic acid mixes, for use in detergents and/or other applications. CONTRACT NO. 14-32-0001-1724
161.	July 1, 1974 (36 months)	1,750,000 OCR- 875,000 NBS- 875,000	National Bureau of Standards Washington, D.C.	Utilization of contractor's capabilities to provide technical and scientific services to OCR for its coal conversion programs, including such tasks as evaluation of proposals received by OCR, and R & D and standards services to provide information and data on construction materials for conversion processes and on process chemistry. CONTRACT NO. 14-32-0001-1749
162.	July 1, 1974 * (one month)	13,741.83	Wright-Malta Corporation Malta Test Station Ballston Spa, New York	To determine the feasibility of the Wright-Malta rotary kiln concept as an alternate gasifier configuration for coal conversion of coal to low-B.t.u. gas to be used with a gas-steam turbine combination in the generation of electric power. CONTRACT NO. 14-32-0001-1747

* Completed.

CONTRACTS AWARDED BY THE OFFICE OF COAL RESEARCH

Date of Award	Estimated Total Cost	Contractor	Purpose
163. July 29, 1974 * (4 months)	116,119	Avco Everett Research Laboratory, Inc. Everett, Massachusetts	The Contractor shall carry out a comprehensive preliminary design study of a Channel for the U-25 Facility. CONTRACT NO. 14-32-0001-1738
164. July 29, 1974 * (4 months)	61,219	Modern Electric Power Products and Service Company (MEPPSCO) Boston, Massachusetts	The Contractor shall carry out a comprehensive preliminary design study of a Channel for the U-25 Facility. CONTRACT NO. 14-32-0001-1733
165. Aug 20, 1974 (15 months)	750,000	National Aeronautics and Space Administration (NASA) Washington, D.C.	For the conduct of a research study project related to coal energy conversion technology. NASA shall undertake an energy conversion alternative study (ECAS) to make an assessment of energy conversion systems on a common basis with respect to its impact on (a) economics, (b) natural resources, (c) environment, and (d) performance. CONTRACT NO. 14-32-0001-1751
166. Sep 4, 1974 (23 months)	8,132,596 OCR- 5,421,731 * - 2,710,865 *Contributors & Participants	Hydrocarbon Research, Inc. Washington, D.C.	Originally executed as a letter contract, December 1973. Definitive contract was executed September 1974 for pilot plant design as well as bench-scale operations for H-Coal Liquefaction Process. CONTRACT NO. 14-32-0001-1544
167. Sep 4, 1974 (150 days)	96,935	The Mitre Corporation McLean, Virginia	Planning assistance to OCR on advanced power cycles based on the use of coal to include advanced gas turbines, combine Brayton-Rankine cycles, MHD cycles, high temperature binary cycles, low temperature Rankine bottoming cycles, direct energy conversion, alkali metal systems, and fuel cells. CONTRACT NO. 14-32-0001-1746
168. Sep 4, 1974 (150 days)	99,095	The Mitre Corporation McLean, Virginia	Planning assistance for OCR on atmospheric and pulverized coal-fired, fluidized-bed combustion systems. CONTRACT NO. 14-32-0001-1748
169. Sep 7, 1974 (51 months 24 days)	156,000	Borough of Indiana (Pennsylvania)	The Borough will provide for disposal of waste effluent from OCR's coal gasification pilot plant at Homer City, Pennsylvania. CONTRACT NO. 14-32-0001-1538
170. Sep 15, 1974 (4-1/2 months)	24,620	Arthur D. Little, Inc. Cambridge, Massachusetts	Study to evaluate the benefit/cost methodology and application to advanced power cycles technology. CONTRACT NO. 14-32-0001-1756
171. Oct 1, 1974 (48 months)	3,607,660 OCR-13,739,389 C.E.- 6,869,695	Combustion Engineering, Inc. Windsor, Connecticut	A research and development effort relating to an entrained coal gasifier system with sulfur removal, to produce an environmentally clean low-B.t.u. gas from coal suitable for use in central station electric power generating plants. CONTRACT NO. 14-32-0001-1545
172. Oct 29, 1974 (12 months)	30,596	U.S. Department of the Navy Office of Naval Research	Government-sponsored research and development in the nonpropulsive power field. CONTRACT NO. 14-32-0001-1763
173. Oct 31, 1974 (12 months)	247,600	Institute of Gas Technology Chicago, Illinois	Preparation of a coal conversion systems technical data book. CONTRACT NO. 14-32-0001-1730

CONTRACTS AWARDED BY THE OFFICE OF COAL RESEARCH

	Date of Award	Estimated Total Cost	Contractor	Purpose
174.	Oct 31, 1974 (7 months)	36,460	University of Scranton Scranton, Pennsylvania	To arrange, convene, and conduct an advanced anthracite technology research conference. CONTRACT NO. 14-32-0001-1774
175.	Nov 8, 1974 (12 months)	95,694	Systems Consultants, Inc. Washington, D.C.	This project is for the design and implementation of a project management and planning system for the demonstration plant program. CONTRACT NO. 14-32-0001-1771
176.	Nov 25, 1974 (1 month)	95,770	TRW Systems Group TRW, Inc. Redondo Beach, California	Planning Assistance for the Office of Coal Research Liquefaction Program. CONTRACT NO. 14-32-0001-1755
177.	Nov 25, 1974 (36 months)	2,990,892	The Ralph M. Parsons Company Pasadena, California	The objective of this contract is to provide technical evaluation services to the Office of Coal Research, U.S. Department of the Interior, to develop practical processes for producing liquid and/or solid fuels from coal. CONTRACT NO. 14-32-0001-1775
178.	Nov 25, 1974 (21 months)	2,002,300	U.S. Atomic Energy Commission Argonne, Illinois	Continuation of a Development Program on Pressurized Fluidized-Bed Coal Combustion CONTRACT NO. 14-32-0001-1780
179.	Nov 27, 1974 (7 months)	3,607,660 OCR-2,405,107 AGA-1,202,553	CONOCO Coal Development Co. Library, Pennsylvania	Test and evaluation of CO_2 Acceptor Process for production of pipeline-quality gas. CONTRACT NO. 14-32-0001-1734
180.	Nov 29, 1974 (24 months)	111,946	Brigham Young University Provo, Utah	Study of the influence of mixing on kinetic processes in entrained coal gasifiers. CONTRACT NO. 14-32-0001-1767
181.	Dec 3, 1974 (4-1/2 months)	44,425	Arthur D. Little, Inc. Cambridge, Massachusetts	A study to implement a multiyear project plan for OCR. CONTRACT NO. 14-32-0001-1750
182.	Dec 3, 1974 1/ (6 months)	98,400	Tetra Tech, Inc. Arlington, Virginia	Technical support services for the Office of Coal Research. CONTRACT NO. 14-32-0001-1768
183.	Dec 11, 1974 (12 months)	320,572	Fluidyne Engineering Corp. Minneapolis, Minnesota	Preliminary Design of a Single Air Heater Segment Suitable for a Coal-Fired, Open-Cycle Magnetohydrodynamic System. CONTRACT NO. 14-32-0001-1537
184.	Dec 12, 1974 (40 months)	6,913,293	Atomics International Division Rockwell International Corporation Canoga Park, California	To perform intensive research leading to the development of commercially economic equipment for gasifying coal. CONTRACT NO. 14-32-0001-1529
185.	Dec 12, 1974 (12 months)	195,140	Hudson Institute, Inc. New York, N.Y.	Research study of issues relative to the development and commercialization of a coal-derived synthetic liquids industry. CONTRACT NO. 14-32-0001-1752
186.	Dec 12, 1974 (14-1/2 months)	568,000	Arthur D. Little, Inc. Cambridge, Massachusetts	Experimental study of an extractive coking process to produce low-sulfur liquid fuels from bituminous coal. CONTRACT NO. 14-32-0001-1754

1/ Awarded 12-3-74; however, work began 6-17-74 for completion 12-31-74.

CONTRACTS AWARDED BY THE OFFICE OF COAL RESEARCH

	Date of Award	Estimated Total Cost	Contractor	Purpose
187.	Dec 15, 1974 (1/2 month)	2,400	Walter Lobo, P.C. New Canaan, Connecticut	The Contractor shall provide necessary technical review of a contractor program. CONTRACT NO. 14-32-0001-1734.
188.	Dec 23, 1974 (12 months)	270,000	Bureau of Mines Washington, D.C.	Extractive coking of bituminous coals to produce low-sulfur liquid fuels. CONTRACT NO. 14-32-0001-1753
189.	1/	8,150,792	University of Tennessee University of Tennessee Space Institute Tullahoma, Tennessee	Development program for MHD direct coal-fired power generation test facility. CONTRACT NO. 14-32-0001-1760

1/ No effective date, no period of performance.

OCY FY 1975 Budget Obligations
Through 12/13/74

Program Element	FY 1975 Appropriation ($ Thousand)	Budget Obligation Through 12/13/74 ($ Thousand)
Liquefaction	79,600	33,240
High BTU Gasification	37,800	13,358
Low BTU Gas/Power	49,000	27,019
Advanced Power Systems (MHD etc.)	17,700	6,704
Direct Boiler Combustion	34,000	9,332
Advanced Research and Supporting Technology	19,100	3,469
Systems Studies	2,500	1,094
Demonstration Plants	(24,000)*	10,620
	239,700	104,836

* Funds made available from Liquefaction

New Contracts and Continuations for which Funds
Have Been Obligated in FY 1975 through 12/13/74

Liquefaction (Total 17)

OCR Contract No.	Contractor
1516	Stanford Research Institute
496	Pittsburgh & Midway Coal Mining Co.
1544	Hydrocarbon Research, Inc.
1234	Ralph M. Parsons Co.
1534	Dow Chemical Co.
1220	U.S. Steel
1212	FMC
1517	Fluor Engineering
734	U.S. Bureau of Mines
390	Penn State University
1224	University of North Dakota
1200	University of Utah
1225	Colorado School of Mines
1508	Hittman Associates
1758	U.S. Commerce Department
1740	U.S. Atomic Energy Commission
1755	TRW, Inc.

High BTU Gasification (Total 7)

OCR Contract No.	Contractor
415	Consolidation Coal Co.
1734	Continental Oil Co.
1221	Institute of Gas Technology
1518	Institute of Gas Technology
1513	Battelle Memorial Institute
1538	Borough of Indiana, Pa.
1758	U.S. Commerce Department

Low BTU Gasification (Total 10)

OCR Contract No.	Contractor
1751	NASA
1524	McDowell-Wellman
1731	TVA
1545	Combustion Engineering
1527	Bituminous Coal Research, Inc.
1521	Foster-Wheeler, Inc.
1529	Atomic International
1236	Gilbert Associates, Inc.
1758	U.S. Commerce Department
1730	Institute of Gas Technology

Advanced Power Systems (Total 14)

OCR Contract No.	Contractor
1230	National Bureau of Standards
1227	Stanford University
1211	STD Research
1540	Westinghouse Electric Corp.
1537	Fluidyne
1542	Arnold AFS
1208	AVCO
1533	General Electric Co.
1233	M W Kellog Co.
1751	NASA
1746	Mitre, Corp.
1209	MIT
1763	Office of Naval Research
1740	AEC

Direct Boiler Combustion (Total 6)

OCR Contract No.	Contractor
1237	Pope, Evans and Robbins
1536	Combustion Power
1543	AEC
1748	Mitre
1742	HUD
1758	U.S. Commerce Department

Advanced Research & Supporting Technology (Total 8)

OCR Contract No.	Contractor
1548	Eyring Institute
1724	IIT Research Institute
1749	National Bureau of Standards
1550	Virginia Polytechnical Institute
1758	U.S. Commerce Department
1743	Continental Oil Co.
1774	University of Scranton
1740	AEC

Systems Studies (Total 3)

OCR Contract No.	Contractor
1552	Bechtel
1526	Denver Research Institute
1520	Fluor Utah

Demonstration Plants (Total 4)

OCR Contract No.	Contractor
1756	A. D. Little, Inc.
1759	U.S. Corps of Engineers
1757	U.S. Bureau of Reclamation
1771	Systems Consultants, Inc.

GRAND TOTAL - 69 Contract Actions

Mr. McCormack. I would like to know, if I might, to whom the grants have been made, and how much, and how much they have contributed, and generally what they're doing, so that we'll have some perspective of that.

Dr. Zahradnik. I'll be very glad, sir. We have a running record, which is quite thick, which has a contract record of each contract that was written forever, and we can send that to you, or I'll try to extract it for the record.

Mr. McCormack. If you can extract it, with a short dissertation on a few pages, I'd appreciate it, and I'm sure that the other committee members would like to have some perspective on this.

Incidentally, as this becomes of more concern to Members of Congress, this will be very helpful.

Dr. Zahradnik. I might mention that the Office of Coal Research contractors represent a major cross-section of the energy research and development community, ranging from universities to government and nonprofit laboratories around the country; major energy companies, including the major oil and manufacturing companies and the leading engineering companies in the country have at one time had contracts with the Office of Coal Research.

Mr. McCormack. Incidentally, may I ask how long you've been with the Office of Coal Research?

Dr. Zahradnik. Since the beginning of June.

Mr. McCormack. I see. And has the office changed character in recent months? Since your coming in as Acting Associate Director, with new personnel, is it a comparatively new organization? Here we see a very abrupt change in appropriations. Has the office itself dramatically changed?

Dr. Zahradnik. Very definitely. Subsequently, I'll have it in the form of testimony to show you, but we've essentially gone from an office of 40 people to an office of over 200 people, and we would look to double that again, to 350 to 400 people next year. We have established a new organization, and I'll show you a diagram of that in a moment. We've established procedures for dealing systematically with the contracts, both from an evaluation viewpoint and as well as our contracting procedures, to try to facilitate movement of procurements.

Perhaps the most interesting change in the way the office operates is that we have gone from an agency that responds opportunistically to unsolicited proposals to an agency that tries to take a lead in this program by issuing requests for proposals, and competitive procurement has become our method of operation now, rather than responding to unsolicited proposals. We work very hard within our own staff and with the aid of systems planning consultant groups to develop long-term plans for the OCR, and these have been published, and we have issued them as documents from the Department, showing what way we're going and the kind of program that will get us there.

So the office has changed very dramatically.

Mr. McCormack. Do you respond to any unsolicited proposals?

Dr. Zahradnik. Yes, sir, we do. We will continue to respond to unsolicited proposals, because this is a very real way in dealing with new ideas that come into the office.

I would say, by and large, in the future perhaps the majority of our contracts will be in response to unsolicited proposals, although

the majority of our dollars may well be spent in the competitive procurement method.

Mr. McCormack. Thank you very much. I'm sorry to interrupt you.

Dr. Zahradnik. Not at all. Please interrupt at any time.

Mr. McCormack. The cross hatches on the diagram up there, what does that represent?

Dr. Zahradnik. These represent supplemental budget additions, and I think I'd like to take a moment, since you've raised that, to explain.

After the initial appropriations, the initial $1 million, and through 1972, in fiscal 1974 an additional $50 million was added on, bringing our budget for that year to $123 million. This was part of the President's $115 million supplemental request, as you recall, from last year, and $50 million of that was appropriated for the Office of Coal Research.

The interesting feature about that diagram is that in 1974 the funds appropriated were almost equal to the entire funds of the previous 13 years of existence, and in 1975 the funds are again equal to everything that went on before, so our expansion is, indeed, very dramatic.

Mr. McCormack. It's a doubling curve.

Dr. Zahradnik. Yes, it's a doubling curve. I don't think it will go this way after the next year.

Mr. McCormack. $261 million for fiscal 1975?

Dr. Zahradnik. Yes, sir.

Mr. McCormack. There was $15 million transferred out of your office into the Geological Survey by OMB?

Dr. Zahradnik. Both into Geological Survey and Public Land Management, yes.

Mr. McCormack. You say you've committed how much in this year's program?

Dr. Zahradnik. We've committed over $100 million to programs as of early this week.

Mr. McCormack. I see. So that transfer really was not critical, nor harmful.

Dr. Zahradnik. It was not critical or harmful, that is correct. It's always a painful experience for someone in an agency to lose funding, of course. So that, indeed, was painful, but not critical.

Mr. McCormack. Thank you very much.

Mr. Hechler. What was the reason for the OCR not expending that money?

Dr. Zahradnik. This was a program, Congressman Hechler, that was put into the Office of Coal Research late into the fiscal year, and we received authorization to go ahead with it only at the beginning of this fical year, and so we were in the process of developing plans as to how best to expend this money, and exactly what we would do with it.

Maybe I can clarify that with the budget slide.

Essentially, the $261 million budget of the Office of Coal Research had a $15 million segment to it for pioneering plants. The major purpose of that program was to share the risk of private developers in taking old technology and putting it into use with Federal investments covering only that part of the process which involved significant technical risks.

The second purpose was that the OCR would make use of existing industrial facilities to piggyback experiments of interest to the OCR and to the Nation. For example, if gasification systems were in operation without any effective cleanup system, OCR would provide that research activity into the facility and carry out experiments, the research results of which would be available all over the Nation for free.

And I think it's fair to say at this time that with this very broad charter, the development of specific proposals would be a little bit slow in coming, and we were spending the early part of the fiscal year in developing proposals to this specific component of our program.

Mr. HECHLER. And OCR requested these funds at the beginning?

Dr. ZAHRADNIK. Yes, sir.

Mr. HECHLER. And you had anticipated to develop proposals and expend them, but simply could not expend them, is that correct?

Dr. ZAHRADNIK. I think we anticipated the ability to expend them, but, like any process which was a dynamic one, which involves not only the willingness on our part to fund proposals, but the willingness of private industry to submit to us proposals directed toward this program, and I think it would be fair to say that we were carrying on an effective dialog with the private sector in order to develop proposals which might be funded by this activity, but none had been received in a formal way. We had received a number of preliminary proposals, but not of a formal order.

Mr. HECHLER. Just to make sure that I understand the chart and your comments, how much of this $15 million, what was the total of the project by year, how much of the $15 million represents the percentage thereof?

Dr. ZAHRADNIK. The pioneering plants project was a $15 million item in our budget.

Mr. HECHLER. This was the entire amount?

Dr. ZAHRADNIK. The entire amount of the pioneering plants concept, yes, sir.

Mr. HECHLER. Did you review or consider any projects or proposals under this?

Dr. ZAHRADNIK. Only in the preliminary form. We had not received any formal proposals. I would say that the preliminary proposal idea is something where private industry generates an idea and comes to us and asks us how we like it, and we iterate, by means of dialog, that we are interested in their idea. Sooner or later this jells into a formal proposal. We had not come to this jelling point yet, but I think there were a number of companies with whom we had carried on an interesting enough dialog to suggest that this was an intriguing concept, and on which we could usefully spend some of our dollars.

Mr. HECHLER. Did you obligate any funds?

Dr. ZAHRADNIK. No, we did not.

Mr. HECHLER. The reason I'm pursuing, Mr. Chairman, this line of questioning is that I'm sure you're aware of the colloquy that I had with the gentleman from Pennsylvania for 2 days on the floor at the time that these funds were transferred, and frequently it's very, very difficult for those of us here in the House to understand why

money which is appropriated suddenly it's discovered that somebody wants to use it someplace else and transfers it out. In an area as important as coal research activities, work which you are conducting in the Office of Coal Research, this seems to me incomprehensible that this money, which was appropriated by the Congress, which OCR asked for, all of a sudden somebody discovers that they don't need it, and the story that we get is frequently laundered to the Office of Management and Budget.

I make that as an observation only. If you care to comment, I'll be grateful.

Dr. ZAHRADNIK. I'll comment to the following extent: That we certainly appreciate the budget we've been given and the resposiveness of all the committees of Congress to help us out. We feel in answer to Congressman McCormack, that the loss is painful to us, but by no means critical.

A lot of the ideas, that may have been developed as a result of this item being allocated, will find their way, by rerouting, into different parts of the program. When the preliminary proposals we have the early stages of development, when they do jell into formal proposals, we feel that we can adequately deal with them in other parts of our budget. So that the effort of putting the item into the budget in the first place and the exercise of trying to find work that meaningfully spends this money, I think is by no means wasted, sir, and we are intending to take those programs that are useful and meaningful and reroute them to different parts of our program, to be funded with different line items.

Mr. HECHLER. In the 16 years that I've served in Congress I've run across many situations where the Congress has felt that the executive branch could move faster in particular areas, and it's been very frustrating when we appropriate additional funds to find those funds to be unexpended, or brushed aside.

I'm sure that you could conclude from the tone and temper of the remarks this morning that all the members of this committee want to do everything possible to speed up the program that you are directing, and it's for this reason that I would hope in the future when we attempt in the Congress to provide the necessary wherewithal to speed up this program that sufficient comparable activity can take place in the executive branch, in order to carry out the intent of Congress.

Dr. ZAHRADNIK. I certainly did gather from the tone and temper of the statements that were made this morning the urgency felt by all, and I just want to inform you that we feel a similar urgency at the Office of Coal Research, and I hope that as I go through our program in the remaining time that I can convince you that not only do we have a sense of urgency, but we are doing something about it.

Mr. HECHLER. Thank you.

Mr. MCCORMACK. Go ahead, Dr. Zahradnik.

Dr. ZAHRADNIK. Thank you.

Cathy, would you put on the organization chart? Congressman McCormack had asked a question about organization and the people associated with it.

I would just like to point out that in January of this year, and again in May, we did reorganize the Office of Coal Research into the

structure shown on this figure. There are five technical directors and three support directorates, each headed by an assistant director. Selections have been made for all of these positions, and six of these positions have been permanently filled, and, as I indicated, we have a staff now of over 200 people, shooting for something like 350 or 400 people in this operation in the next fiscal year.

If we can return now to the budget that was described, I would like to use this as a vehicle for describing our program to you. I apologize for it being a little light. I will essentially recount the numbers to you in my oral statement.

I'll leave liquifaction for last, and only point out that its budget is $79.6 million, of which $24 million is being used in our demonstration plant program, and I'll defer my comments on that, while I continue with the chart.

In the high Btu gasification area, the specific objective of our program is to provide the technology for the manufacture of pipeline gas from coal. We are seeking improvements which conserve coal as they permit greater efficiency and decrease the cost of manufacture of gas compared to present technology. There are two pilot plants in operation in this program, one in the late stages of construction. A fourth pilot plant, constructed by the U.S. Bureau of Mines, is nearing start-up.

The Office of Coal Research efforts in this area have been encouraged by the American Gas Association, which in August 1971 entered into a cost sharing agreement with the Department of Interior to accelerate the coal gasification program. The funds in this area, as you see, are $37.8 million.

The objective of our low Btu gasification program is to develop one or more gasifier systems that can economically convert coal into gas suitable for power generation and industrial use. Several feasible concepts are being studied concurrently, and pilot plants are planned.

We are receiving substantial cost sharing by private industry in this area, including the Electric Power Research Institute. Our budget for fiscal 1975 is $49 million in this area.

The direct boiler combustion program is geared to develop both atmospheric and pressurized fluidized-bed combustor systems capable of burning high-sulfur coals. A 30-megawatt atmospheric fluidized-bed boiler is being installed in a generating station today at Rivesville, W. Va., and a request for proposal has been issued for the design, construction and operation of a 20-megawatt pressurized fluidized-bed boiler-combined cycle plant. The funds allocated for this in fiscal 1975 are $34 million.

The budget allocation of $17.7 million was made in fiscal 1975 for projects in advanced power systems. Increased efficiency of coal burning electrical power generation is the goal here, and the program focuses largely on developing advanced gas turbines capable of operating on coal-derived fuels and on developing magnetohydrodynamic systems which utilize coal directly.

Supporting all of these program elements in the Office, including specific component research, research in advanced conversion concepts, basic coal science, and development of an active, productive university research program in coal is the responsibility of our advanced research

and supporting technology program. Here, also; a significant materials research program is being developed to support the entire coal conversion fields. The budget, as you see, is $19.1 million. And I would point out that a byproduct of this activity will be the training of technologists required by this new synthetic fuels industry, and we're very aware of that, indeed.

We talked briefly about pioneer plants.

The administration of $6.5 million concludes our budget.

I would now like to return to the program with most relevance to H.R. 17400, namely, coal liquefaction.

Mr. McCormack. If I may ask a couple of questions here?

Dr. Zahradnik. Certainly.

Mr. McCormack. What is a pioneer plant?

Dr. Zahradnik. Well, as I tried to explain, the pioneering concept was one which was really to enable the Office of Coal Research to take out some risk involved in a piece of equipment that might go into an existing facility. The idea was that, by the Office of Coal Research piggybacking, or risk sharing in existing industrial research facility, a lot more information would be gained about that particular element in a real world situation, and so the pioneering idea was that this would be providing some of the first information and data about commercial technology in coal.

Mr. McCormack. Can you give us an example?

Dr. Zahradnik. I cited one earlier, namely, for example, if a plant existed with a coal gasifier in it that did not have an adequate cleanup system, it might be that the Office of Coal Research would install at federal expense a cleanup system into this plant in order that the successful operation of that system could be demonstrated, and the data from the operation itself would be made available to a number of plant locations.

Mr. McCormack. Is a primarily criterion for the demonstration of a new piece of equipment quality?

Dr. Zahradnik. I think that was one of the original intentions of the pioneering plant program.

Since the funds were allocated to us, and we've been carrying out a dialog, as I mentioned, with the private sector, it's become apparent to us that, although that was an interesting idea originally, that perhaps a more important idea would be to use federal funds to share some of the risks at the very front end of a project, either in the engineering assessment or the detailed engineering design phase.

A number of companies seen willing to go forward with major plants, a major projects, if at the beginning they could have some of the risk taken out of that project. We were finding that the pioneering plant concept provided us a platform on which to embark on these risks with the private sector.

Mr. McCormack. Do such plants really involve themselves in new technology?

Dr. Zahradnik. Some of them would involve new technology, and some would not. I think the plants of most interest to us are the ones which involved either new technology or some significant extension of existing technology.

Mr. McCormack. You're referring to R. & D.?

Dr. ZAHRADNIK. R. & D., and I'm trying to say that there has to be something unique and different about the plant to justify its inclusion in our program. If it's a novel, or new idea, a new experience with the existing facility which would take its operability into a new region, if you will, then it's these kinds of things that we're looking for.

Mr. MCCORMACK. Are you doing any work in combined cycles?

Dr. ZAHRADNIK. The combined cycle work we have is in the low Btu gasification area, where at least one, or possibly two, of our pilot plants would involve a combination of low Btu gasification and combined cycle operation.

I might mention in our advanced power systems area that we have issued a major request for proposals for a pressurized fluidized-bed system, which would be with a combined cycle plant. So we are looking for a combined cycle plant, both in the Btu gasification area and the area of pressurized fluidized-bed combustor system.

Mr. HECHLER. Have any of the Centers of NASA done any research in the fluidized-bed that would lend assistance to OCR that you're aware of?

Dr. ZAHRADNIK. I'm not aware of it. Of course, the Environmental Protection Agency has had for some time a program in fluidized-bed technology.

Mr. HECHLER. I was under the impression that Lewis Research had engaged in some of this type of research. I may be mistaken on that point.

Dr. ZAHRADNIK. Not to my recollection.

Mr. HECHLER. I see Mr. Wells here. I wonder if I could ask him to comment on this point.

Mr. WELLS. It's been reported to us during the fiscal 1975 NASA authorization hearings that Lewis was examining this area in connection with pressure combustion technology, and was prepared to proceed on a more arduous scale.

Dr. ZAHRADNIK. Yes. I think what you're referring to may be the ECAS study, which is the Energy Conversion Alternatives Study. This is a study which is being funded at about a $3 million level, in which two contracts have been let by NASA Lewis, one to the General Electric Corp. and one to the Westinghouse Corp. In addition to those contracts, an extensive in-house study is being done by the NASA Lewis people in order to examine on a systematic basis with common assumptions the efficiencies and costs associated with various advanced conversion technologies. These contracts were awarded in the summer, and work is continuing on this. The Office of Coal Research was a co-sponsor of this, putting up $750,000, with $1 million provided by the National Science Foundation, NASA provided the remaining funds.

We're looking forward to the results of that work to provide direction for our activities in the advanced power system area, as well as perhaps to modify areas in both low Btu gasification and direct combustion.

I think the kind of study that's being done, and in the breadth that it's being done, will be very useful as guidelines along all these lines.

Mr. HECHLER. I appreciate your saying this, because as an alumnus, it seems that it's part of this position to tie together with what NSF has done and is doing.

I simply raise the question to indicate strong support for Dr. Stever's concept that he mentioned this morning, that there is a role for advanced research that both NASA and NSF can fill in a very useful way that does not duplicate nor interfer with, nor impinge on the administrative authority of ERDA.

Dr. ZAHRADNIK. I couldn't agree with you more. We work very closely with the National Science Foundation in all of these things to get the job done by the best performer possible. We have interagency agreements with the Atomic Energy Commission, the Bureau of Reclamation, the Army Corps of Engineers. We have projects which are cost shared with the Federal Energy Administration, the Environmental Protection Agency, the Bureau of Mines, and I'm sure that this spirit of cooperation pervades all the things that we do.

Mr. HECHLER. Thank you.

Mr. MCCORMACK. I have a couple of more questions.

Right off the top of my head it seems totally unrealistic to conceive of low Btu gasification as a direct competitor of scrubbing technology, and I'm curious to know if any consideration has been given to this, if any papers studying this have been made, or if any thought has been given to this approach?

Dr. ZAHRADNIK. As a matter of fact, extensive thought has been given to that, very definitely, both in the Office of Coal Research and by private industry as well on that very subject.

We feel that from a cost point of view and an implementability point of view, and a reliability point of view, that the promise of low Btu gasification for utility application is very good with the combined cycle concept, involving low Btu gasification and advanced gas turbines, you have, a system that's comparable in cost, you have a system that's more efficient, which stretches our supplies of fuels, and which really gives us the kind of overall efficiency that we feel we want to have. We feel that low Btu gasification technology has a real role to play. It's probably the primary candidate for coal conversion plants in the future, from a cost point of view and from an efficiency point of view.

I can insert for the record a number of records to document this, if you'd like.

Mr. MCCORMACK. Let's wait until we get into detail later on in the year.

Dr. ZAHRADNIK. OK.

Mr. MCCORMACK. I just think it isn't essential now, but I have no doubt we'd want to look at it later and in greater depth.

One other question.

I ran into on two occasions, in conversations on the conversion of material, using high energy neutrons as a source of ethane.

Had you been aware of this in the Office of Coal Research? Have you explored this subject at all?

Dr. ZAHRADNIK. I'm aware of it in a very general way. The Office of Coal Research has done no work at the moment to explore this area.

Mr. MCCORMACK. Of course, the obvious reason for this, because of the necessary hydrogen characteristics, I believe if a synthetic would produce ethane as easily as hydrogen that we'd be way ahead.

Dr. ZAHRADNIK. One of the points I want to make in my remarks which follow, and I would like to take this as an opportunity, is that, really, coal should be considered as a feedstock from which to produce a spectrum of products: Hydrogen, methane, liquids of all kinds, chemicals of all kinds, in much the same way that petroleum is looked upon today.

I think that if it were required, let's say, to make high octane gas only from petroleum the price would double, and we'd be under extreme difficulty in finding the technology. I think we should afford coal the same luxury, to say that, really it should be considered a raw material to be refined into those products which meet marketing requirements.

The point I'm making, which is really in answer to your question, is we're seeking in the Office of Coal Research to develop, a broad technological base, from which we can at sometime in the future synthesize the kind of processes in the plants that we have envisioned. If in the course of this evolution of the technology base we develop a specific process, such as for methane production and hydrogen production, so much the better. But I think we don't want to let such processes be our only major thrust.

Mr. MCCORMACK. Following that comment, do you think the production of methanol, for instance, as part of your liquefaction program has priorities, or what priorities does it have as compared with other nonliquid products?

Dr. ZAHRADNIK. The production of methanol is a technology we have looked at very extensively.

We are well aware of the new areas in development whereby methanol is produced commercially today at about one-half the cost that it was a few years ago. We feel the present existing technology is well-known; namely, the conversion of synthesis gas to methanol. However, the production of a synthesis gas from coal is an area we're vitally interested in, and, as part of the proposals that we have in various stages of development from private industry, we've looked for means to couple our uncertainty about coal gasification to synthesis gas with the commercial availability of methanol convertors, so that we can put together a plant, funded in part by the industry for methanol conversion that is commercially available, and funded in part by the OCR for that part which would involve new technologies. It's these kinds of partnerships that we hope to create in the future.

So I would say, we're interested in methanol. We know there's an interest in the private sector in methanol, and if people were to build plants, we would be glad to participate in that area, where there's limited technology.

Mr. MCCORMACK. So then you're not looking to taking advantage of this new technology, but for programs in the future?

Dr. ZAHRADNIK. We've tended to adopt the position that if the technology is commercially available then it's really not the responsibility of the Office of Coal Research.

Mr. MCCORMACK. What I'm fishing around for is, bypassing the actual creation of the specific feedstock as a definitive step, but rather moving perhaps on a continuous basis from coal right into methanol, blending the new technology into some sort of a distillation process, or something of this sort, that you get from your feedstock.

Dr. ZAHRADNIK. Yes; and that possibility we are looking at. We are looking at it, as an indirect synthesis variation, which would produce methanol, or any higher series of alcohol, or chemical series of other kinds. That's something that we are looking at, mainly at the experimental level.

On the other hand, we would like to integrate this existing technology somehow with coal. If we find the right vehicle we might just as well go ahead and do it.

Mr. MCCORMACK. Are you doing any paper analyses, comparing the cost, time, the technical requirements for this sort of approach as compared to the traditional approach?

Dr. ZAHRADNIK. Yes. As a matter of fact, the National Science Foundation sponsored an Engineering Foundation Conference this summer at Henicker, N.H., on the production of methanol fuels. Dr. Gouse and myself were co-chairman of this conference. The proceedings of this conference will be out very shortly, and they speak directly to this point. They analyze methanol production imbedded in a wide array of technological possibilities: for example, the use of the low British thermal units gas, which will provide the gas to a power station during peak loads, and methanol conversion during offpeak loads, a whole sequence of such alternatives. These analyses are interesting. They provide a basis for methanol, and they also suggest that it would be very expensive as a fuel. As a fuel it will have to find premium uses. As a chemical it may be feasible.

Mr. MCCORMACK. Is anyone doing a systems approach to the total business of relating coal to transportation efficiency?

Dr. ZAHRADNIK. Yes; we have a study with the Bechtel Corp. to do just that, where we're looking at the entire energy system as a series of linkages between the mine and the customer, in which coal has to be transported to a purification system, or preparation system, converted, transported, and finaly used. We're developing methodology to study this, not only in a temporary way in today's situation, but within the evolving energy equation of the country, so that as we come to have new technologies available, or other kinds of transportation alternatives, we can build this into the methodology, running it through a computer, so to speak, and then come up with the results.

The results to date are very encouraging, not only providing us with the results of the program, but providing us with a pretty firm handle on what promising technologies are coming along down the pike.

Mr. MCCORMACK. I think you can appreciate that we all want to be kept well informed on this committee in this sort of consideration and discussion, and the ultimate responsibility of not only people in your jobs for making these decisions, but ones that are closely associated with them.

Dr. ZAHRADNIK. We want to keep you as well informed as you have the time for.

I would like to add one more thing, and that is that part of my comments today, in addressing the proposed legislation, have to do with the fact that, in a synthetic fuels demonstration plant, or any coal conversion plants, you have to imbed that program in an integrated R. & D. effort. Otherwise, you're not going to get maximum results.

Just the things you're talking about: transportation studies, on the one hand; engineering evaluations; new exotic fuels on the other. These things have to be continuously ongoing activities, so that they reinforce the technology that's being developed, providing guidance to the program, and the ultimate decision of the people who have control of it. I think it is very important to any R. & D. effort.

Mr. McCormack. I've been listening to speeches for the last 3 years saying we have to have a comprehensive systems approach. This is exactly the sort of thing I'm talking about.

Excuse me. Congressman Brown is back. Would you take over the chair? I'll excuse myself.

Mr. Brown. I'm sure that Mr. McCormack will want to continue his questioning when he returns.

Unfortunately, I missed much of your earlier testimony. You haven't completed your prepared statement yet, have you?

Dr. Zahradnik. I have a few more things that I would like to say.

Mr. Brown. Perhaps it would be best if you just continued with that.

Dr. Zahradnik. OK.

Getting, finally, to that segment of our program, Congressman Brown, which had to do with liquefaction, the area with the most relevancy to the proposed legislation.

I would like to simply point out that liquefaction is a concept of coal processing that's been known for some time.

There are four time-honored methods for liquefying coal: pyrolysis, or essentially heating up of the coal; solvent extraction, in which a liquid tries to dissolve the coal; direct catalytic hydrogenation, where a catalyst is used to speed up the process; and indirect synthesis variations, like the Germans practiced in their Second World War technology.

Our strategy has been to explore projects utilizing each of these four methods. Our strategy is to explore selected areas of process and unit operations options through large bench and pilot plant stages in order to develop a broad technological base. From this base we can synthesize the most efficient and economical process or combination of processes to produce clean liquid fuels.

Our major project in the area of pyrolysis is the Coed Pilot Plant at Princeton, N.J., which was built and dedicated in 1970, and which has successfully tested a variety of coals. We have completed a commercial design for this process. The process consists of a number of pyrolysis vessels which are housed in the building at the left in the slide, and in which coal is subjected to a series of stages of increasingly severe conditions. Coal-derived liquids and unconverted coal—char—were produced in this way. The liquid products from this process have been tested in a number of applications, including destroyer tests by the U.S. Navy, and in recent tests in gas-turbine combustors. The char byproduct has been successfully burned in commercial boiler and gasification tests in a commercial gasifier are planned for early in 1975.

We heard testimony this morning about a solvent extraction plant built at Wilsonville, Ala. We have in that area a major pilot plant at Fort Lewis, Wash., and you can see a shot of it here during construction.

The product from this plant is a heavy oil which, although not a liquid at room temperature, could be fired as a liquid into utility boilers. Much of the ash and sulfur originally present in the coal is removed by this process, and a product of remarkably uniform quality is produced from a variety of coals, and we had a sample passed around this morning.

This plant is currently in startup operation, and it represents a factor of about a 10 scale up in size over a similar facility constructed at Wilsonville, Ala., under sponsorship of the Electric Power Research Institute and Southern Services, Inc. These two plants will not only serve to determine the commercial and technical viability of this process, but, just as importantly, provide valuable information on the scaleup of coal conversion plants.

The use of a catalyst to accelerate the hydrogenation reactions of coal has been studied for the greater part of this century. Engineering of a reactor to provide appropriate contact between coal, catalyst, hydrogen, and solvent has remained, however, a complicated problem.

Two reactor configurations seem attractive, one, using an ebullating bed, in which there is a lot of stirring and mixing and a fair degree of uniformity achieved, is the basis of the so-called H-coal process.

In September of this year a contract was awarded for the detailed design and engineering for a pilot plant to test the H-coal process. In a recent announcement, the Secretary of the Interior disclosed that this plant would be located at the Ashland Oil site in Catlettsburg, Ky. The product of this plant can be either a synthetic crude oil similar to petroleum, or a heavier liquid suitable for use as a boiler fuel.

A second reactor configuration, using a fixed bed of catalyst, is the basis of the Synthoil process, developed by the U.S. Bureau of Mines. A pilot plant is also planned to test this concept. Product distribution is expected to be similar to that an H-coal plant.

Congressman McCormack had just asked about a variety of indirect synthesis variations. Our program in this area is exploratory, and we have no plans at the moment to construct a major pilot plant. However, a number of interesting variations are being explored and, if successful, could be considered for testing at a larger scale.

I hope that this brief description of the OCR program, particularly its liquefaction activity, provides a perspective on the synthetic liquid fuels program at OCR. I realize it's difficult in a short time to cover the topic adequately, but even my brief description highlights the basic points I'd like to make:

1. Coal conversion is a complex technology; and
2. The optimum route to liquids from coal is as yet undetermined.

Because of the complexity of the technology, a broad-based, integrated program is essential to success. Each of the processes I have described involves coal feeders, solid-liquid separation systems, cyclone, filters, pumps, valves, heat exchangers, and so forth, all of which need development within the coal-handling context. The operability and reliability of these components are crucial to process success, and problems in development must be solved in an integrated way.

One of the first facilities constructed by the Office of Coal Research was at Cresap, W. Va. and I show a slide of this facility, on the right. This facility will be operated as a component test facility where

process equipment can be developed and tested under realistic conditions.

So that a program of synthetic liquids development requires not only pilot plants, but plants of this kind dedicated specifically to equipment developed.

The ultimate commercialization of a synthetic fuels process depends very heavily upon process efficiency and cost. Small increases in process efficiency—small increases—result in huge annual savings because of the large throughput of product released from these plants.

The experience in the petroleum industry has been that the tremendous variations in petroleum feedstocks, production and transportation costs, regional demands for product mix, seasonal cycles, and local prices for competing fuels have resulted in a wide variety of refinery designs.

A large number of competing refinery process operations are available to the refinery designer, and even after 50 years of sophisticated technical development, no single process for petroleum refining has emerged.

Coal feedstocks are even more viable than petroleum feedstocks, and coal product markets are extremely susceptible to competition by easily transportable fluid fuels. Thus, the liquefaction program of the Office of Coal Research is not characterized by the development of a single liquefaction process, but is a continuing effort to broaden the advance of a series of processes, specifically suited to limited ranges of feedstocks and markets.

However, it is necessary to keep our program tracking toward optimum process configurations. The Office of Coal Research supports several evaluation contractors, as I mentioned earlier, whose responsibility is to provide continuing comparative evaluations of the process alternatives being considered. These studies are necessary for program guidance, as well as for the development of realistic plans for demonstration plant projects.

The program plans, budget and personnel of the Office of Coal Research are now merging with similar resources from the U.S. Bureau of Mines in anticipation of joining the Energy Research and Development Administration.

The experience of the Office of Coal Research in managing contract research programs will meld with the extensive in-house R. & D. capability of the U.S. Bureau of Mines energy centers to provide a unique fossil energy capability within the Federal Government. We believe this capability will be the best instrument to carry out the intentions of this subcommittee, as expressed in H.R. 17400.

The intentions of the proposed legislation to encourage not only studies in the production of liquid fuels, but demonstration projects as well, is likewise our intention.

In July of this year we issued a request for proposals for a demonstration plant to produce a clean boiler fuel from coal. We've received three proposals in response to this RFP, two of which we considered to be responsive. Contract negotiations are underway with one of these proposers today, as a matter of fact, and we could sign a contract for the initial phases of this project soon.

The second contract could be signed early next year.

Each of these projects will produce pipeline gas as a coproduct. The boiler fuel product will be tested by utilities and commercial users. The gas coproduct will be evaluated by gas utilities and their customers.

What I'm trying to say here is that it is not merely enough to build a demonstration plant. One has to look at the use of the final product as well.

The final selection of the plant to be built will be made upon completion of the detailed plant designs and cost evaluations. We expect to have at least 50 percent cost sharing of the construction and operating costs of the selected facility. By this arrangement, coupled with the product testing I mentioned, we hope not only to build a plant, but to develop a sound basis for a synthetic fuels industry from mine to customer.

We mentioned this morning the various time schedules involved. I would like to show you what is along the line of our latest thinking here, and I would like to show you the kind of time schedule which is involved.

The top schedule was the schedule we published in the June issuance of our RFP. We revised this issuance in early November to a broader schedule.

I think the point to make is that the preliminary and final design phases for such a plant, even if they overlap, require at least 18 months for completion. Construction will require 30 months, under the most optimistic conditions, meaning you're talking about 4-year period from the commencement of design to the final operation of the plant.

We anticipate at least operation over a 42-month period in order to test a variety of coals and to obtain reliable operating economic data. So that we're talking about a project that in duration approaches 8 years.

I cite these time periods to you this afternoon in order to illustrate the time scale involved in a demonstration plant program. Careful planning, skilled personnel and long-term commitment by both the Federal Government and its industrial partner are all needed.

We are looking forward to ERDA to provide the means for assembling all of these ingredients, not only for a demonstration plant for the production of synthetic liquid fuels from coal, but for other coal conversion technologies as well.

We appreciate the opportunity to describe our program and our plans to you, and to provide our comments on H.R. 17400.

We would be pleased to arrange more extensive briefings on the entire fossil energy program at any time.

Mr. McCormack. Thank you very much, Dr. Zahradnik.

You may be certain that the Subcommittee on Science, Research and Development and the Subcommittee on Energy will be inviting you for future and more extensive discussions early next year.

I would like to ask you a question on what I suspect may occur, and may have occurred, to every member of this committee and perhaps every Member of Congress, and that is, just looking at your schedule there for demonstration plants, this is typical, I suppose, not only for low-sulfur boiler fuel, but coal gasification or coal liquefaction of any sort?

Dr. ZAHRADNIK. Yes.

Mr. MCCORMACK. There are some basic assumptions in this. One of them is, I think, a certain caution on the part of everybody involved that they should not make any mistakes, not have any visible booboos or waste of money. Yet, we're talking about one demonstration plant in each one of these charts.

Now, in your mind, what would the output of a production plant be in equivalent barrels of oil a day?

Dr. ZAHRADNIK. Equivalent barrels of oil a day would be between 10,000 and 20,000 barrels, of the kind we're contemplating.

Understand, this would not be a commercial plant, but a demonstration plant.

Mr. MCCORMACK. What about a commercial plant?

Dr. ZAHRADNIK. A commercial plant, 50,000 to 100,000 barrels a day.

Mr. MCCORMACK. Let's say 50,000 barrels a day. We're short 5 million barrels a day. It would take, then, a thousand commercial plants, to close the presently existing gap.

Dr. ZAHRADNIK. A hundred.

Mr. MCCORMACK. I beg your pardon, 100. Thank you. You're right. To close the gap, at 50,000 barrels a day, between total consumption and domestic production.

Bearing that in mind, what we're really after is getting plants on the line, a lot of plants, as quickly as possible, and so it is not out of order to talk about taking chances, making mistakes.

Dr. ZAHRADNIK. Let me address that point before you go on, because I think I disagree with that at the offset.

I don't think we're moving cautiously because we're afraid to take chances. I think you realize when you're talking about an industry which consists of 100 such plants, you're going to be talking about a capital investment of $100 billion.

Mr. MCCORMACK. Yes.

Dr. ZAHRADNIK. And what we're looking for is the evolutionary change, the small improvements in efficiency that will accompany engineering design. That cost for this, even 1 percent change in efficiency, of $100 billion is a tremendous investment.

Mr. MCCORMACK. Exactly. But I think I'm getting a slightly different view.

I'm not talking about freezing design, or anything like that, but what I am talking about is this: I'm talking about speeding this operation up and, even though we may have less than a perfect demonstration plant, if we work something then we could go ahead and pile three or four or five of these right on top of one another as soon as we possibly can, have them overlapping, and what I'm talking about is putting enough money into these to work the design teams and the construction teams around the clock starting in the very near future, to telescope that time down. Right now imports are running us $22 billion a year. There's no more money that we can put into this. Plant costs amount to a thimbleful in comparison to that cost.

But this country, once it has the perspective and recognizes that this is really the equivalent to putting this on a wartime footing to solve this problem, can easily afford it, to pay the additional wages, and for the additional manpower, overtime and all, as these programs develop.

I'm curious to know whether you've taken this into consideration, or at least thought about it, and if you'd be prepared to respond to that sort of thing.

Dr. ZAHRADNIK. I think we've thought about it, but only in a very general philosophical way, and I think our approach is, as you correctly surmised, not one of "business as usual," but certainly the kind of approach engineering construction would take in building these large facilities. I have no doubt that some of the design phase and some of the construction phase could be compressed slightly as a result of overtime and working around the clock, and so on.

A lot of the other reasons for these times are simply that the procurement times for some of these items are very long, and, again, if it were to go on a very crash basis you would have to obtain priorities for the obtaining of the long-leadtime items. While this could be done, and it would take a major crash effort. Don't deceive yourself; this schedule can't be compressed from 4 years to 1 year.

Mr. MCCORMACK. I'm completely aware of that, but I'm thinking of compressing it from, I see 12 years up there, if I read that correctly.

Dr. ZAHRADNIK. That's correct.

Mr. MCCORMACK. I can see compressing it from 12 years to 8 years.

Dr. ZAHRADNIK. Yes, we would be very anxious to do that.

Mr. MCCORMACK. And that's worth a lot of money.

Dr. ZAHRADNIK. There's a lot of risk involved in it.

Mr. MCCORMACK. I think this is the point: We have to really take that risk. I think that the people of this country have recognized in other critical situations, that one takes risks. Whether it takes congressional miscalculations, or pilot plant failure, we take that chance and we do it, because we have to find out whether its capable to do the job.

This obviously means putting our entire energy program into a comprehensive effort, but the race is literally between bankrupting this country and economic survival.

Dr. ZAHRADNIK. It's a Catch 22 situation. We can't build the plants today because they're not economical, and if we wait 10 years we won't have the capital to build them anyway.

Mr. MCCORMACK. That's right, so we have to face up to it.

Mr. Brown is trying to say something.

Mr. BROWN. I was just going to point out that, for example, you have a gap or 2, 2½ years between the completion of the final design of your pilot plant, at the bottom of your chart, and the beginning of a design of a commercial plant. Whereas, it seems to me that when you've completed the design of your pilot plant the same design engineers should begin to work on the scaling-up to commercial plant, so that you can perhaps save a couple of years just in that phase of it.

Of course, that will, in effect, to some degree force you to treat the first commercial plant as a pilot operation.

Dr. ZAHRADNIK. That's the point.

Mr. BROWN. But the first commercial plant, if you're going to build 100 of them, justifies your doing that.

Dr. ZAHRADNIK. I think you've really put your finger on the problem.

We've assumed in our diagram here that there would be some natural caution on the part of the investor to build, or to even commit to the

building of a facility of this kind until he saw some evidence of a plant existing.

As you've heard in the testimony this morning, the fact that even though you've gone through bench level, pilot plant, semiworks operations, it's only when you're committing to commercial scale that the results are being trusted, and I think we've felt here that in the normal evolution of affairs that the bankers wouldn't be willing to commit until they saw a plant operating, and that's the basis of our commercial plant design starting during the operation of our demonstration plant.

But you are absolutely correct, if we interpret this first commercial facility also as a project perhaps to be shared by someone, that design phase could indeed move far to the left, and we would be very, very supportive of that.

Mr. McCormack. If we put a penny tax on gasoline we could move a dozen plants of this type, to be paid completely, all the construction work of a dozen plants within the next 10 years, commercial plants, and that envisions the kind of thinking we'll be into in this kind of a crash program, before the first day of July 1975.

Mr. Brown. Congress has been very slow to wake up to the urgency of the situation with imported oil, but once they wake up and become aware of that, that your problem is going to be to keep the reins on it in some reasonable proposal.

But I think something such as Mr. McCormack has suggested, of treating this commercial plant on a comparable basis with a semipilot plant is going to be very, very important.

Dr. Zahradnik. I would like to point one thing out, though, in response to your comment about Congress reacting, and that is that a lot of the construction proposals are limited by the availability of resources, such as manpower and critical materials.

I would like to alert you, and I'm sure you've been alerted by others, to that fact. There are other problems that lie in the wake that may slow down this acceleration.

Mr. McCormack. You are aware that there's a need for manpower and materials.

Dr. Zahradnik. Yes, indeed.

Mr. Brown. You talk about the need for manpower and materials. There's no comparison between that and the requirement for commercial coal gasification and liquefaction requirements, or nuclear reactors or fusion reactors, in which critical materials are 100 times more in shortage.

Mr. McCormack. So we're going to have to be pushing hard from all of these points to become a part of a comprehensive energy program. It's going to mean a reallocation of manpower. They're laying people off in automobile plants. We'll have to put them back in this. That's better than to have them doing something else, and we might as well be giving them salaries that pay enough so that people who work in automobile plants would be willing to move to the coal country and start building gasification and liquefaction plants, and retraining programs to do that.

Mr. Brown. If we can't get them from the automobile industry, we'll get them from the construction industry.

Mr. McCormack. The point is, I appreciate very much what you're saying in your testimony, but I would ask you to also be thinking of other scenarios, which are much more aggressive than the very reasonable program you have presented to us today.

Dr. Zahradnik. I'll certainly take your advice.

Mr. McCormack. So that we will be able to respond to the requests that are coming before us for more R. & D. work.

Dr. Zahradnik. We thank you very much for the early warning, and we will get to work right away.

Congressman Brown, do you have any further questions?

Mr. Brown. I'm not sure, and you may not have dwelt on this in your conversation, but coal technologies are not absolutely new to the industrial world, and many countries have technology involving coal.

I wanted to inquire as to the degree to which there is an international sharing of technology in this field, so that we could get a feel of what work might be done in Germany and England and Russia.

From just casual reading, I gather that the Russians might be making some advances in MHD, for example, beyond anything we've done over here.

Dr. Zahradnik. I did open my comments by saying, Congressman Brown, that we are well aware that there are programs being developed, not only by other nations, but by the private industry of this country.

We have tailored our R. & D. effort with full cognizance of these other activities. The work we do, in concert with the work by the private sector in this country, constitutes a national R. & D. plan.

With regard to international activities, we have international bilateral agreements with the English and the Germans. We're well aware of what the Russians are doing. As you know, their MHD program is also a part of a cooperative effort with the United States and Russia in advancing MHD, and we're about to, or I guess we have, signed an agreement with them to look upon the coal conversion more generally. So that we are well plugged into the Russian program.

With Poland, I understand, a small liquefaction plant will be built, patterned after an American designed plant.

So I think that the international R. & D. community is reawakening to coal, and, if I might be allowed to say it, I think we're playing a central role in that reawakening and playing it very well indeed, with all these communities.

Mr. Brown. In your systems studies has this concept of net energy accounting gone into your input?

Dr. Zahradnik. It's entering slowly. We're well aware of net energy accounting, and I've heard some of the advisements that have been offered on the subject. Of course, we're very concerned with efficiency in our processes because it's a high cost industry and efficiency will mean a lot of dollars ultimately. So the net energy out of our processes is extremely crucial to us, and without adopting the net energy considerations as a method of operations, I would say that our efficiency in general is the high priority with us. Our whole program, if you will, is geared toward a more efficient operation, and so we are addressing that question automatically.

Mr. BROWN. As a very highly efficient operation, there's a very low energy output.

Dr. ZAHRADNIK. From the overall system, yes, sir. I mentioned earlier that we have some transportation studies, which are studies from the mine to the customer. We track not only the efficiency, but the integration of the efficiency, as the coal travels through a series of processes. We're doing this both to provide us with R. & D. programmatic guidance, as well as to provide advice to people who might want to go out and do something in the energy system.

So I think we're starting to develop some really excellent scenarios in this regard.

Mr. BROWN. What is beginning to worry me in a very broad sense is the fact that we may, in our devotion to providing additional sources of energy, accentuate the number of imbalances in our total system, our total economy, the material shortage that you mentioned, for example, a shortage of resources for other kinds of programs, merely because of an obsession with this demand for energy, in which we are getting very little, relatively speaking, net energy output, at best.

Dr. ZAHRADNIK. I think you're right, Congressman, and we have started some studies, both in the Office of Coal Research and with the National Science Foundation.

However, at this point I might just take a second to elaborate on what we're doing.

We're looking at what the direct energy requirements may be for manpower, for capital, and materials, and then we're taking these requirements and breaking them up into the inputs that are required in econometric models to see how this requirement would transfer through the rest of the economy, and we're getting some very interesting results, about these ripple effects. So we're finding out. This is a project that's just underway. We'll have some more definitive results to report, I'm sure, to this committee in the spring.

But I think we are concerned specifically about that problem, and I hope to have some concrete evidence as to what the indications are in the spring.

Mr. BROWN. We'll want to explore it with you further in the spring, because it occurs to me more and more that this is not something that can be measured just by the energy aspects, and, therefore, we need to make quite some parallel studies in such areas as economics to arrive at reliable and sound policy decisions.

Dr. ZAHRADNIK. I totally agree with you on that, and I believe that the results of our program will be very interesting to you, and as they evolve I'll send copies.

Mr. BROWN. Thank you.

Mr. MCCORMACK. Do you have any other questions, Mr. Hechler?

Mr. HECHLER. Following up a very perceptive line of questioning by Mr. Brown, have you discovered that material shortages and other changes in the economy in the past year have cooled the enthusiasm, or the interest of private industry in coal liquefaction and coal gasification in any specific instance?

Dr. ZAHRADNIK. Yes. We've observed a number of examples of this, both within our program and within the programs of others.

You may be aware of an announcement by the Exxon Corp., that they're postponing work on their coal gasification project, and basically

they cite the market uncertainty and capital limitations as the reasons for it, and I believe that that's really the case.

I think in a number of instances we have received less than enthusiastic response, both to our requests for proposals and our ongoing projects from the private sector because of capital limitations, because of opportunities elsewhere, and because of the general uncertainty regarding the marketplace for synthetic fuels. We have noticed this very dramatically, and, of course, we've heard the Ashland Oil people today bring up about the unwillingness of the colony group to go forward. We've heard about the Arco situation. All of these things do suggest an emerging pattern in which the private sector is unwilling to commit large amounts of money to programs with some risk in the face of market uncertainty and certain instabilities of regulatory practice.

In response to this, I believe that the Office of Coal Research's coal gasification program, more than ever before, has to go forward in this direction.

Mr. HECHLER. Thank you.

Mr. BROWN. The gentleman's questions remind me that we have just seen a flurry of similar announcements with regard to the construction of refineries.

Dr. ZAHRADNIK. Yes, that's right.

Mr. BROWN. And certainly there is no technological risk, but there is a risk as to the market factors?

Dr. ZAHRADNIK. That's right.

Mr. BROWN. And this, of course, brings us back to a possibility that there would need be a risk sharing, or some sort of a support, or, as I think Congressman Perkins mentioned this morning, a Defense Protection Act kind of long-term contractual arrangement in these fields in order to alleviate, if not eliminate, some of these risk factors, which I don't think perhaps are risks, but are primarily difficulties in forecasting, to a degree, as to the period of time.

Mr. MCCORMACK. I would like to ask Dr. Zahradnik what he thinks of this idea that we've been shooting around this morning and previously, that, of Government guarantee for the first units, or the first producers of both liquid and gaseous fuels, at so much per unit we could assume, that they were all equivalent for synthetic liquid fuels, or have the underlying Btu's for pipeline quality gas, and simply project what the demand would be in the period immediately after you get the first plants on line. When you do get the first plants on line, offer the first corporations that put plants into operation a guarantee that the Government would amortize the cost of the plants, for instance, for 10 years at $10 a barrel, or the first so many barrels a year of oil, and guarantee it, and guarantee also that at the same time if there's domestic production that we will not import the commodity.

What would you think of that sort of an approach?

Dr. ZAHRADNIK. I think the approach as a general one is quite good. Certainly right now the only mechanism we have in the Office of Coal Research in its initiating programs in the demonstration plant area are to receive proposals and write research contracts. That's our only mechanism. You're talking about another kind of mechanism, a financial mechanism, to get these plants going.

I would be in favor of this. I think it's the kind of thing we need to have. Whether I agree precisely with the mechanism you describe for private industry, I'm not sure. I just don't have enough information. I haven't carried on a personal analysis.

I will say this: That whatever mechanism w use to get this thing going, that it's going to have to be done in a competitive way. In other words, rather than saying we will pay $10 a barrel for 10 years, or will develop guarantees for someone who will erect a plant, we're going to have to do this by saying, "If we were to pay you, what would you want for how long?" and that this be decided competitively, because we aren't in a position to project, with the kind of uncertainties that exist, any better than the private sector is.

Mr. McCormack. Do you think that there are some fairly certain guideposts out there though, for instance, so that in spite of the limited domestic production of hydrocarbons we would have a shortage of 5 million barrels a day in the future, that it's not going to get any cheaper, at $5 a barrel?

Dr. Zahradnik. Yes, I think those guideposts exist, and we ought to take advantage of them.

But I think, at the same time, one of the most difficult handles, in the business today, with regard to plant construction or plant installations is cost. We've seen costs rising as much as 30 percent in the last year in some of our major contracts, and it becomes a very difficult thing to pin down the cost that one would be willing to support, price support.

All I'm suggesting is that, because of the uncertainty of the technology, coupled with the cost uncertainty it becomes a very tricky job indeed to pick an accurate final cost number.

Mr. Brown. Mr. Chairman, one other factor that I think to some degree weakens these guideposts, those we mentioned, is the fact that we're engaged in an economic international war. The Middle Eastern oil, I'm sure you're aware, could be bought at half the price that we're paying, and under conditions of gamesmanship we relate to the OPEC countries, they're quite capable of seeking, at least, to emasculate our national efforts by drastic reduction of costs if they thought it would succeed.

Mr. McCormack. That's exactly the reason I'm suggesting in these hearings that these products should be domestically produced.

Mr. Brown. And if it requires a commitment on our part to a 10- to 20-year energy program, with these guarantees, in order to protect ourselves against these movements, which are quite feasible from any economic standpoint.

Mr. McCormack. It might be possible to write a formula into such a form that would, on the one hand, guarantee a profit to produce and, on the other hand, still be responsive to the international gamesmanship, although I don't immediately see it. It might be of interest.

Mr. Hechler, do you have any comments?

Mr. Hechler. Not quite along that line. I think we've pretty well exhausted it.

Mr. McCormack. May I pursue just one other question then?

What is the proposed production of a full-size commercial coal gasification plant?

Dr. ZAHRADNIK. 250 million standard cubic feet per day.

Mr. MCCORMACK. 250 million, a quarter of a billion. That sounds like we would need 240, or at least 240, plants for the use that we now can assume.

Dr. ZAHRADNIK. That is about the number, yes.

Mr. MCCORMACK. Do you have any projected shortages, for, say, in 1985?

Dr. ZAHRADNIK. We have the projected shortages that others have provided us and which the Office of Coal Research participated in the Task Force's report—to Project Independence Report: Generally we subscribe to our findings with Gulf in that anaysis. We have no special additions of the information that has been published extensively in these areas. We know that shortfalls will exist, and we would hope that the production of synthetic natural gas and coal will fill some of this. But, again, it's a question of how rapidly we can bring these many required plants on line. They, like the synthetic natural gas, or synthetic liquids, as shown on the right, have long times associated in design, construction and operations, and it's just a question of how rapidly that technology can be developed.

Mr. MCCORMACK. So we're still talking about the mid-1980's, and we're still talking about 100 plants, and we're still talking about $1½ billion to $1 billion a plant?

Dr. ZAHRADNIK. That's correct.

Mr. MCCORMACK. Thank you.

Mr. HECHLER. I would like to pursue a minute the comment you made on page 7 of your prepared statement, that on fuel liquefaction there are four different methods that you have ongoing research underway. You say—

> A parallel approach, not only in liquefaction but in coal conversion generally, is not a luxury but a necessity.

This morning's testimony indicated that there were perhaps even other methods that were underway with other nations, and I wonder whether the economic and materials questions that we would face affects this decision to proceed along so many different courses, whether at some point it won't be necessary to start to narrow down and concentrate?

Dr. ZAHRADNIK. Very definitely; I think your point is well taken. I don't mean to say that our parallel approach is going to remain parallel forever. Each of the projects we start is not necessarily a success oriented project designed to ultimately succeed into some demonstration plant.

We are prepared to cut off a project when we can make a definitive decision as to whether it is technically or economically unrealistic to go forward. That's why I mentioned we have onboard a large number of evaluation contractors. These people provide for us continuing input on the practicality of going forward on every one of our projects, and when we see a project for some reason or another is not going to succeed, we'll stop it at that point.

So I think we're tracking a program that has a number of parallel starts, and we'll continue on just as long as they remain viable, and when their viability ceases, the project will cease as well.

We have the mechanisms to do that, and we're prepared to do that.

Mr. HECHLER. This is true of gasification as well?

Dr. ZAHRADNIK. It's true all across the board.

Mr. HECHLER. How many different methods do you have working currently on coal gasification?

Dr. ZAHRADNIK. Well, we have three currently at pilot stage. A fourth is being built, and we have a couple of variations that we're looking at.

Mr. HECHLER. Are these all different methods?

Dr. ZAHRADNIK. They're all different methods.

And I would like to point out, as I mentioned in my statement, and I would like to reemphasize here, that these pilot plants which are built are testing out an idea of some unique way of converting coal, but at the same time they are solving problems associated with materials, problems associated with pumps and heat exchangers, the process equipment necessary to make coal conversion technology go, and these problems are being solved in an integrated way throughout our program. You are not going to be able to build any demonstration plants at all until you get these individual components to work, and that's a very real part of our program, and we have an integrated effort throughout to make sure that these pieces of equipment are adequately developed, and I think that's really the key point.

Mr. HECHLER. Thank you. Thank you, Mr. Chairman.

Mr. MCCORMACK. Thank you, Dr. Zahradnik. Thank you, Congressman Hechler.

I believe this will conclude our hearing today.

I do want to observe that I think the material we covered today, even though we have covered it rather superficially, is important for the Members of the Congress and the members of the general public to understand. I think it's essential that the Members of the Congress and the members of the public in general come to an understanding of how desperately important it is that we move with wartime urgency in developing coal gasification and coal liquefaction processes in the commercial stages in the very near future, as quickly as is technologically possible, as quickly as we can do it.

We need every bit of emphasis we can bring to bear in providing capital support and essential materials, and, of course, this applies also to other uses of coal: Combustion coal, desulfurization of coal, or whatever technology is required.

Certainly, as this Nation undergoes the decline of natural gas and oil this Nation will be dependent upon nuclear energy, or coal, for virtually all of its energy, and we must get at this matter immediately, and we must be prepared, starting now, to enter into a crash program, to spend millions of dollars in order to protect this country from bankruptcy, military vulnerability, and ultimate catastrophe.

I thank you for your statement.

[Whereupon, the subcommittee adjourned at 3:30 p.m.]

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