

1040

214
In 8/13
C 63/4

COAL GASIFICATION DEVELOPMENT

Y 4
In 8/13
C 63/4

GOVERNMENT

Storage

THE LIBRARY
STATE UNIVERSITY

HEARINGS

BEFORE THE

SUBCOMMITTEE ON
MINERALS, MATERIALS, AND FUELS

OF THE

COMMITTEE ON
INTERIOR AND INSULAR AFFAIRS
UNITED STATES SENATE

NINETY-SECOND CONGRESS

FIRST SESSION

ON

S. 1846

A BILL TO ESTABLISH A COAL GASIFICATION
DEVELOPMENT CORPORATION, AND FOR OTHER
PURPOSES

JULY 27 AND 28, 1971



Printed for the use of the
Committee on Interior and Insular Affairs

U.S. GOVERNMENT PRINTING OFFICE

WASHINGTON : 1971

66-694 O

COMMITTEE ON INTERIOR AND INSULAR AFFAIRS

HENRY M. JACKSON, Washington, *Chairman*

CLINTON P. ANDERSON, New Mexico

ALAN BIBLE, Nevada

FRANK CHURCH, Idaho

FRANK E. MOSS, Utah

QUENTIN N. BURDICK, North Dakota

GEORGE MCGOVERN, South Dakota

LEE METCALF, Montana

MIKE GRAVEL, Alaska

GORDON ALLOTT, Colorado

LEN B. JORDAN, Idaho

PAUL J. FANNIN, Arizona

CLIFFORD P. HANSEN, Wyoming

MARK O. HATFIELD, Oregon

TED STEVENS, Alaska

HENRY BELLMON, Oklahoma

JERRY T. VERKLER, *Staff Director*

WILLIAM J. VAN NESS, *Chief Counsel*

DANIEL DREYFUS, *Professional Staff Member*

MARY JANE DUE, *Staff Counsel*

CHARLES COOK, *Minority Counsel*

(II)

CONTENTS

S. 1846	Page
Departmental reports:	3
Budget	13
Interior	12
Science and Technology	13

STATEMENTS

Bennett, Hon. Wallace F., a U.S. Senator from the State of Utah	85
Chilton, Dr. Thomas H., chairman, National Academy of Engineers	106
Clay, Herbert D., president, Iroquois Gas Corp., National Fuel Gas Co. chairman, American Gas Association Government Relations Committee; accompanied by George H. Lawrence, a vice president of the American Gas Association and director of Government Relations, and Douglas T. King, director of Research and Engineering, American Gas Association	113, 122
Proposal	117
Freeman, S. David, Office of Science and Technology, Executive Office of the President; accompanied by J. F. Weinhold	24
Garvey, James R., executive vice president, National Coal Association; and president, Bituminous Coal Research, Inc.	62
Hansen, Hon. Clifford P., a U.S. Senator from the State of Wyoming	16
Hoffman, Prof. E. J., College of Engineering, University of Wyoming	57
Jackson, Hon. Henry M., a U.S. Senator from the State of Washington, and chairman, Committee on Interior and Insular Affairs	17
MacMullan, Russell J., assistant to the president, Pullman, Inc., Chicago, Ill.	156
Morgan, John H., Jr., president, Great Western Pipeline Corp.; accompanied by Clarence Justheim, president, Justheim Petroleum Co.	74
Pickelner, Joel M., National Wildlife Federation; accompanied by William E. Lloyd	67
Roddis, Louis H., Jr., president of Consolidated Edison	142
Roe, Kenneth A., president, Burns & Roe, Inc., Oradell, N.J.	157
Rogers, Walter E., president, Independent Natural Gas Association of America	86
Roncallo, Hon. Teno, a Representative in Congress from the State of Wyoming	18
Swidler, Joseph C., National Association of Regulatory Utilities Commissioners; accompanied by Paul Rogers, general counsel	41, 48
Woerthwein, Arthur T., vice president, ITT Corp., for Gas Appliance Manufacturers Development Corp.; accompanied by Harry A. Paynter, managing director, GAMA	99
Appended statement	104

COMMUNICATIONS

Justheim, Clarence I., president, Justheim Petroleum Co. : Letter to Senator Jackson	80
Lawrence, George H., director, Government Relations and Services, American Gas Association, Inc. : Letter to Senator Moss, dated August 3, 1971	138
Muskie, Hon. Edmund S. : Letter to Senator Jackson, dated June 15, 1971	15
Oblad, Alex G., associate dean, College of Mines & Mineral Industries, and Robert G. Larsen, director, Utah Engineering Experiment Station: Letter to the committee, dated July 22, 1971	16

IV

ADDITIONAL INFORMATION

Clay, Herbert D., president, National Fuel Gas Co.:	Page
Appendix A-----	131
Appendix B-----	135
Pickelner, Joel M., material submitted:	
Carbon dioxide acceptor process consolidation coal-----	71
The Hygas Process Institute of Gas Technology-----	72
The B.C.R. two-stage superpressure process, Office of Coal Research, Department of the Interior-----	72
Synthane process, the Bureau of Mines-----	72
Swidler, Joseph C., chairman, New York State Public Service Commis- sion—material submitted:	
Case I and Case II—to satisfy estimated U.S. gas consumption gas find- ing rates-----	50
Resolution-----	56
"U.S. Oil-Gas Advisory Panels Hit as Industry Dominated," by Morton Mintz, Washington Post, July 28, 1971-----	153

APPENDIX

Allen, Frank J., general counsel for Western Oil Shale Corp., Salt Lake City, Utah-----	163
Boyle, W. A., president, United Mine Workers of America-----	161
UMWA news release-----	162
"Development Also Urged, But McKetta Report Finds U.S. Energy Re- sources 'Sufficient' " by Jim Collins, The Oil Daily, July 27, 1971-----	163
Frazier, Charles H., National Economic Research Associates, Inc., Phila- delphia, Pa. : Letter to Senator Moss, dated August 27, 1971-----	165

COAL GASIFICATION DEVELOPMENT

TUESDAY, JULY 27, 1971

U.S. SENATE,
SUBCOMMITTEE ON MINERALS, MATERIALS, AND FUELS OF THE
COMMITTEE ON INTERIOR AND INSULAR AFFAIRS,
Washington, D.C.

The subcommittee met, pursuant to call, at 10 a.m., in room 3110, New Senate Office Building, Senator Frank E. Moss (chairman of the subcommittee) presiding.

Present: Senators Moss, Hansen, Jackson, and Gravel.

Staff members present: Mary Jane Due, staff counsel; and Charles F. Cook, minority counsel.

Senator Moss. The subcommittee will come to order.

This is a public hearing this morning on S. 1846, a bill that proposes to establish a coal gasification development corporation.

The purpose of this hearing before the Minerals, Materials, and Fuels Subcommittee is to take testimony on S. 1846, which was introduced by Senator Jackson and myself to establish a coal gasification corporation. There is general agreement that regardless of steps which may be taken to increase production or find new sources of natural gas, supplements will be necessary from synthetic gas by 1980.

Processes for the conversion of coal to synthetic gas have been known for many years and research work to improve the processes has been underway in the country. What is needed now is the incentive and assistance for industry to take the expensive steps toward development of full size, commercial plants, S. 1846 would create a Government-industry, jointly supported and operated corporation with the objective of demonstrating on a commercial scale at least two alternative methods for the production of gas from coal. This would be the sole purpose of the corporation. When the objective was attained, the corporation would cease to exist. Financing would be shared by Government and industry.

While the committee would be interested in the various gasification processes and the estimates of the time and funds that each will require to reach commercial development, this phase of the problem will be basically the responsibility of the corporation, if established, and should be provided to it at the appropriate time. This hearing will not go into these specific processes. It will instead concentrate on the following questions:

(1) Is there a need to intensify the coal gasification effort in order to speed up the initiation of a commercial coal gasification industry?

(2) If there is such a need, what alternative methods exist to accomplish this objective?

(3) If one of the more viable alternatives appears to be a joint industry-Government program, what methods are available that would improve on the provisions of S. 1846?

The text of S. 1846 and the reports of the departments will be included at this point.

(The documents referred to follow:)

92D CONGRESS
1ST SESSION

S. 1846

IN THE SENATE OF THE UNITED STATES

MAY 12, 1971

MR. JACKSON (for himself and Mr. Moss) introduced the following bill; which was read twice and referred to the Committee on Interior and Insular Affairs

A BILL

To establish a Coal Gasification Development Corporation, and
for other purposes.

1 *Be it enacted by the Senate and House of Representa-*
2 *tives of the United States of America in Congress assembled,*

3 That (a) the Congress recognizes that—

4 (1) natural gas is the least polluting of the fossil
5 fuels in that it causes no pollution from sulfur oxides and
6 particulate and emits the least amount of nitrogen oxides
7 per heat unit supplied;

8 (2) natural gas can be produced and transported
9 with less environmental degradation than the other fuels

1 and at costs that compare favorably with the competitive
2 fuels for uses where the various fuels are interchange-
3 able;

4 (3) for three consecutive years the amount of gas
5 consumed in the United States exceeded new supplies
6 found in the contiguous forty-eight States;

7 (4) projections of future gas demand are such that
8 every new supply source must be developed, including
9 natural gas by pipeline, importation of liquefied natural
10 gas from overseas sources, and the gasification of coal;

11 (5) gasification of coal has been tested on a small
12 scale in a variety of processes by a number of investiga-
13 tors, but to achieve commercial status for any of these
14 methods will require the construction and operation of
15 a large demonstration plant followed by the construc-
16 tion and operation of a commercial sized plant;

17 (6) it is important to provide the cleanest fuel to
18 the American consumer using resources that can be pro-
19 duced by American miners and which are secure from
20 the vagaries of foreign supplies; and

21 (7) the research and development effort is too large
22 for any single company to risk undertaking and a con-
23 sortium of companies would be difficult to assemble
24 without Federal leadership.

25 (b) It is therefore the policy of Federal Government to

1 bring this technology to commercial development as quickly
2 as possible by establishing a Government-industry program
3 jointly managed and funded to demonstrate commercial scale
4 methods of producing substitutes for natural gas.

5 SEC. 2. (a) There is hereby established the Coal
6 Gasification Development Corporation (hereinafter referred
7 to as the "Corporation"). The Corporation shall have a
8 Board of nine Directors consisting of individuals who are
9 citizens of the United States, of whom one shall be elected
10 annually by the Board to serve as Chairman. Five members
11 of the Board shall be appointed by the President of the
12 United States, by and with the advice and consent of the
13 Senate, and four members of the Board shall be appointed
14 by the President on the basis of recommendations received
15 by him from any private entity or entities entering into
16 contractual arrangements pursuant to subsection (d) of this
17 section. Pending the appointment of such Directors on the
18 basis of the aforementioned recommendations, three mem-
19 bers shall constitute a quorum for the purpose of conducting
20 the business of the Board. The President of the United
21 States shall call the first meeting of the Board of Directors.
22 Each Director of the Board not employed by the Federal
23 Government shall receive compensation at the rate of \$300
24 for each meeting of the Board he attends. In addition, each
25 Director shall be reimbursed for necessary travel and sub-

1 sistence expenses incurred in attending the meetings of the
2 Board.

3 (b) The Board of Directors is empowered to adopt and
4 amend bylaws, consistent with the provisions of this Act,
5 governing the operation of the Corporation.

6 (c) The Corporation shall have a President and such
7 other officers and employees as may be named and appointed
8 by the Board. The rates of compensation of all officers and
9 employees shall be fixed by the Board. No individual other
10 than a citizen of the United States may be an officer of the
11 Corporation.

12 (d) In order to assemble and organize industrial par-
13 ticipation in the carrying out of the purposes and functions
14 of the Corporation, the Administrator of General Services is
15 authorized to enter into contractual arrangements with any
16 private entity or entities under which such entity or entities
17 agree to participate in the carrying out of such purposes and
18 functions, including the furnishing of financial assistance in
19 connection therewith. Such contract or contracts shall
20 include such terms and conditions, consistent with this Act,
21 as the Administrator of General Services may prescribe.

22 SEC. 3. (a) It shall be the function of the Corporation
23 to select, on the basis of the best engineering information
24 available, the two most technically and economically feasible
25 methods for manufacturing substitute natural gas from coal.

1 After selection of such methods, the Corporation is author-
2 ized to design, construct, operate, and maintain a demon-
3 stration-type facility for each such method selected in order
4 to determine the technical and economical feasibility thereof.
5 If on the basis of the operation of each such demonstration
6 facility the Corporation determines that the method so dem-
7 onstrated is a technically and economically feasible method
8 for manufacturing substitute natural gas from coal on a
9 commercial scale, the Corporation is authorized to design,
10 construct, operate, and maintain, for each such method
11 demonstrated, a full-scale, commercial-size facility to manu-
12 facture substitute natural gas from coal by such method.

13 (b) Substitute natural gas produced by such commer-
14 cial facilities shall be disposed of in such manner and under
15 such terms and conditions as the Corporation shall prescribe.
16 The Corporation shall arrange to deliver any substitute nat-
17 ural gas so manufactured to such buyer as may be author-
18 ized, by contract or otherwise, by the Corporation. All
19 revenues received by the Corporation from the sale of such
20 gas shall be available to the Corporation for use by it in
21 defraying expenses incurred in connection with carrying out
22 its functions under this Act.

23 (c) The Corporation shall make available, by license
24 or otherwise, on a nonexclusive royalty free basis without ter-
25 ritorial limitation the use of any patent obtained by the

1 Corporation under any law of the United States or any
2 foreign country for or with respect to any invention made
3 in the performance of any activity conducted pursuant to
4 this Act. On and after the dissolution of the Corporation and
5 the transfer of its patent rights in accordance with section 6,
6 the Administrator of General Services shall administer such
7 patents rights in accordance with the provisions of this
8 subsection.

9 SEC. 4. In carrying out its functions under this Act, the
10 Corporation is authorized to enter into contracts, leases, or
11 other arrangements; to own, manage, operate or contract
12 for the operation of facilities authorized by this Act; to con-
13 duct research and development related to its mission; and
14 to acquire by construction or purchase, or to contract for the
15 use of, physical facilities, equipment, and devices which it
16 determines necessary in carrying out such functions. To
17 carry out its functions, the Corporation shall have, in addi-
18 tion to the powers conferred by this Act, the usual powers
19 conferred upon corporations by the District of Columbia
20 Business Corporation Act. Leases, contracts, and other ar-
21 rangements entered into by the Corporation, regardless of
22 the place where the same may be executed, shall be gov-
23 erned by the laws of the District of Columbia.

24 SEC. 5. The Corporation shall transmit to the President
25 of the United States and the Congress, annually, commenc-

1 ing one year from the date of the enactment of this Act,
2 and at such other times as it deems desirable, a comprehen-
3 sive and detailed report of its operations, activities, and
4 accomplishments under this Act, including a statement of
5 receipts and expenditures for the previous year. At the time
6 of its annual report, the Corporation shall submit such legis-
7 lative recommendations as it deems desirable, including the
8 amount of financial assistance needed for operations and for
9 capital improvements, the manner and form in which the
10 amount of such assistance should be computed, and the
11 sources from which such assistance should be derived. Such
12 report shall be available to the public.

13 (b) All reports, plans, specifications, cost and operat-
14 ing data of the corporation acquired by it in connection with
15 the carrying out of its duties under this Act, shall be made
16 available by the Corporation in accordance with the provi-
17 sions of section 552 of title 5 of the United States Code.

18 (c) The Corporation shall make annual reports available
19 to interested parties on the progress of its operations. Such
20 reports shall be in sufficient detail so that independent engi-
21 neering and economic judgments can be made based on such
22 reports. Detailed drawings and other information of value to
23 those who might be interested in commercial development
24 shall be placed on open file by the Corporation on a con-
25 tinuing basis for examination by interested parties.

1 SEC. 6. On or before the expiration of six years follow-
2 ing the date of the enactment of this Act, the Board of Di-
3 rectors shall take such action as may be necessary to dissolve
4 the Corporation. In carrying out such dissolution, the Board
5 of Directors is authorized to dispose of all physical facilities
6 of the Corporation in such manner and subject to such terms
7 and conditions as the Board determines are in the public
8 interest. All assets of the Corporation, including the proceeds
9 from the disposition of such facilities, on the date of its dis-
10 solution, after satisfaction of all its legal obligations, shall be
11 made available to the United States and deposited in the
12 United States Treasury as miscellaneous receipts. All patent
13 rights of the Corporation shall, on such date of dissolution, be
14 vested in the Administrator of General Services.

15 SEC. 7. (a) Each department, agency, and instrumentality
16 of the executive branch of the Government, including in-
17 dependent agencies, is authorized and directed to furnish to
18 the Corporation, upon its request, any information or other
19 data which the Corporation deems necessary to carry out its
20 duties under this Act.

21 (b) The Corporation is authorized to utilize, on a reim-
22 bursable basis, the services of any personnel made available
23 by any department, agency or instrumentality, including
24 any independent agency, of the Government.

1 (c) The Corporation may procure the services of
2 experts and consultants without regard to the provisions of
3 title 5, United States Code, governing appointments in the
4 competitive service, and may compensate such experts and
5 consultants without regard to the provisions of chapter 51
6 and subchapter III of chapter 53 of that title relating to
7 classification and General Schedule pay rates, in accordance
8 with section 3109 of that title.

9 SEC. 8. There are authorized to be appropriated to the
10 Corporation, for the fiscal year beginning July 1, 1971,
11 the sum of \$5,000,000, and for each of the next five
12 succeeding fiscal years, such sums as may be necessary.
13 All funds appropriated pursuant to this section shall remain
14 available until expended. Notwithstanding any other pro-
15 visions of this Act, in no case shall funds appropriated
16 pursuant to this section for any fiscal year be expended in
17 an amount in excess of 60 per centum of the costs to the
18 Corporation in connection with the carrying out of its
19 duties under this Act for that fiscal year.

U.S. DEPARTMENT OF THE INTERIOR,
OFFICE OF THE SECRETARY,
Washington, D.C. July 23, 1971.

HON. HENRY M. JACKSON,
Chairman, Committee on Interior and Insular Affairs,
U.S. Senate, Washington, D.C.

DEAR MR. CHAIRMAN: There is pending before your Committee S. 1846, a bill "To establish a Coal Gasification Development Corporation, and for other purposes."

We recommend against enactment of this bill.

S. 1846 would make it the policy of the Federal Government to bring technology to commercial development as quickly as possible by establishing a government-industry program jointly managed and funded to demonstrate commercial scale methods of producing substitutes for natural gas. Specifically, the bill establishes the Coal Gasification Development Corporation whose principal function would be to select the two most feasible methods for manufacturing substitute natural gas from coal. The Corporation would be authorized to design, construct, operate and maintain a demonstration-type facility for each method selected in order to determine the technical and economic feasibility of each. S. 1846 further requires that the Corporation be dissolved 6 years after enactment of the bill, and authorizes the appropriation of \$5 million for the year beginning July 1, 1971, and such sums as may be necessary for the succeeding 5 years.

The Department of the Interior has had underway for several years a coordinated program involving research, design, construction and operation of several coal gasification prototype plants. The President's June 4 Clean Energy Message announced a major new initiative in coal gasification. This initiative will make it possible to expand the number of pilot plants, making it possible to test new methods more expeditiously so that we can soon select the appropriate technology for a large scale demonstration plant. Under this new initiative, Federal expenditures for a joint government-industry program would be expanded to \$20 million a year. Industry has agreed to provide \$10 million per year for this effort. We believe that the President's program should have the opportunity for going forward any consideration is given to an independent corporation to conduct the operation described in S. 1846.

The Interior Department has just completed an agreement with the industry on the management of this expanded joint program. In addition, we have requested the National Academy of Engineering to make an independent study of coal gasification technology. The Academy will advise us on the technological aspects of this program.

A new organization, such as that created under S. 1846, would bring confusion and delay to this carefully developed program. We believe that the most effective way of accomplishing our common goal of making coal gasification a commercial reality is to move ahead as rapidly as possible along the lines already established.

Finally, S. 1846 would be incompatible with the philosophy of the President's proposed reorganization of the Federal Government. The President's proposal would group most of the energy functions of the Federal Government into the Department of Natural Resources. We firmly believe that the planning and funding of energy research and development should be accomplished within an agency charged with the mission of insuring that the total energy resources of the Nation are effectively utilized.

The Office of Management and Budget has advised that there is no objection to the presentation of this report from the standpoint of the Administration's program.

Sincerely yours,

HOLLIS M. DOLE,
Assistant Secretary of the Interior.

EXECUTIVE OFFICE OF THE PRESIDENT,
OFFICE OF MANAGEMENT AND BUDGET,
Washington, D.C., July 26, 1971.

HON. HENRY M. JACKSON,
*Chairman, Committee on Interior and Insular Affairs, U.S. Senate, New Senate
Office Building, Washington, D.C.*

DEAR MR. CHAIRMAN: This is in response to your request of July 2, 1971, for the views of the Office of Management and Budget on S. 1846, a bill "To establish a Coal Gasification Development Corporation, and for other purposes."

The Office of Management and Budget concurs in the views of the Department of the Interior and the Office of Science and Technology in their reports on S. 1846, and accordingly, recommends that the bill not be enacted.

Sincerely,

WILFRED H. ROMMEL,
Assistant Director for Legislative Reference.

EXECUTIVE OFFICE OF THE PRESIDENT,
OFFICE OF SCIENCE AND TECHNOLOGY,
Washington, D.C., July 26, 1971.

HON. HENRY M. JACKSON,
*Chairman, Committee on Interior and Insular Affairs, U.S. Senate, Wash-
ington, D.C.*

DEAR MR. CHAIRMAN: Your letters of June 11, 1971, July 2, 1971 and July 15, 1971, requested that we provide the Committee with a written statement on S. 1846; a bill to establish a Coal Gasification Corporation. I am most pleased to respond.

The bill would establish a policy of developing the technology for producing substitutes for natural gas from coal through a jointly funded and managed government-industry program. To accomplish this objective the bill would establish a Coal Gasification Development Corporation whose function would be to select and demonstrate two coal gasification technologies. For each technology the corporation would build and operate a demonstration plant and subsequently a full-scale commercial plant. The corporation would have a life of six years and would obtain its funds from government and industry commencing with \$5 million in federal funds for fiscal year 1972.

The concept of converting the nation's vast reserves of coal to gaseous fuel is timely and important but it is not altogether a new idea. In many areas coal gas was used before natural gas became available even though it was product with lower Btu content and relatively expensive. After the Second World War this form of gas was displaced by natural gas transported in large diameter natural gas pipeline systems to consumers throughout the country. Natural gas is a high-Btu, relatively clean source of energy that became available at savings to consumers over competing sources. It now provides about one-third of all the nation's energy.

The rapid growth in natural gas consumption had been expected to taper off in the 1970's. But the urgent pressures for new supplies of clean fuels to meet our recently established air quality standards and the higher growth rates in energy use generally have resulted in a continued high demand for natural gas. The result has been a shortage of natural gas as compared to the potential demand. Our present supply of natural gas is limited by the available wells, pipeline and other facilities. We have not yet exhausted our natural gas resources, but future demands are so great in relation to potential supplies that the limited volumes of this resource available in the ground do not appear adequate to meet our future needs.

The President's June 4, 1971 message to the Congress on energy outlined the various federal efforts underway to augment gas supplies. The short term measures included accelerated leasing of federal lands to speed the discovery of new gas fields, actions by the Federal Power Commission to provide industry

with greater incentives to develop new supplies of natural gas and facilitating imports of gas.

The important point in the President's message with respect to gas supply is that over the longer term we must expand our supply of this relatively clean form of energy by the conversion of coal to high-Btu pipeline quality gas.

The development of coal gasification technology was singled out by the President as one of the three major technological initiatives in his message. We propose to develop a new technology to produce high quality gas at the coal mine which can then be transported inexpensively by our vast gas pipeline system. This technology is quite different from the old manufactured gas which is not compatible with natural gas transportation or use, and can only be produced and used locally at relatively high cost.

The President's energy message announced the initiation of a cooperative program with industry to expand the number of pilot plants in order to facilitate the selection of appropriate technology for a large scale demonstration. This decision was based on the realization that greater focus and urgency were required in order to make coal gasification a commercial reality as promptly as possible. A number of technical and economic hurdles remain. To overcome these an expansion of the current Interior pilot plant effort is required followed by the construction of a large scale demonstration plant.

During the pilot plant phase, which will require another three or four years, this program is planned to be funded at a level of \$30 million per year—\$20 million from the federal government and \$10 million from the American Gas Association and its members.

As we move into the demonstration phase the level of funding required will increase and so will the industry's share of the larger total since the effort will be nearer to commercialization. Based on continuing technical and economic success, we could expect that under the contemplated program a demonstration plant on the order of one-third the size of a full-scale commercial plant would be operational by 1980. Gas from coal could therefore be expected to have a significant impact on natural gas supplies during the latter part of the 1980's after a number of full size plants were in operation.

In reviewing S. 1486 the first point to be noted is that we are in close agreement with essentially all of the findings made in Section 1 thereof. The policy statement itself is fully consistent with the Administration policy announced in the President's energy message. S. 1846 seeks to accelerate the coal gasification research and development efforts through a high priority joint government-industry program. That is precisely the type of program initiated in the President's energy message. And an accelerated program is now underway in the existing organizations within the Interior Department working with industry.

We are currently seeking the higher level of federal funding from the Congress and the AGA is now security pledges from individual companies for its share of the \$30 million annual effort. We have every expectation that both the federal and industry funds will be forthcoming. And Interior will soon be completing arrangements for a joint management agreement to guide the research and development effort.

To provide technical assistance in the expansion of the program Interior has contracted with the National Academy of Engineering to establish an ad hoc panel which is currently evaluating coal gasification technology. The panel has already met with the developers of all of the major processes, and is now preparing their recommendations. Dr. Thomas H. Chilton is the Chairman of the group.

In view of these recent initiatives we believe that the most effective means of accomplishing our goal of making coal gasification a commercial reality is to move ahead as rapidly as possible along the lines already established.

The forming of a special corporation to deal only with coal gasification along the lines presented in S. 1846 is, of course, an alternative administrative mechanism that might have value in the absence of an ongoing joint effort between government and industry. But in the present circumstances it would not appear to be necessary since the President's energy message announced such a program. Shifting the new program to a new special corporation could in fact be expected to delay the new pilot plant work. In addition, the establishment of a special corporation for coal gasification would tend to establish a precedent for other ad hoc measures to deal with specific urgent energy problems. We doubt that further fragmentation of the responsibility for energy research and development is wise.

What is needed is to consolidate all of our important federal energy resource development programs within a new Department of Natural Resources. A pro-

posal for such a Department is now pending before the Congress as part of the President's government reorganization program. We believe that the planning and funding of energy research and development should be accomplished within such a Department charged with the mission of examining all of the possible options and insuring that the total energy resources of the nation are effectively utilized. The execution of these programs would be accomplished by those agencies and institutions most appropriate under the particular circumstances.

I believe we should also note that for several years we will still be building and operating pilot plants to determine which approaches are feasible to pursue to larger sizes. As we move toward the construction of a large coal gasification demonstration plants, special new institutions may well be required to construct and operate the facility. We would expect such arrangements to evolve out of the continuing cooperative program with the industry, however, rather than be prescribed at the outset.

In summary then we support the findings and policy stated in S. 1846 but do not believe the formation of a special coal gasification development corporation is necessary or warranted at this time. The cooperative government-industry program announced in the President's energy message is intended to accomplish this important policy goal as expeditiously as possible.

Sincerely,

EDWARD E. DAVID, Jr.,
Director.

Senator Moss. I also would like to place in the record at this point two letters that have been received by the committee, one from our colleague, the junior Senator from the State of Maine, in which he sets out his inability to be here but he does set forth in his letter an interesting bit of comment. As you know, the junior Senator from Maine, Mr. Muskie, is chairman of the Subcommittee of Public Works having to do with pollution. He says in part:

This proposal could provide an excellent vehicle to assure that any adverse environmental byproducts of the large-scale use of coal for gasification will be avoided. I would hope, therefore, that any reported bill would include requirements that the coal gasification development corporation find ways to deal with, (a) control and recovery of sulfur oxides and nitrogen oxides which would otherwise be released during coal conversion; (b) capture and treatment of any ash so both the ash and heavy metals contained therein will not be released into the environment; (c) control or removal of phenols, ammonia, and other pollutants which would otherwise be released in effluent water from the process; and (d) problems resulting from the coal mining itself, especially acid mine drainage and strip mine reclamation.

These are very good points made by the Senator, but more properly I think would come up when we have hearings, or the corporation has hearings, on the actual processes, the technical processes, and not the overall question of whether a corporation of this sort should be formed.

I also have a letter from the University of Utah signed by Dr. Alex G. Oblad, associate dean of the Mines and Minerals Industries, and Robert G. Larsen, director of the engineering experiment station out there.

These two letters will be placed in the record at this point.
(The documents referred to follow:)

U.S. SENATE,
COMMITTEE ON PUBLIC WORKS,
Washington, D.C., June 15, 1971.

HON. HENRY M. JACKSON,
Chairman, Committee on Interior and Insular Affairs,
U.S. Senate, Washington, D.C.

DEAR SCOOP: Thank you for your letter of May 24 asking me to cosponsor S. 1846, a bill relating to the development of a commercial gasification program. I would be happy to join with you in cosponsorship of this legislation.

This proposal could provide an excellent vehicle to assure that any adverse environmental by-products of large scale use of coal for gasification will be avoided. I would hope, therefore, that any reported bill would include requirements that the Coal Gasification Development Corporation find ways to deal with:

- a. Control and recovery of sulfur oxides and nitrogen oxides which would otherwise be released during coal conversion;
- b. Capture and treatment of fly ash so that both the ash and heavy metals contained therein will not be released into the environment;
- c. Control or removal of phenols, ammonia, and other pollutants which would otherwise be released in effluent water from the process;
- d. Problems resulting from the coal mining itself, especially acid mine drainage and strip mine reclamation.

I would appreciate your including this letter in the record of any hearings held on S. 1846.

Best personal regards,

Sincerely,

EDMUND S. MUSKIE, *U.S. Senate.*

THE UNIVERSITY OF UTAH,
Salt Lake City, Utah, July 22, 1971.

MISS MARY JANE DUE,
*New Senate Office Building,
Washington, D.C.*

DEAR MISS DUE: We are genuinely concerned about the energy picture in the U.S. and in the world. In particular, it appears that the supply of gas is rapidly becoming critical, and the need for this energy source will increase rapidly since it is so effective in maintaining a clean environment. We, therefore, heartily endorse the need to accelerate the development of methods to increase gas supplies. There are, of course, many methods whereby this might be accomplished, but we feel your proposal to form a corporation to carry out the work is quite feasible and, therefore, we as individuals endorse this project and wish to encourage Senators Jackson and Moss in bringing it about.

Sincerely,

ALEX G. OBLAD,
Associate Dean, College of Mines & Mineral Industries.
ROBERT G. LARSEN,
Director, Utah Engineering Experiment Station.

Senator Moss, sitting with us this morning is my colleague, the Senator from Wyoming, who I am pleased to have here, and I hope he will be able to remain for a good part of the hearing, though I know he has other commitments, as ordinarily all Senators do. We find ourselves sitting in three places at a time each morning. I welcome Senator Hansen. He may have some opening statement or some remarks to make about the bill, or the witnesses who are to come before us.

STATEMENT OF HON. CLIFFORD P. HANSEN, A U.S. SENATOR FROM THE STATE OF WYOMING

Senator HANSEN. Thank you very much, Mr. Chairman. It is a pleasure to be here this morning, not only to demonstrate my very real interest in the bill which is before us, which you and the distinguished junior Senator from Washington are cosponsors of, but as well to take this opportunity to introduce my longtime friend and distinguished Member of the other body, from the State of Wyoming.

Congressman Teno Roncalio was born in Wyoming; he was educated there. He went through grade school and high school and through

the University of Wyoming. He was raised in a coal town. I think, if I am not mistaken, his father was a coal miner.

I suspect there are few people who can claim a longer association with the energy problems and with the actual production problems of coal than could be claimed by him. He understands the acuteness of our energy supply, the extent and variety of our resources, and the problems of making these resources fully responsive to our needs.

I know he has been vitally interested in the development of the West and in the security of our country, and I say to my colleagues that as he testifies here this morning, we are hearing from an expert, a man who knows firsthand the problems of this country, energy problems particularly, the extent and variety of our natural resources, and ways in which Government can join hands with industry to bring about the kind of cooperation which will result in a fruition of planned strategy that will make certain this Nation is dependent upon no foreign source for the supply of something as vital to its needs as is energy.

I am proud to have the privilege of introducing my colleague from Wyoming, Mr. Roncalio.

Senator Moss. Thank you very much, Senator Hansen. We are anxious to hear from Congressman Roncalio.

The chairman of the committee and coauthor of the bill, Senator Jackson, has arrived. Before you begin, I will ask him if he has any opening remarks. Would you be seated and be prepared to start?

STATEMENT OF HON. HENRY M. JACKSON, A U.S. SENATOR FROM THE STATE OF WASHINGTON, AND CHAIRMAN, COMMITTEE ON INTERIOR AND INSULAR AFFAIRS

Senator JACKSON. I think it has all been said very well. All we need now is to marshal our scientific and technological resources to do what we hope can be done. I am confident that if we give it the kind of priority that is needed here, we can in fact come up with some real answers as we face the energy crisis, not just in this decade but for the balance of this century.

When we stop to consider that there is about I trillion tons, I believe, of coal in known reserves in the United States—I think that is the figure; that is probably a nice rounded number that someone came up with—this is but an indication of the opportunities, it seems to me, that exist by providing an energy source of environmental quality. My recollection is, too, that there is about 100 billion tons of low sulfur content coal. Most of this coal is in the West, a substantial distance from the great energy centers, load centers, so that the real opportunity here is the gasification process that can convert this latent energy into useful forms which will meet particularly the environmental problems and which, of course, is a crucial matter as anyone in the utility industry knows today.

So, I just want to join my colleagues in welcoming you and the other witnesses here today to participate in this effort. I hope that we will get the kind of comments that will help to spur this effort. We want all the facts out on the table. We don't want just polite responses. I think we need some hard comments. I am a great believer in the

adversary proceedings. Unless we get some of the problems out on the table early, we are going to pay a price for it later.

Over the years, I have watched a lot of R. & D. efforts get underway only to find that we have not been hard nosed enough about some of these problems. The result has been that we had delays, and delays can result in a lack of confidence and faith in the effort.

So, I hope that all of the witnesses will proceed on the assumption that what we want is all of the hard facts so that the committee, in connection with its responsibility, can draft a final bill that will give to the executive branch the tools to do the job in concern with industry.

Senator Moss. Thank you, Senator Jackson.

Senator Gravel, do you have any comment at this point?

Senator GRAVEL. No.

Senator Moss. It is very significant that our opening witness is the Hon. Teno Roncalio, Representative from the State of Wyoming. As his colleague pointed out, his whole background is in the field of coal and production of coal and energy, and he comes from a part of the country which will be called upon, I am sure, to supply a great deal of the energy that we are going to need in the decades ahead.

We will listen now to Congressman Ronsalio.

STATEMENT OF HON. TENO RONCALIO, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF WYOMING

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

First, members of the committee, I am happy to be with you. I want to say to my friend, Senator Hansen, a dear friend for many years, that I am deeply grateful to you for the introduction.

I would like to say that the prefatory remarks of Senator Jackson and of the chairman, Senator Moss, make a sufficiently strong enough case for this legislation in my opinion that we perhaps can now sustain it with the cold, hard facts Senator Jackson asks for, and proceed to enactment, creation of the commission, and the establishment of a pilot plant.

I submit that pilot plant should be in Wyoming because if the cold, hard facts suffice, that is where it will be. I will prove that. If other things suffice instead of the cold, hard, objective facts, if pressure and influence suffice, then the plant will be in maybe Columbia, Mo., as was the last coal hydrogenation experimental plant, instead of where the coal was. Maybe it will be where the population is. So, I hope that the plant will go where the hard facts dictate because the hard facts will dictate, these hearings will, that a large majority of the coal reserves of that trillion tons you mentioned, are located in the State of Wyoming, and that the State of Wyoming is close enough in location to the fields of the Dakotas, the excellent coal of Colorado, Utah, to the rest of the West, even Walla Walla, Wash., where the Union Pacific mined when I was a boy.

The facts dictate Wyoming.

Senator JACKSON. It gets cold in Wyoming, too.

Mr. RONCALIO. It invigorates the people to work better in research and coal gasification.

The introduction is deeply appreciated in view of the fact that you and I have labored diligently in the public service in Wyoming. Now

I am happy to be in the role of a colleague with you in these proceedings.

I am touched by the introduction that mentions my family because my father was a coal miner. He gave the last 30 years of his life mining coal in Wyoming.

The fields of Wyoming hold, some of them in the very bowels of the earth today, the remains of early cave-ins and tragedies where hundreds were killed and left in the bowels of the earth where they couldn't be moved in the early days. Some of us who feel coal in our veins maybe feel we can come with some factual material and make a good case of presenting it to you.

I wish my mother and father were still alive, Senator Hansen, because they would have so much enjoyed—I know my father would have been honored to have heard your words and my mother would have believed them. [Laughter.]

Gentlemen, although the problem of energy is not new, it has only recently reached public concern and its consequences are now considered with an eye to the future.

Dealing with this problem, we realize certain objectives and priorities and have given each the consideration it deserves.

First, we must develop a new energy supply, and we restrict the possibility by saying it must be developed without undue harm to the environment. When I first came across this legislation, I was pleased and proud to consult with my colleague in the Senate and then to be honored to cosponsor the legislation in the other body of the Congress, and I have a bill so in the offering to the Interior Committee there.

The facts are that by 2000, the demand for energy will double or triple. The departments projects we will need a thousand, trillion cubic feet of gas during the next 30 years. In the next decade, our energy demands will increase by 56 percent.

Evidence of this is that in 1970 our American homes consumed more than six times the electricity as 20 years ago. Fuels for home heating increased by half in the same period. The United States, although accounting for only 6 percent of the world population, consumes 40 percent of the energy. The most important element is decline in the natural gas industry.

By decisions handed down by the U.S. Supreme Court in 1954, regulation of the production and field prices of natural gas sold for interstate delivery was brought into effect to keep gas prices down. As the price of natural gas leveled off at an inexpensive rate, it attracted more and more consumers, but the small profits did everything but encourage new investors to explore for new locations. The effect was a growing disinterest from investors which caused little exploration for new gas, and a consequence shortage in gas. Lower gas prices include coal prices, effecting exploitation for new sources in a negative manner.

Government and industry have two duties to the American people. One is to satisfy the Nation's great need for energy at a reasonable rate, and the other is to provide energy that will have no adverse effects on the environment. S. 1846 supports both these points. It provides means for cooperation between government and industry which is imperative to answer our problems in an intelligent manner. The need for a corporation of this type is very plain.

To industry, the cost of this venture would be prohibitive and Government alone would not be able to provide the leadership necessary to prove it a success. Only by working in a joint cooperative program, pooling the resources and funds, will these two powerful sources tackle the problem and resolve it.

Here, I would like to inject the fact that I don't believe there is such a thing as the private sector and the public sector any more in such acute crises as pertains now to the public safety of the people of America, to the defense of the United States. These things are everyone's concern. The line separating public from private sector disappeared of necessity in our present way of living.

There is great need for a program like this to assure cleanliness of the environment. Nonpolluting natural gas will not meet our energy growing demands. High sulfur content coal is in tremendous supply. Whatever the sulfur content of coal, it is evident we are not using it to its optimum. With the development of this corporation, nonpolluting synthetic gas derived from coal gasification processes would be in vast supply, not only solving a great part of our energy crisis and utilizing by virtue of this coal to its fullest capacity, but protecting the environment by using nonpolluting synthetic gas as a source of energy.

In compliance with section B of the act, I would hope Wyoming would be the successful locale for the demonstration facility. That is why I am here. I mean this. I am happy to have the support of everyone from Wyoming, and the rest of the West in this final pitch for something the State deserves.

The State of Wyoming contributed tens of billions of dollars to the wealth of two great corporations in American enterprise today, the Union Pacific Corp. and Birmingham Northern. Wyoming contributed billions of dollars of wealth in its natural resources, natural gas, oil, low sulfur content coal, all to the well-being of millions of people all over the Nation.

When the tourists leave, Wyoming puts up with the wind and the cold and the absence of employment, and the falling population and the difficulty of economic life. Everyone in the Nation elsewhere benefits from the natural resources of our State.

We have a moral right, a legal right, and a factual right and objective right to this location. Wyoming rates from zero to 3,000 feet overburden over almost half a billion tons in total resources and from 3,000 feet, the remainder that puts it in the highest category of any State in the Union in the quantity of coal.

The fact that its quality would make this that much more a successful plant is evidenced by the fact that today, except for the current railroad strike, long trains of low content coal are being mined by overburdened processing and strip mining in Wyoming, and going out to where it is needed.

How much better to have the plant there, convert the energy into gas and send it out in pipelines to where it is needed. How much cheaper for the consumer. How much more profitable for the entrepreneur. How much better for all concerned.

Wyoming has 120 billion tons of measured coal reserves, 12 billion in bituminous, and 108 billion in subbituminous reserves. These reserves are over 500 billion tons in total estimated reserves. That is nearly 25

percent of the figure that Senator Jackson mentioned before. Wyoming has sufficient reserves to last in coal for centuries, regardless of the amount mined per year.

This is important because again we are planning not for the remainder of the 20th century, or the 21st century, but for hundreds of years to come so once and for all we can prove we have planned sufficiently to put up with the technology of the future.

Utah Power & Light Co., and Idaho Power & Light Co. have steam plants in Wyoming, or are considering locating them there, and making vast extensions to them. When the coal reserves of Colorado, Utah, and Montana are added to those of Wyoming, it becomes clear the energy resources of the future are located in the western half of the country, and Wyoming sits in the logical objective, factual center of all of this.

Pacific Power & Light is the third company, I might add, with tremendous growth and effort in plants in Wyoming, and Wyoming seems to present a happy balance between public power and private power. It doesn't get overshadowed by matters of refining the Columbia River Valley where power is dominant. It doesn't get overpowered by the fact that private power is dominant. Wyoming has a healthy balance which again is in the best interests of all concerned, public and private, consumer, investor.

Recognizing the energy problem, the coal gasification process comes into proper perspective as an important supplier of energy in the future. Realizing this problem is only the first step to resolution, the next step requires definite action if future generations are to be provided with the power to support this country. Coal gasification is a positive step in that direction and an imperative one.

Thirty-five years ago, one of your predecessors named Joseph Sellmanic—33 years ago I had the honor to be on his staff in this area as a member of the Senate staff for Joseph Sellmanic, and the gentleman's heart was saddened when the first coal hydrogenation plant in this process—because influence put it there—was located in Missouri, not in Wyoming. He went back to his office at 2:30, he said, "This isn't fair. This is what happens when political power overcomes all factual bases of right and justice. This plant belongs in Wyoming." I am glad to be alive to repeat his words to you today.

Thank you, gentlemen.

Senator Moss. Thank you very much, Congressman Roncalio.

We know of your long association with the problem and your efforts that you have made to get this matter in a position where we could begin to utilize our vast coal resources in a way that is compatible with the distribution of our population as against the location of the resource, and also to give attention to the environmental problems that have become so much more visible and of concern to our society today. We are pleased to have you as our opening witness and to have your views.

I don't have any question to ask you other than to perhaps ask if you think we have chosen the right sort of vehicle in making this a joint industry-government corporation type of thing, or would you make any change in that?

Mr. RONCALIO. I would defer to the, in my opinion, better judgment and experience of Senator Jackson. We see examples of Comsat-type

corporations. We see examples of others more heavily weighted with public interest. I think this balance will come out right. I have every confidence in the framework of this bill as to the management, board, and the methods.

Senator Moss. Thank you.

Senator Jackson?

Senator JACKSON. Teno, I want to compliment you on a very fine statement, vigorous as always. I think you have already gasified the coal. [Laughter.]

That statement was pretty warm and hot. I don't think you were talking about cold facts. I want to compliment you on a very fine presentation. I think you have helped to add to the urgency of this effort.

I think we all find there is so much frustration involved, certainly the utility industry and those associated and working with the utility industry, the degree of frustration, the public is not aware of the rapidity with which we are growing in this country. The growth rate is enormous and it is hard to explain to the public what it takes to make all this possible.

You know, it took us 188 years to get our first one-half trillion of the Gross National Product, 188 years. Then it only took us this last 12 years to get the second half. That is a half trillion in 12 years that took us 188 years to get, and if you can believe projections—but it is within the ball park, I think—they are going to double all the 200 year effort in 10 years, a little over 10 years.

Energy requirements are doubling every 10 years. As a matter of fact, as we try to solve the problems of the environment, it seems to me we need more energy. What we are really talking about is more automation and more devices to reduce the air pollution, water pollution, and land pollution. Therefore, at the core of all of this, what we are talking about, economic growth and the assault that must be made on air pollution, water pollution, land pollution, the core of it all is energy.

It seems to me that we are talking today about a very substantial role that can be played by coal in this effort that must be made.

Thank you for a very fine statement.

Senator Moss. Senator Hansen?

Senator HANSEN. I do have a couple of questions.

First of all, I would like to compliment my colleague for his very forceful, very strong statement here this morning that I think does indeed underscore the thrust that the distinguished chairman of the full committee hoped we might take in stressing the urgency of getting on with this.

As one who certainly is extremely knowledgeable in the multiplicity of natural resources we have not only in the United States, but indeed in our own State of Wyoming, I would like to ask your opinion Teno. From your background and experience with university personnel, with people in the Geological Service who have made estimates of the untapped oil and gas resources in this country, your knowledge of our coal reserves in Wyoming, the oil shale we have there along with Colorado and Utah, as well as our uranium reserves in Wyoming, is there any question in your mind if we put ourselves to the effort, if

we join hands. Government on the one hand and business on the other, determined to shore up our reserves so as to need to depend upon no foreign country, is there any question in your mind but what we can do that job if we get ourselves to the task?

Mr. RONCALIO. There is none whatever if we can do it objectively and based upon facts and in the spirit of the cooperation that this project requires. Though my statement may have been warm, may I say to the friendly chairman of the full committee, I still intended it to be objective. Objective in this way, to answer you, Senator Hansen: The shale will probably generate toward Colorado because they have the larger basins of it. The shale research will probably go there because they started it 30 years ago at the Navy plant there. The pipeline and gas efforts will probably have a tendency to go other places because Utah got in there first with installations, especially interstate pipelines. But Wyoming can fill this effort you mentioned in the coal area and in this precise area before us today.

As we look to the Colorado fields, the Utah fields and their respective energies, we can bring coal to the forefront in this effort and thereby become independent and nondependent rather upon any foreign nation. LNG from Tunisia or whatever the big planners may have in mind from Asia in the decades to come, the most important thing in this Nation is our own dependency for having to rely on any other source for energy.

In further answer to your question, you will have testimony undoubtedly showing where the pipelines are that can transmit this gas to where it is needed. I believe that again this will inure to the benefit of Wyoming in this area.

Senator HANSEN. Is it not true as we contemplate the gasification of coal, bearing in mind at the same time the great concern that is expressed and evidenced everywhere over clean environment, healthful environment, that it seems only natural that we should look to gas from low sulfur Wyoming coal?

Mr. RONCALIO. Yes, sir; I think the evidence is clear in that regard, and certainly will support that proposition as a fact.

Senator HANSEN. Thank you very much, Mr. Chairman.

Senator MOSS. Thank you.

Senator GRAVEL?

Senator GRAVEL. Only to say that I am very impressed with the persuasiveness of the Congressman's argument. Thank you.

Mr. RONCALIO. Thank you very much.

Senator MOSS. Thank you, Teno. It is your opinion that this corporation that we propose in this bill is about the right mix to get the job done.

Mr. RONCALIO. Yes, I do. I will not be allergic to there being statutory authority in this bill directing that corporation where the plant will be located. I wouldn't want that to—

Senator MOSS. I gathered that from your testimony. [Laughter.]

Mr. RONCALIO. Thank you, gentlemen, very much.

Senator MOSS. Our next witnesses are from the Office of Science and Technology, Mr. S. David Freeman and J. F. Weinhold.

We are very glad to have you gentlemen here. We look forward to having your presentation.

STATEMENT OF S. DAVID FREEMAN, OFFICE OF SCIENCE AND TECHNOLOGY, EXECUTIVE OFFICE OF THE PRESIDENT; ACCOMPANIED BY J. F. WEINHOLD

Mr. FREEMAN. Thank you, Senator Moss, Chairman Jackson, other members of the committee.

We have provided the committee with a report setting forth our views on this legislation which I hope can be made part of the record.

Senator Moss. Without objection, it will be part of the record.

(The report referred to has already been inserted.)

Mr. FREEMAN. I would like to summarize the views expressed in that report, if I may.

As the committee is well aware, natural gas is high B.t.u., relatively clean source of energy that now provides about one-third of all of the Nation's energy supply. The rapid growth in natural gas consumption had by many people been expected to taper off in the seventies from the rapid growth that took place since World War II, but what has happened is that the urgent pressures for new supplies of clean fuels to meet our recently established air quality standards have combined with the higher than expected rates of growth in energy used generally to result in a continued high demand for natural gas, and the result of this has been a shortage of natural gas, as compared to the potential demand.

Now, we have not yet exhausted our natural gas resources in the ground, but from all of the studies that have been made available to us and our own studies suggest that future demands are so great in relation to the potential supplies and the limited volumes of this resource that are available in the ground that we don't believe that the natural gas supplies are adequate to meet future needs.

The President's June 4, 1971 message to the Congress on energy outlined several Federal efforts underway to alternate gas supplies. The most important point in the President's message with respect to gas supply is that over the longer term we must expand our supply base of this relatively clean form of energy by the conversion of coal to high B.t.u. pipeline gas.

The development of coal gasification technology was singled out by the President as one of the three major technological initiatives in his message. I am sure this committee is well aware that there has been a limited coal gasification research effort underway in the Department of Interior for a number of years, for perhaps a decade, and the existence of this program has put us in a position where we can in a sense take off and make some breakthroughs in the near future.

The President's message announced the initiation of a new program in cooperation with industry to expand the number of powerplants now underway in order to facilitate the selection of the best technology for scaling up to large-scale demonstration plants and then to commercial plants. This decision was based on the realization that greater focus and urgency were required in order to make coal gasification a commercial reality as promptly as possible.

A number of technical as well as economical hurdles remain and to overcome these hurdles an expansion of the current effort within

the Interior Department with respect to pilot plants is required, followed by the construction of large-scale demonstration plants.

Now, during the powerplant phase which will, in the opinion of those intimately involved, require another 2 or 3 or 4 years, this program is planned to be funded at the level of \$30 million per year, \$20 million from the Federal Government and \$10 million from the American Gas Association and its members. This is to be compared with the current level of funding which is roughly about \$14 or \$15 million a year, so that the contemplated program would roughly double the funding effort to pursue the pilot plant program.

As we move beyond the power plants in the coming years to the scale up into the demonstration plant size, the level of funding will obviously be required to be increased. We contemplate that at that time the industry share of this larger total will also increase since we will then be approaching commercial realization in the industry that will have an economic basis for putting more money into it.

Based on continuing technical and economical success, we would expect that under the contemplated program a demonstration plant on the order of one-third the size of a full-scale commercial plant would be in operation during the decade of the seventies; probably toward the latter part of the seventies before we can finish the pilot plant effort and build the demonstration plant, but it will be pursued just as promptly as the technology will permit.

Gas from coal could therefore be expected to have a significant impact on natural gas supplies during the 1980's, most likely the latter part of the 1980's before a very large impact would be had, because it would require a number of full-sized plants to be in operation before a substantial contribution would be made.

We have reviewed S. 1846, which I think we should note for the record was introduced prior to the President's energy message. The first point to be noted is that we are in quite close agreement with essentially all the findings made in section 1 thereof. A policy statement in S. 1846 is fully consistent with the administration policy announced in the President's energy message.

S. 1846 seeks to accelerate the coal gasification research and development efforts through a high priority joint Government-industry program, and that is precisely the type of program initiated in the President's energy message. An accelerated effort is now underway in the existing organization within the Interior Department working with the industry. We are currently seeking the higher level of Federal funding from the Congress and the American Gas Association is now securing pledges from individual companies for its share of the \$30 million annual effort.

We have every hope and expectation that both the Federal and the industry funds will be forthcoming with the cooperation of the Congress and the efforts of the gas industry and the Interior Department will soon be completing arrangements for a joint management agreement with the industry to guide the research and development effort.

In view of these recent initiatives, we believe that for the coming years the most effective means of accomplishing our goal of making

coal gasification a commercial reality is to push ahead as rapidly as possible along the lines that have already been established. The formation of a special corporation to deal only with coal gasification along the lines presented in S. 1846 is, of course, an alternative to administrative mechanism that might have value in the absence of an ongoing effort between Government and industry, but in the present circumstances it would not appear to be necessary since the President's energy message announced just such a program. In fact, shifting the new program to a special corporation could be expected perhaps to delay the new pilot plant work which is now hopefully going to be pursued within the coming months.

In addition, the establishment of the special corporation for coal gasification at this time would tend, I think, perhaps to establish a precedent for other ad hoc measures to deal with specific urgent energy problems and other technology that perhaps would claim equal institutional arrangements. We doubt that further fragmentation of the responsibility for energy research and development is wise. What we think is needed is to consolidate all our important Federal energy resource development programs within a new Department of Natural Resources and a proposal for such a department is now pending before the Congress as part of the President's Government reorganization program.

We believe that the planning and the funding of energy research and development should be accomplished within such a department, a department charged with the mission of examining all of the possible options and ensuring that the total energy resources of the Nation are effectively utilized.

I think, however, that we should also know that for the next several years we will still be building and operating the pilot plants in this coal gasification effort to determine which of the pilot plant approaches are best feasible to be pursued to the larger size demonstration plants. As we move toward the construction of a large coal gasification demonstration plant, special new institutions may well be required to construct and operate the facility. We would expect that such arrangements would evolve out of the continuing cooperative program with the industry and shouldn't be prescribed at the outset of the program.

In summary, then, we support the findings and the policy and the objectives of S. 1846, but we don't believe that the formation of a special coal gasification development corporation is necessary at this time.

The cooperative Government-industry program announced in the President's energy message is intended to accomplish this important policy goal as expeditiously as possible.

Senator Moss. Thank you very much for your statement. Do you have a prepared statement as well?

Mr. WEINHOLD. No, sir.

Senator Moss. Well, we will ask questions of either one of you then, or both.

Do you believe, Mr. Freeman, that the existing Federal agencies concerned with coal and gas are geared to bringing the new technology to a commercial status?

Mr. FREEMAN. They have been in charge of the pilot plant program and they are now engaged in a new effort cooperatively with the industry to expand that program and to move it forward in a very prompt and expeditious way. I would not want to rule out the possibility of new institutional arrangements. Indeed, we are before the Congress proposing new institutional arrangements in the energy field in the form of a department of natural resources, perhaps not different in kind from the department which you, Senator Moss, have advocated so well and so long over the years. So we do feel that strengthened institutional arrangements are needed in Government to pursue the energy activities with greater cohesiveness and from a more overall energy perspective and more effectively.

Senator Moss. The reason I asked the question is that, of course, we have seen this energy problem building for some time and we haven't gone out to meet it very well. At least the track record is not too good. I just wondered if you felt we would get the kind of emphasis on it by leaving the problem in the department where it is or whether by dramatizing it into a separate corporation we might get a burst of speed that would get us back up abreast of the problem.

Mr. FREEMAN. Well, it is difficult to be sure on a question like that. I think you are entirely correct about the energy problem. I came into Government 3 years ago to try to spearhead the energy coordination effort and you almost had to buy space in the newspapers to get any attention to the energy problems. I think that we have overcome that part of the handicap. Now at least the leaders in the Congress and the leaders in the Executive branch are aware of the problem. The President has sent to the Congress the first special message on energy in the history of the country, to my knowledge, and I believe that the fact that these energy problems need attention is well recognized and I think there is an accelerated effort underway to speed things ahead.

A special corporation is an intriguing concept. As I suggested in my testimony, I would not rule out the possibility of some special organization to pursue the coal gasification effort when the construction of the demonstration plants begin. I rather think, though, that it would have a better chance of moving ahead rapidly if it were part of a department charged with the whole energy mission. A special corporation all by itself could be rather lonely in the Government bureaucracy, and that is a danger, I guess, that also exists, especially if it is small and does not have a major program. I can't be too dogmatic in answering the question, though.

Senator Moss. I appreciate your answers and, of course, we are searching and trying to determine what is the best concept. You are indicating that the corporation would be rather specialized in its particular search for energy, and coal was a lead on to another question I was going to ask.

Would it be feasible or desirable to broaden the scope of the corporation, for instance, to take in oil shale, or should it be devoted purely to gasification of coal?

Mr. FREEMAN. I think your question really suggests part of the dilemma. Once one starts broadening it to take in oil shale, MHD, the fuel cell, the liquification of coal, and other technical options, pretty soon one has an energy research organization, and you are back

to the Department of National Resources idea that you yourself have advocated over the years. You have a dilemma that is posed by this bill, and I think it deserves thoughtful consideration. Our judgment is that we can best strengthen the energy program if we put a Cabinet officer in charge of that responsibility, and give him the whole energy research and development ball, and put the responsibility on his back to come up with the best program for the country, looking at all of our energy options, including solar energy and the fusion and other options we have on the nuclear side, and to come up with a strong and vigorous program that is best for the country.

Senator Moss. Would there be an unacceptable overlap if there were separate corporations such as this bill envisions, but nevertheless research that would continue within the gas and coal section of Interior where it is now?

Mr. FREEMAN. The pilot plant work, of course, is now underway in the Department of Interior, and pursuant to the President's message is being accelerated. It seems to me that we shouldn't do anything that would in any way delay that effort which is now a joint Government-industry effort. It is possible that out of that joint relationship, the executive branch and the industry itself will want to set up some special mechanism to build and operate the demonstration plants. I guess what I am suggesting is that at that stage it may very well be that some special mechanism would be useful.

Senator Moss. Thank you very much. We certainly appreciate your contribution.

Other Senators may have some questions. Senator Jackson?

Senator JACKSON. Mr. Freeman, as always, you come to the committee with great expertise and good judgment, which I admire very much. I am concerned with how best to marshal our talents in both the governmental and private sector to do this job. In the past, of course, when we get something sufficiently urgent, we made our greatest progress; this is especially true in nuclear energy, by bringing together the talents in both Government and industry.

Now, it is in that context that it seems to me we must approach this problem. I don't know whether this corporation is the best means of achieving that kind of cooperation. I would agree with you—we are going to try to hold hearings next week on the Department of Natural Resources to get it going—I would agree with you that you have a precedent problem, but I am wondering if this entity were to be in the Department of Interior and when the new department is created be in that department, the Department of Natural Resources, might not be an answer to the mechanism by which you would handle this. I am not wedded to any particular concept except that I am wedded to the idea that we will have to draw on the talent that we have in both Government and in the private sector.

What would be an alternative course to follow and to really get some sight into this?

Mr. FREEMAN. I think that you have put your finger on just the key point. It is building up within the Federal Establishment the degree of technical competence on a large-scale basis that we now have in the Atomic Energy Commission across the board in the energy field. What kind of competence, one can draw on the competence in the industry.

The AEC has pursued a demonstration plant program over the decades that has developed the present nuclear technology and made a commercial reality of it. They have done that through the mechanism of contracts and cooperative demonstration plant programs. The key to it has been the existence within the Atomic Energy Commission of a critical mass of skilled manpower, which has been able to attract the skilled technicians in industry, and the two of them have worked together.

I think it is important that we build up the same type of competence across the board in the energy field so that we can move ahead in the R. & D. projects with respect to the fossil fuels that are needed just as urgently as any of the others.

I do think that a mechanism that would enable industry to work with the Government would be useful, and I think that bringing it within the Department would be a step in the right direction.

Senator JACKSON. What you are saying is that we could achieve this kind of a joint venture, in a sense, by contract like the nuclear demonstration program, reactor demonstration program, and handle it on that basis rather than setting up a Comsat type of corporation or however you want to describe it. You think that the experience of the Atomic Energy Commission is useful in this regard?

Mr. FREEMAN. I think it is, sir. I have been advocating an acceleration of the coal gasification effort for several years, and I am delighted that this committee is taking this sharp an interest in pursuing it. I am troubled somewhat that if the effort is set off in a sense, all by itself, that the proposals cannot come to the Congress with the backing of an agency that looked at all of the options in the energy field and on a comparative basis and a judgment that this merits this sort of support on the basis of that kind of judgment.

It seems to me that having the Secretary of the Department charged with energy advocating and pressing the funding requirements gives it a better possibility of being pursued to a conclusion than if it is a separate small entity without that kind of support and really without that kind of analysis.

Senator JACKSON. Of course, in this context we are talking about, the Department of Natural Resources, under that Department, under that Secretary, would be all energy efforts. It would be different than the Atomic Energy Commission which, of course, is a single-purpose agency. We do have conflicts which I think are good in the energy area. It seems to me that it is healthy to have a situation in which there is this element of competition, whether it is the oil shale program or the gasification or the nuclear energy effort. All of this can be extremely helpful in getting some push behind it.

What bothers me, Mr. Freeman, is that I am a little fearful that if we proceed along institutional lines within the Government on this kind of a program it is going to get lost in the bureaucracies. There is a reluctance on the part of Government research efforts that are solely within the governmental structure to take the risk and to make the kind of effort that is needed in a situation where I guess time is of the essence. I don't mean to be wasteful, I don't mean that. But there needs to be an element of risk taking in order to get the kind of program going here in a timely way.

Mr. SHERMAN. I share your concern. I think at the time you introduced the bill, Senator Jackson, there was perhaps more basis for that concern than there is today. Since that time, the President, in his energy message, has singled out this technology as one of the key initiatives and has given it a push. There is always the question of the follow-through.

I think there is always the basis for concern. We now have Presidential backing for a coal gasification effort on a high-priority basis. I believe that really the question is: How can that be carried out most effectively and most promptly? I have suggested 2 or 3 years from now when the pilot plant efforts are completed and we are about to begin to build the large size demonstration plants, perhaps some joint venture entity housed within the Department might be a useful entity to put into being.

Senator JACKSON. I agree that it should stay under the control of the Secretary who will have the overall responsibility here. I would appreciate it—it would be helpful to the committee—if we could have the benefit of your judgment as to alternative courses that might be followed in setting up an entity within—at this time it would be within the Department of Interior—to carry out what we all have in mind and that is an effort here which will be in large measure a joint venture on the part of industry and Government. I am sure Senator Moss is not wedded to any single concept. We just want to get the job done. The most effective way to get it done is what we are concerned about.

I certainly appreciate the constructive suggestions that you made here today. Thank you.

Senator Moss. Thank you.

Senator Hansen?

Senator HANSEN. Mr. Freeman, let me compliment you on your testimony, I know of your very real interest in this field.

It occurs to me that in a historical fashion——

Senator JACKSON. Would you yield for one moment? I wanted to correct something.

The hearings, by the way, on the Department of Natural Resources, will be in the Government Operations Committee on August 5, tentatively, and we are going to have the Cabinet and other people up on that day. That is a tentative date.

Thank you very much. I left the impression maybe that it was before this committee. I serve on that one, too. I got my hats mixed up.

Senator HANSEN. I was going to say, Mr. Freeman, that I think we observed two approaches to the solution of problems in this country. One is to give incentive to private industry, a policy to which I subscribe, and a policy which I suggest has not been fully operative for some time, at least in the energy field. You are aware, I know, that we have controlled prices on natural gas, and I suggest and submit that one of the reasons that we are in the mess we are in now is that for a long time we have unrealistically held gas prices down, thinking I am sure in good conscience that this served the wide public interest. Yet it seems to me that it has not now in light of our more recent experience served that wide public interest. We have discouraged exploration and discovery efforts within the United States. We have encouraged the increasing importation of our energy supplies from abroad because

of the far greater fields that have been found over there, the advantages that accrue from much lower priced labor forces in foreign fields than we have here, and it is only in very recent years, as we start to give real consideration to the wisdom of a policy that would place increasing dependence upon foreign sources of supply, are we forced to examine our whole energy policy.

I want to pay my respects now to the distinguished chairman of this committee, the full committee, and to the distinguished chairman of the subcommittee for the leadership they have displayed in trying to come to grips with these problems.

Nevertheless, the other approach that I think we have taken in trying to solve problems of national proportions, if we fail to let private industry do it on the one hand, is to call in Government and industry to join hands and to give some financing as well as public support in other areas to those private efforts. I think that we are forced, it seems to me, at this late date to try to make the best of a poor situation by utilizing this second concept.

With that in mind, it seemed that the questions posed by Senator Jackson and Senator Moss were very timely indeed. How best can we bring about a proper wedding of the forces of Government along with those of private industry to make certain that we shall not suffer the devastating effects that could result from a real energy shortage in this country.

With that in mind, I would like to ask you, do you think that it might also be indicated along with that approach to give serious consideration now to a couple of bills in which I am interested; one which would increase the coal depletion allowance along with some other minerals, from 10 to 15 percent and a second bill, sort of a companion bill—S. 1309 is the number of the first one, S. 1310 is the second bill's number—which would provide for rapid amortization over a 5-year period of time of coal gasification and oil shale conversion facilities.

These two bills, incidentally, are now before the Finance Committee, of which I am a member. My introducing them was prompted by my conviction that anything we can do to make potentially more profitable this research effort and this development of technology effort would serve the wide public interest. I would like, if you would, to comment on the merit or demerit as you may view it now of these two bills.

Mr. FREEMAN. I would be glad to, Senator Hansen. I have not had an opportunity to study the bills, but as you describe them, I would be inclined to think that that is not the direction that we should be going to find the answers to our energy and environmental problems today. I think we can have different opinions about why we are in the situation that we are in today, and still agree that the program for coal gasification is very much in the public interest. It really is immaterial in a sense as to that program as to why there is a shortage of gas. The fact of the matter is that the people of the country are apt to be demanding energy in the form of clean gas that will be greater than the resource base that exists at least in the lower 48 States as far as we can tell.

In a sense if there is a criticism of the regulatory program on the natural gas side, it might very well be just the other way. By keeping

prices perhaps artificially low over the years, we have spurred a demand for natural gas in the market greater than it might have been in the absence of the regulatory process. In effect regulation has resulted in at least a more uniform and perhaps more rapid growth in the gas industry.

It is very difficult for me to accept the fact that an industry that has grown since World War II at an average of roughly 7 percent a year has really suffered from Federal regulation.

What we have today is a market demand that has resulted from the clean air programs that we are implementing plus a much larger than anticipated rate of growth in energy that literally is larger than had been anticipated. Demand probably will exhaust the resource base of natural gas before the century is over.

For that reason, I think it is very much in the national interest to take coal, which is our largest resource base, and perfect the technology to convert it to this clean gaseous form where it is in such great demand.

It seems to me that the remunerations for the industry should come in the price of the product. We have in this country, in a sense, deluded ourselves into feeling that low price energy should be a goal in and of itself apart from other national goals. I think that the price of energy should reflect all of the profits and costs that are needed to give the industry incentives and also all of the environmental costs that are apt to be met.

In that way, the price of energy will tend to help us balance supply and demand and give us greater incentives for energy conservation, which seems to me to be a very important aspect of our national life that needs to be emphasized. We ought to be moving to more efficient uses of energy and by letting the price reflect all of the cost we will have greater incentives for doing so.

Senator HANSEN. I am confused. If I understood you correctly, you said that you felt the remuneration of the industry should be in the price of its product. Was that right?

Mr. FREEMAN. Yes, sir.

Senator HANSEN. I think you also said this would provide or should provide the incentive necessary to make available adequate supplies, is this also what you implied?

Mr. FREEMAN. That is right.

Senator HANSEN. Well, it seems to me you have stated my case better than I could state it myself. That is precisely my feeling. That is exactly what hasn't been done for the last 15 years because I suggest to you precisely the activities of the Federal Power Commission this: the price that gas would have brought or that any other form of energy would have brought in this country has not been reflected by the interplay in the marketplace between supply and demand. We have held the price artificially low.

I submit that that is exactly why we are in part of the mess we are in now. I say to you that if the price of natural gas had been allowed to reflect the inflation that has reflected everything else in the country which has not been affected in natural gas, we would have had the price up higher and the incentive necessary to interest the coal industry would have been there long ago. The coal industry would have

been then taking steps necessary to perfect the techniques and technology in order to make gas from coal now available. And they haven't done that.

The reason they haven't done that is that they were looking at the competition between the artificially depressed low price of gas on the one hand and what they would have to sell their gas for.

Now, we are in the anomalous situation of having LNG coming into this country from foreign sources and selling for upward of three times as much as the Federal Power Commission permits our domestic natural gas suppliers to receive—does that seem to you to be the kind of arrangement that would give the incentive to industry necessary to bring up the dollars to get on with this job?

Mr. FREEMAN. What I was attempting to comment was on the question of whether we should go to larger and larger depletion allowances as a means of providing incentives. I think, perhaps, you and I are in agreement that looking to the future that we should permit the price, the marketprice to provide incentives. I am not at all sure though that this suggests the reason we have a potential shortage of gas is because of the policies of the past.

I think we are in a brand new ballgame in the whole energy field and specifically with respect to natural gas. This has come about through the force of the Air Quality Act which has made gas such a premium fuel for so many uses, and increased the demand beyond what I think anyone reasonably anticipated.

Looking to the future, I am not at all certain about the desirability of the well head controls in terms of price controls—

Senator HANSEN. You are not certain about them?

Mr. FREEMAN. I am not certain they are really helping. I rather suspect that the elimination of price controls as to the future gas supply is, perhaps, an idea that ought to be seriously considered. In my judgment, that does not suggest that the price controls that took place in the fifties and sixties weren't in the public interest, because then we had adequate gas supplies that primarily had been found as a byproduct of the search for oil. I think one of the things we shouldn't do is to somehow suggest to the general public that if price controls were lifted that this gas shortage would go away. In my judgment the gap between the supply and demand situation for gas is one that would persist even in the absence of price controls.

What we are faced with is a demand that seems to be larger than the resource base in the United States. For that reason I am here advocating the coal gasification research program. I think we need to add to that resource base if the gas industry is to continue to serve consumers with a gaseous product in the future at reasonable prices.

Senator HANSEN. Well, I don't know that we disagree as much as I may have suspected we did originally. I appreciate your clarification.

Let me say, however, that when you speak about the adequacy of supply during the fifties and sixties, I guess I might liken it to a situation that could obtain if a farmer was halfway through the blizzard of 1949 and he says there is no problem, we still have hay in the barn, but come the first day of February he is completely out. I think that is about what we have been doing in the fifties and sixties. We haven't had the good judgment to look ahead to see what the vast reserves were.

I suggest to you from the evidence I have seen that they have been steadily declining. Now, anyone, or I think most people, who were really cognizant of the long-range public interest of the American people have seen or observed a warning flag at that time if they had looked at the steady declining ratio of reserves to daily consumption. That curve has been steadily declining for I think 10 or 15 years. Not many years ago we had gas reserves for 20 years, by which is meant at the present rate of consumption we could look ahead at a reserve then known to be in existence that would take us for 20 years, but it has dropped down to 10 now. The only reason I have proposed these two bills, or I should say the main reason I have proposed them, is that I think it is important that we give every incentive to industry, to private industry, that we can.

I say that first of all because I like to see the interplay of competition take place. I like to see private industry wherever it can meet the needs of America, take care of our essential needs that impinge so greatly on our national security, and to see that business pays its full share of the taxload.

I just think that it is awfully late in the day and for that reason it seems to me not to be unindicated to give every advantage we can to industry in order that it shall have all of the incentives and all of the spurs that we can give it in order to get on with this job.

Now, these are only correlative to the other considerations, but I do think that is important. With this in mind, I am especially interested in your observations as to the manner in which we may best bring about the cooperation of industry and business to meet a very critical situation now. I am sure that you are familiar with the hearings on the National Energy Bill. I am certainly convinced that we are in a pretty serious situation. I don't like to wait until I throw out my last bale of hay to say we have an emergency on our hands. I like to count a few in the left ahead of time.

Mr. FREEMAN. I agree completely. We are trying to look ahead. What I am trying to suggest is that if we look at the life cycle of our children, we have to think that this natural gas is a very short term resource. If we have abused it in any way, in my judgment it is using it too quickly for too many frivolous purposes. We have to think in terms of supplemental sources and alternatives and in terms of conservation of this and our other precious energy resources.

Senator HANSEN. I would like to agree with everything you just said. When I do that, may I point out that by our artificial pricing of gas too low, we haven't hit the most important uses. About a third of it—I would like to check this figure to be sure I am right—is being sold intrastate only because it didn't then come under the control of interstate agencies and it could—contracts could be made between a supplier on one hand and industry within the State on the other. We have been burning gas out in much of the West where it is produced doing jobs that could have been done almost equally as well by other alternate sources of energy.

Instead of saving that critical gas supply for New York City and Washington, D.C. where the pollution of the air becomes a real problem, we have been wasting it out there when we could have been using

coal just as well, simply because the Federal Power Commission said you can't sell it for over so much interstate. Because of that we have been using it where we shouldn't have been using it. I suggest that the quicker we can change that policy around the better off this country will be.

I agree completely that we have a serious environmental problem. It is recognized that natural gas is the cleanest of all fuels. It is too bad that some of the regulatory agencies in this country didn't have the good judgment 15 years ago to recognize the shortsightedness of their processes and of their tasks which resulted in this sort of condition continuing for as long as it has.

Mr. FREEMAN. I just want to observe that what Senator Hansen says with respect to natural gas could probably be stated with respect to many other of our energy resources and the patterns of use which have assumed pretty much a bottomless barrel.

Now that we realize that the barrel does have a bottom and that perhaps we are approaching the bottom of the barrel in terms of our gas resources and others, that perhaps we will change our policies.

I think one would like to be very wise and be able to see the right answer 15 years in advance, but when these issues stare you in the face as they do now, I hope that we will act.

Senator HANSEN. Thank you, Mr. Chairman.

Senator MOSS. Senator Gravel?

Senator GRAVEL. Thank you, Mr. Chairman.

I was very impressed with the colloquy between yourself and Senator Hansen, but it sort of stays under us that how will the regulatory agencies—if it is recognized that they haven't been doing the best job possible, how could they now undertake to do a better job? Who will—

Mr. FREEMAN. Senator Gravel, I tried to suggest that I don't think the answer to our natural gas supply problem for the future lies with the regulatory agencies. It seems to me that if one takes a broad perspective of our future energy demand that natural gas is a short term resource and that if we accelerate the exploration development effort greatly, all we will succeed in doing is using up what gas we have that much faster. It might help solve the problems of the seventies, but then the peak of our natural gas resource will be reached that much sooner.

If one looks further down the road at what this committee is considering today, and other options are perhaps of more basic importance—

Senator GRAVEL. I appreciate that, but I was picking up the last thread you left with Senator Hansen. Since there seems to be unanimity of agreement, I was wondering if some facet of the problem could be solved with some type of regulatory policy change. I think you made a very fine point about the final price being the absorber of all costs. Do you just leave that? You made a few nice statements which I agree with, but what happens after that with respect to the executive? Is there something afoot within the executive that would address itself to that facet of the problem?

Mr. FREEMAN. I am not aware of any such activity. I believe there are legislative proposals pending before the Congress. I think there will be hearings on some of these proposals.

Senator GRAVEL. With respect to the President's extensive statement on June 4, do you envision no effort with respect to the Executive in redoing or reexamining the philosophy of some of the regulatory problems?

Mr. FREEMAN. I don't know of any such studies that are now underway or apt to be completed soon. We are trying to address the more fundamental problems of looking to the future and broadening our energy resource base. Also, the actions of the regulatory agencies are the actions of independent agencies and it is not the province of the executive branch to be in any way involved in their decisionmaking process.

I think you are speaking of more fundamental changes in the charter of the regulatory agencies. That would be appropriate for the executive branch.

Senator GRAVEL. I don't know precisely what I am speaking to. I am picking up on the point you made—and I think it is a proper one—and the one Senator Hanson made. We see the administration come forward with what is supposed to be a definitive approach to the energy problem and all I am asking is as part of that broad approach, you seem to indicate there is some reason, that something should happen with respect to the regulatory sector of Government and I view that sector more germane to the functions of the executive rather than the legislative.

So, the answer you are giving me, and I will rephrase it, is that part of the total energy crisis or problem that this Nation faces is knowing of policy being contemplated with respect to the approach to the regulatory aspect of it.

Mr. FREEMAN. I would expect that the agencies themselves are perhaps not unresponsive to the kind of problems we are talking about today.

Senator GRAVEL. I appreciate that. I think they are staffed by intelligent people who have made good decisions and bad decisions like all of us do, and have and will in the future. But I just wanted to ascertain if there was something as part of the President's approach to this total problem that was really being done in that area.

Mr. FREEMAN. I might say, Senator Gravel, I suffer from either the curse or blessing, whichever way you may wish to phrase it, of having worked at one of the regulatory agencies and I understand the problems as well as the opportunities that one has for service over there.

Senator GRAVEL. I think you stated it very well. The point I was making was that there is nothing that is visible now or there is nothing that the administration contemplates in grappling with the energy problem from that end.

Mr. FREEMAN. To my knowledge, there isn't.

Senator GRAVEL. With respect to the way it has been grappled, you mentioned that we have a \$30 million effort, \$10 million of which would come from the private sector and \$20 million from the Government.

What has been done thus far in this gasification use of coal?

Mr. FREEMAN. There has been a research effort which I think began very early in the sixties to try to learn more modern and more economical ways of gasifying coal. Of course, you are aware that the gas

industry was based on manufactured gas before natural gas came in the picture, so we are sort of coming full circle, except we are trying to develop a technology that will provide high Btu., high quality gas that will be compatible with the natural gas.

We have reached the point where there is a pilot plant now in operation by the Institute of Gas Technology that was funded primarily with Federal funds which is located in Chicago, Ill. It is in the beginning stages of operation, and is perhaps the most advanced item in our program.

There is another pilot plant which is located in Rapid City, S. Dak., which is trying to make feasible an alternative method of gasifying coal. We expect to proceed this year with the beginning of construction of perhaps two or more other pilot plants and the President's program provides for an acceleration and an enlargement. We have marched along the paths of coal gasification to where we are out of the laboratory and we are building small-scale pilot plants.

The next step will be to select the best of the technologies from the pilot plants and go to a large scale demonstration plant and beyond that to a commercial sized plant.

Senator GRAVEL. This probably is an unfair question, but would you be qualified to explain to me in a thumbnail fashion how each one of these plants work? How the fuel is fired and the containment?

Mr. FREEMAN. If I could ask Mr. Weinhold, my associate, to answer that—

Mr. WEINHOLD. I will give you a little bit. I haven't studied all of them in great detail.

Essentially, you are talking about a three-step process in most of coal gasification. You first try to get the coal from its solid form into a chemical that you can put through a chemical plant. This is a difficult process always.

Senator GRAVEL. So, you mine the coal in a conventional way. That would be strip mining or shaft mining.

Mr. WEINHOLD. Yes. You mine the coal in a conventional method and bring it to a coal gasification plant. Somehow you take this solid coal and make it into a chemical input into the plant.

The first step in virtually all of the processes is then to use a simple steam reaction with the coal to make a hydrogen-rich gas. This is similar to the process used in making normal manufactured gas.

Then the next step is to clean this gas up, by removing the sulfur, and other pollutant materials from the manufactured gas. The final step is to methanate it, essentially to convert the extra hydrogen into methane, a carbon hydrogen compound. Pipeline quality gas is essentially methane.

The alternatives involve the various ways to perform these different key steps. The HY-gas process—the one in Chicago is an electrothermal process of using electricity to heat the coal for the steam reaction in the first step. There are various other alternative processes and each involves some different approaches to the key steps.

The object of the program is to try a lot of these different steps and then to synthesize the best overall system for making gas. I think that is about as far as—

Senator GRAVEL. What percentage of this type of gas will be used to generate electricity and what percentage will be consumed, let's say, in the household or for industrial use directly?

Mr. FREEMAN. My guess is that this gas would primarily go to households. Most likely it would not be economical enough to be used for boiler fuel. It would tend to be more expensive than the average gas and would therefore move into households. But I think one has to consider that there is a pipeline system which is meeting the demands of all of the customers of the pipeline and this would be supplemental gas that would move into the Nation's network of natural gas pipelines. It would be supplemental gas that would serve just as useful a purpose as gas coming out of a well.

Senator GRAVEL. Has any assessment been made of the ecological consequences? Is there any thought within the administration to prepare a 102 statement relative to this—

Mr. FREEMAN. I am certain there would be a 102 statement prepared prior to the time that any large scale demonstration plant were built. We are, as you say, in the pilot plant phase and I think that we would be very conscious of the environmental aspects.

Of course, the whole project is an attempt to provide technology to clean up the environment, to take this high sulfur coal which presently cannot be utilized in conformity with air quality standards and convert it to a gaseous fuel that could be delivered essentially directly to industries or households in underground pipeline systems that have no impact on the landscape. It would provide a source of energy that would then be relatively clean which would be burnt at low enough temperatures not to provide a serious oxide of nitrogen problem, and would really be among our cleanest sources of energy.

Senator GRAVEL. I don't question that, but I do wonder that we might be able to make the case more cohesive if we had a total 102 statement on this endeavor now rather than later so that you could use that to chase greater appropriations in the effort.

Mr. FREEMAN. I think that there is no reluctance whatever to publishing a 102 statement just as early as we know enough about the type of program to lay it out intelligently and in a way that would enable people to comment. I am certain that this will be done at the earliest time that we are able to do so.

I will make a note of your suggestion and check up on just when the department does plan to put out a 102 statement.

Senator GRAVEL. The degree of funding, \$30 million a year, is it contemplated for this year's effort or will we accelerate that?

Mr. FREEMAN. This is, Senator Gravel, an acceleration over and above the current effort. We would expect that this \$30 million a year level would be adequate to take us through the next 2 or 3 years while we are in the pilot plant stage, but it will require a considerably larger effort when we are ready to start building a large scale demonstration plant. The \$30 million a year effort is a level of effort to build and operate the series of pilot plants to learn which technology is best.

Senator GRAVEL. How do you arrive at the ratio of 2 to 1, \$20 million for the Government and \$10 million for industry? How is that arrived at?

Mr. FREEMAN. I think that it is a pattern that is not different in kind from the ratio that we have in mind in the demonstration program for the nuclear breeder reactor and other comparable programs. I don't think that there is any magic in it.

At the moment the ratio is probably 90-some-odd percent Federal and just a few percent industry. We are going into a cooperative program with the industry putting up a larger percentage. As the program moves closer and closer to commercial reality, we would expect the industry share to increase so that when we get to the demonstration plant program it would seem reasonable and logical for the industry to be putting up the majority of the funding.

I think that the committee's bill suggests a 60-40 split of the funding. I don't think that there is any magic in any particular figure except that it is reasonable to expect that as we move closer to commercial reality for the industry to put up higher and higher percentages of funds.

Senator GRAVEL. The American Gas Association is made up of all the utility members in the country that sell gas as a public utility?

Mr. FREEMAN. I think it is made up primarily of the distributors of natural gas with many of the pipeline companies belonging and some of the producers. I don't think that it includes all of the producers of natural gas. I think it is an industry organization that is predominantly distributor and pipeline, but I think the representatives of AGA could describe their organization with more particularity.

Senator GRAVEL. Wouldn't it be an easier way and get a larger application to put a straight sales tax right on top of the product and pump that right into research?

Mr. FREEMAN. Well, that is another alternative that would require legislation and raises the kind of questions of whether you want to set up a trust fund or not. We have been able to work with industry and we have on a voluntary basis an industry-Government program that is now started and in being.

It seems to me that it makes sense to pursue something that is already underway and perhaps better if the industry will voluntarily contribute the money than to move to some other system.

On the other hand, if we look at our energy needs broadly and look at the requirements needed across the board, getting away for a moment from this particular technology, it is certainly my judgment that we need to be spending a lot more money for energy research and development in this country and I think that is the thrust of the President's energy message.

Senator GRAVEL. I gathered that, but I was just trying to make a point here that it is hard to determine whether or not there is a major effort, that it is an improvement, I am the first to admit. It is an improvement with respect to the public-private participation from 9/10 to 2 to 1, I think, is also an improvement. If I could suggest some figures, I don't know what the figures are, but, one, if the American Gas Association does not go for everybody, then there is certainly built in inequities right in the private sector and some are carrying water for others that will benefit from it. Two, and these are figures that if you could find out how much advertising the gas utilities do in

the country as opposed to how much they spend in research. I don't know what it is, but I know what it is for the electrical utilities.

In 1969 it was \$320 million for advertising and \$41 million for research. I am sure that \$41 million was padded heavily with conventions and travel and the like so if that is the kind of effort that has been the pattern from the private sector in the past, and we know it hasn't been present in the Government sector, then I think what we need is a new look at the approach. Maybe a tax rate on top of the energy, this money forced into research and find a way to discourage utilities from just plain advertising.

Senator HANSEN. Would the Senator yield at that point?

It might be interesting to note that some utility companies are doing precisely the opposite of what they used to do. Instead of trying to encourage more people to use their appliances, they are now saying, turn off that unused light and so forth because they recognize that they are in a very critical situation.

I am sure Mr. Freeman is aware of that. I am sure the Senator is, too.

Senator GRAVEL. Right. I heard some of those advertisements. They are good. But I wonder why they should have to spend advertisements to sell electricity and then put more advertisements on not to use so much electricity.

I can see advertising a toaster, and there is nothing else you can do with a toaster but plug it in. But as far as electricity, I don't know of anybody who builds a house nowadays that doesn't go out and get it wired and you don't have to read an advertisement to tell you to do that. It is a waste of wealth, in my mind, to a good degree.

Mr. FREEMAN. I have no difficulty at all with this, Senator Gravel. I have been making much the same point myself. I feel the priorities of industry have been somewhat distorted to the extent they spend more money on advertising than research, but I would compliment the industry for beginning to turn around in that respect in this program, which represents a very large effort by industry compared to efforts of the past. It is one that I applaud and I think it should be encouraged.

It is our judgment that the \$30 million a year level will adequately fund the pilot plant program on a schedule that is as close to optimum as we can visualize. In other words, that doubling or tripling the funding at this stage would not materially affect the pace of progress.

We have a variety of pilot plants that are either under construction or are going to be built and we have to go through that phase before we really need the big money. I think at that time some self-taxing mechanism by the pipelines and distributors may very well be needed in order for them to raise the money.

Senator GRAVEL. I agree with most everything you said except that last point. I believe very strongly in the philosophy that bigger effort brings out bigger results and I am not prepared to accept the fact that this is the best that this Nation can do as far as an effort in this particular problem area.

If we were able to double it and make it \$60 million a year, I am sure the projection you gave us for having an operating commercial plant by the end of the decade could be brought to somewhere in the middle of the decade. Not knowing the crisis, using the parallel for

Senator Hansen, we don't know when the barn will empty out. We can make projections, but they are alterable every year.

The only point I am making on that is that I disagree. I think if we forced more money into it, I think we could accelerate it to a good degree.

I might suggest if you could look into how much advertising is done by the gas utility companies around the country in relationship to what they put into research, this might be a good place to get some extra money without doing any bodily harm to the utility companies and certainly increasing the effort that could be made or investigate the possibility by executive action of a tax rate on the gas itself.

Let the people who use it pay the cost of improving it.

Mr. FREEMAN. I don't mean to rule out any of the suggestions that you make. I think we might very well need to go to all of them. I am usually make the kind of argument that you are making, I just happen to think this coal gasification program which has been singled out by the President as a high priority effort is being funded at a much higher percentage of optimum than most programs that I know of in that we are making really a first rate effort to push this one along.

Senator GRAVEL. Thank you.

Senator Moss. Thank you very much, Mr. Freeman and Mr. Weinhold. We appreciate your testimony. We kept you a long time, and it was because of the great interest that we have.

We have run off into the subject of technology which I said we were going to leave out of this hearing and just talk about the method of funding an effort to have a short-lived corporation with private industry on the board to try to infuse extra drive in it, or whether to continue with R. & D. within the established structure. As you point out, there is new emphasis being placed on coal gasification by reason of the President's directive. The question still is whether we ought to have a separate method or whether we ought to just increase the R. & D.

Thank you very much. We appreciate it. Your statement was very interesting and valuable to this committee.

I think we have time for one more witness before we recess. He is a very distinguished witness, Mr. Joseph C. Swidler, representing the National Association of Regulatory Utilities Commissioners, formerly Chairman of the Federal Power Commission, a very long-time friend of this committee and distinguished public servant.

We are very glad to have you with us and we look forward to having your testimony.

STATEMENT OF JOSEPH C. SWIDLER, NATIONAL ASSOCIATION OF REGULATORY UTILITIES COMMISSIONERS; ACCOMPANIED BY PAUL ROGERS, GENERAL COUNSEL

Mr. SWIDLER. Senator Moss, Senator Hansen, it is a pleasure to be back in Washington testifying again before this committee.

Senator Moss. Thank you.

Would you turn the microphone close so all the people can hear? Fine.

Mr. SWIDLER. I must say that my ears burned a little as I listened to some of the colloquy that took place, especially some questions and comments of Senator Hansen.

Senator HANSEN. I am sorry, I am unable to hear you, Mr. Swidler. I want very much to hear you.

Mr. SWIDLER. I said my ears burned a little as you were questioning the prior witness.

Senator Moss. I anticipated this when you came on as former Chairman of the Power Commission. Go right ahead. We are anxious to hear from you.

Mr. SWIDLER. I am not here to defend my record in previous stages of my career, but rather to talk about a bill to create a corporation which would promote the project for gasification of coal.

I appear not only as chairman now of the New York State Public Service Commission, but also as you mentioned as the spokesman for the National Association of Regulatory Utilities Commissioners, which is a national organization of all the State and Federal associations with membership of the governmental bodies of all 50 States engaged in the regulation of carriers and utilities.

Sooner or later this Nation must develop coal gasification capabilities to help satisfy its energy demands. No one argues against that proposition. Coal is by far the most abundant of our fossil fuel resources. Perhaps 30 times the B.t.u. value of our petroleum resources and the other fossil fuel resources are now in short supply. But burning coal creates serious environmental problems. The cleanest, the only feasible way to use coal under the present conditions of technology, is to convert it to gas.

The controversies that relate to coal gasification concern the proper pace of effort to develop commercial gasification processes and the institutional framework for pursuing that effort, whether by a coal gasification development corporation with federal and industry participation or some other way.

My remarks today will be addressed primarily to the pace of coal gasification efforts. S. 1846 gives recognition to the need for speedy development of commercial coal gasification processes. It represents in my mind an important step beyond the announced administration program for coal gasification. It represents a demonstration of Congressional interest and congressional determination to speed that program. I think it requires some amendments.

In particular, I would recommend that there be State representatives on the board of any coal gasification development corporation, or on the policy advisory committee established under the legislation.

In the President's energy message, he announced a doubling of the Federal-industry cooperative research effort and proposed that the Department of Interior's level of funding be raised to about \$20 million annually, instead of the previous level of about \$10 million a year in cooperation with the American Gas Association, which would contribute about \$10 million annually. This program was elaborated by Secretary Morton before this committee on June 15.

We have knowledge in New York about the participation of the New York companies and I understand that most of them are planning to participate. We understand that the effort is progressing on

a pace which might take 8 to 10 years, but that speeded up it could be done perhaps in as little as 6 years.

Sections 3 and 6 of S. 1846 require the building of demonstration plants and if warranted, full-scale commercial size coal gasification facilities within 6 years. We see the urgent need for commercial gasification processes within that time.

The big difference between the program envisioned in S. 1846, in the administration program, is that 1846 sets a target and remains flexible about expenditures, evidences a determination to make that target, while the administration program fixes a target expenditure and leaves wholly indefinite the schedule for achieving success. Because we think the urgency of the project warrants whatever additional expenditures may be required, we prefer the S. 1846 approach with its firm timing objectives.

Of course, there are constraints, not excluding bad luck, that may frustrate the purposes of S. 1846. Given the promise of known possibilities for coal gasification, the progress made thus far, we think that the sites should be set on a target date for establishing a commercial gasification process in light of the imminent need for that development.

Now, I have prepared a table and two cases which illustrate the extent to which our underground resources are inadequate to meet the projected requirements of the American people. On case 1, beginning with 1970, we show how the projected increase in demands starting with, as I say, 1970 at about 22 trillion and increasing at the rate of 3.5 percent a year, which is the rate estimated by the American Gas Association.

From that, we have deducted the probable imports from Canada. In the parallel columns on the right-hand side of the sheet are the amount of gas reserves that would be necessary at a 10-to-1 ratio which is probably the minimum in order to attain the deliverability of the amount shown on the left-hand side of the sheet, the rate required to maintain that 10-to-1 deliverability.

As you will notice, no findings are required in 1970, 1971, or 1972, because for their 10-to-1 ratio, the existing reserves would be adequate. But beginning in 1973, the findings increase dramatically. In 1974, 33 trillion. In 1977 to 73 trillion; by 1980 the findings required would be 271 trillion, which is in excess of the amount which the potential gas committee of the American Gas Association has estimated to be the probable reserves. And by 1997, we would have exhausted all reserves, probably, possible, speculative, which that committee estimated to exist in nature within technological limits.

Case 2 is constructed on the same basis except that we have made I think rather more realistic assumptions as to growth. After all, 3.5 percent doesn't compare very realistically with the 9-percent growth that took place last year. So, we have estimated I think 8 percent in the next year. Then 7, 6, and finally 5 percent thereafter.

On that basis, the findings required increased from 41 trillion in 1973 to 95 trillion in 1992, at which time all 1,274 trillion of new findings would have been required.

New reserves, if we were to achieve the high level of annual findings that are the minimum necessary if domestic resources were to satisfy

the demand, that 260 trillion would be reached in either 1978 or 1980, depending on your assumptions as to growth. This is to be compared with the largest finding of 24 trillion declining I think in the last year to about 16 trillion, far in excess of anything that could be expected, so that I think what these tables show is that whatever assumptions you make as to demand, it is inconceivable to find more than a fraction of the gas that we need to satisfy the demand from underground sources.

There may, of course, be more natural gas than was estimated by the committee by making the most favorable assumptions, that you postpone the date of exhaustion only a relatively few years.

Our experience in New York has demonstrated to us the urgent need to reach out as quickly as possible to coal gasification and the other promising ways to augment natural gas supplies. Our distributors no longer take on everyone who wants gas service. In order to meet growth needs and even to sustain present levels of gas deliveries, distributors in New York State and some of their pipeline suppliers have turned to alternatives such as importing liquefied natural gas from abroad and converting that to gas. Our day to day experience with the gas supply situation makes us conclude we could use coal gas right now in New York.

Gas distributors in the State of New York have imposed restrictions on gas service to new customers. Five of the large gas systems have filed tariff provisions to restrict the growth of firm gas sales. Additionally, several of the utilities have adopted policies of not taking on any new large loads. The effective tariff provisions contain policies ranging from the denial of service to consumers whose consumption level would be above a specified amount to some restrictions against the extension of mainline facilities. One gas distributor has filed a proposal not yet effective to deny all service, including residential service, if the service were to require a mainline extension. That is Niagara Mohawk.

The Commission's awareness of the gas supply problem led it to investigate the need for and extent of restrictions on the attachment of new gas customers and gas promotional practices. The proceeding is presently before the Commission. The hearing examiner found that New York was suffering from a gas shortage, that tariff provisions restricting new services should be filed and that the restrictions should recognize specified end-use priorities. Service first to residential users and to certain other consumer categories.

Many distributing companies as well as the pipelines that serve them are contributing to widespread gas exploration activities. I won't go into the details because they are included in the written statement, and I don't think I need to take the time of the committee to present them.

I would say, however, that the price seems to me to have only a limited impact on the problem. The price of gas at the well. No more gas is going to be discovered than now exists and tripling the price would not necessarily triple the discoveries. Whatever discoveries were made would be at the expense of the future availability of gas.

Senator Moss. Isn't gas primarily discovered in conjunction with the search for petroleum? Isn't that the largest area of gas discovery?

Mr. SWIDLER. Well, there is a substantial amount of gas that is discovered in areas that are known to be gas prone, such as off-shore Louisiana, where I think a large proportion of the new fields are gas fields and where a good deal of the push for discoveries is in order to find gas supplies.

Senator MOSS. Of course, gas has become very valuable now, but originally it was flared off from petroleum wells because it was a nuisance.

Mr. SWIDLER. Yes. This is the reason why the production of the reserve ratio at one time was so high. There was no market for gas until the great expansion of the transmission network after World War II. A good deal of the gas was capped, recycled. The amount of gas available was very large in relationship to the market, probably far in excess of what would be justified on a commercial basis.

Now, the major plausible supplements to domestic natural gas for satisfying the demand for gas into the foreseeable future are coal gasification, imported liquefied natural gas, and Canadian natural gas supplies. Naptha conversion will also play a part. While all alternatives should be pursued, coal gasification seems the most promising to us.

Briefly stated, a substantial reliance on imported liquefied natural gas carries the risk of supply vulnerability, especially in times of international political tension. The recent experience with the Mideast and North African oil negotiations indicates the substantial possibility of price increases at the foreign sources that would add to an already high price for imported liquefied natural gas. Firm contracts do not seem to provide firm assurance. The supply and price risks of imported LNG do not run evenly across the Nation. The most likely market for imported LNG will be on the east coast, and possibly the west coast as well. If imported LNG constituted a uniform fraction of everyone's gas consumption, the relationship to total national consumption would mean that an interruption of supply might be tolerable. It seems more likely, however, that the dependence on LNG would be concentrated on the east coast, and that the dependence could quickly grow to the point where an interruption would be disastrous for the east coast and accordingly for the Nation.

We have read reports of an enormous potential for gas reserves in the Canadian far north and in eastern Canada, onshore and offshore. It will, of course, take years for the discovery and development of the reserves, and the building of substantial transportation facilities. Furthermore, Canada itself seems the first likely market for most of the gas. I would expect that, especially in the eastern part of Canada, new gas would displace the consumption of imported oil.

Ironically, eastern Canadian gas discoveries may not reach the United States, but instead, by displacing oil imports to eastern Canada, may increase the export of eastern Canadian oil production to Midwest oil markets. In any event, it apparently will be a long time before Canadian reserves are so substantial as to promise a massive increase in exports of natural gas to the United States.

Naptha conversion holds promising possibilities, limited by its cost. Britain has had substantial success with naptha conversion, and

naphtha conversion plants are in operation elsewhere in Europe. Besides the cost disadvantages, the process relies on either foreign naphtha, with the risks attendant to foreign supplies, or on domestic naphtha, the supply of which ultimately depends on the limits of U.S. oil reserves. Considering the large volumes of naphtha required, and the pressures which would be imposed on either foreign or domestic resources, I expect that naphtha conversion will play a firm but limited role in meeting the demand for gas.

By contrast, coal gasification rests on enormous supplies of domestic coal reserves. If air pollution controls further inhibit the direct burning of coal in metropolitan areas and elsewhere, coal gasification will have the advantage of helping the coal industry preserve its established place in the American economy. Because so much of our coal reserve are on Federal and State lands, coal gasification will provide obvious revenue benefits to government. These advantages do not accrue at all to imported LNG and have a diluted significance for domestic naphtha.

The strongest argument for coal gasification is the potential for cost savings in serving U.S. energy needs. Coal gasification holds the promise of dramatic cost advantages that sharpen the need for an early development of commercial gasification processes. The cost of coal gas has been estimated at about 80 cents. The attained cost will depend upon coal prices, which are subject to increase. The estimate also depends upon calculated processing costs which will surely decline, at least in terms of constant dollars, when the processes have been improved and large commercial plants are in operation.

By contrast, the price for imported liquefied natural gas is now over 80 cents. That price reflects present shipping costs, though we know the cost of building tankers generally and for the LNG trade in particular are rising rapidly.

Furthermore, the present price for LNG reflects a price of one-half of 1 percent per thousand cubic feet in Algeria, which constitutes a great deal of foreign material. Surely the foreign field price will increase above a half cent, once markets for the LNG have been established.

If you assume—and these are figures pulled out of the air but which informed people think reasonable—that coal gas will attain a 20-cent price disadvantage over LNG, the amounts involved become truly enormous. If an average of 3 trillion cubic feet of coal gas is produced in the 1980's—displacing the need for importing that much liquefied natural gas—the consumers of America will save about \$6 billion during the decade of the 1980's. If 50 trillion cubic feet of coal gas are manufactured in the 1980's, the savings would amount to \$10 billion. Considering the size of the stakes involved, there is every reason to force the pace of research in order to bring commercial coal gasification to early realization. Even if the amounts of coal gas were relatively smaller, the development of these processes would be tremendously valuable in putting a ceiling on imported LNG.

Without some viable alternative, and in the light of the exhaustion of our underground reserves, it seems to me to be imperative that there be some domestic equivalent to an otherwise unlimited series of price increases which we could expect for LNG.

Coal gasification has important collateral advantages. It would create American jobs, and would generate property taxes and other taxes for local and State governments, as well as income taxes for the Federal Government.

By contrast, the importation of LNG would impose a substantial burden on our balance of trade and balance of payments. Only a portion of the profits on that trade would accrue to the American corporations which participate in the importation. Much of their profits would be taxable by foreign governments, and the foreign taxes would be creditable against U.S. income taxes. The conversion of imported naphtha to gas holds the same cost, employment, foreign trade, and tax disadvantages as importation of LNG.

In the long pull, it seems to me there is hardly any development project more important than getting on with the gasification; but with it, we should couple acceleration of the breeder and the fusion programs if we are to have an adequate supply of energy to meet the long-term needs of the American people.

With respect to the administrative arrangements, it seems to me that the organization of a separate corporation has its strong merits. Any program which is housed within an old-line bureaucracy, is held back to the general level of the rest of the agencies; it is a general experience. If you want to push something much faster than the rest of the programs in a large agency, you almost have to take it out and give it separate status, at least in its initial stages.

This is the secret of the success of the AEC, in the promotion of nuclear energy; and I think you could make a very good case that the urgency of finding a supplement to our natural gas reserves, justifies a corporate device in this case.

Again, I recommend that if a corporation is created that the States be accorded a place on the board of directors, perhaps a representative of the National Association of Regulatory Utilities Commissioners, which coordinates the activities of all the State commissions.

I should like, Senator Moss, to introduce by associate, Paul Rogers, before closing. He is the general counsel of the National Association.

Senator Moss. Very pleased to have you before the committee, Mr. Rogers.

Mr. ROGERS. Thank you.

Senator Moss. It is fine to have you accompany Mr. Swidler, who we have known and respected for a long time. Do you have a statement you would like to give?

Mr. ROGERS. No.

Senator Moss. You are simply in company and ready to answer questions, I take it.

Mr. ROGERS. Yes.

Senator Moss. I especially like your estimate of the fact that a corporation such as we are talking about here having a fixed target date perhaps would have the push, the incentive, the drive, to meet that target date rather than going along with R. & D. as rapidly as possible, but with no real urgent time frame to spur that work along. Is that one of the reasons you think this bill might be the better way to go?

Mr. SWIDLER. Yes, Senator Moss. As Senator Jackson's comments indicated, we do have that situation with respect to nuclear research.

You have a strong specialized agency in the AEC. If you want the same degree of urgency, it seems to me you are not likely to get it through the existing department.

Now, if a new Department of Natural Resources is created with energy a key part of its responsibilities, that could change the picture. But if you assume that the Department of Natural Resources may be delayed for a few years, then I think the case for creating a separate corporation here becomes a good deal stronger.

Senator Moss. The fact that there will actually be representatives of the Federal Government and of industry sitting on the board of directors in a combination that had some desirability over having just strictly governmental R. & D. Do you feel that way?

Mr. SWIDLER. Yes, I do. It seems to me that since both are making a contribution to the program, that the industry people are in a position to insist that the pace of the research be maintained. Otherwise, we all know what happens to good intensions. There is a budget cut, there is always a tendency to spread the poverty to all the programs.

If you want to exempt this one from the general budget cuts, budget freezes that are apt to overtake the old line departments, this is the way to do it, or one way.

Senator Moss. Well, for example, Mr. Freeman said that demonstration plants would not be ready for 2 or 3 more years and I wondered if you thought we could go ahead faster than that and be ready with a demonstration plant perhaps much sooner than that?

Mr. SWIDLER. I would assume that this corporation would take over the existing research effort and that it would force the pace of research or at least make an independent determination as to whether everything was being done that should be done within the scope of a departmental budget that seems to me inevitable that compromises would have been made and that this figure does not necessarily represent the optimum research pace.

Senator Moss. Well, thank you very much, Mr. Swidler. Your statement in full, of course, will appear in the record. You skimmed over parts of it because of the time limitation, and we do appreciate your preparing such a full and definitive text as you have. It will add greatly to our record in our study and we are certainly pleased to have you appear before the committee.

(The document referred to follows:)

STATEMENT OF JOSEPH C. SWIDLER, CHAIRMAN, NEW YORK STATE PUBLIC
SERVICE COMMISSION

Mr. Chairman and members of the Committee, I am happy to be here today to testify on S. 1846. I speak both as Chairman of the New York State Public Service Commission and on behalf of the National Association of Regulatory Utility Commissioners. The Executive Committee of NARUC recently adopted a resolution supporting the major policy objectives of S. 1846, and I have been asked to present to you the Association's favorable views on the bill. A copy of the resolution, which has already been served on the membership of the Committee, is appended to my prepared remarks.

The National Association of Regulatory Utility Commissioners is a quasi-governmental non-profit organization founded in 1889. Within its membership are the governmental bodies of the fifty states engaged in the regulation of carriers and utilities. The Association's purpose is to improve the quality and effectiveness of government regulation.

INTRODUCTION

Sooner or later this nation must develop coal gasification capabilities to help satisfy its energy demands. I know of no one who argues against that proposition. Coal is the most abundant of our fossil fuel resources. Our other domestic energy resources are in relatively short supply. Burning coal creates serious environmental problems. The cleanest way to use coal, within the foreseeable future, is to convert it to gas.

The controversies that relate to coal gasification concern the proper pace of effort to develop commercial gasification processes and the institutional framework for pursuing that effort, whether by a coal gasification development corporation with federal and industry participation or some other way. My remarks today will be addressed primarily to the pace of coal gasification efforts. S. 1846 gives recognition to the need for speedy development of commercial coal gasification processes. It represents an important step beyond the announced Administration program for coal gasification. It requires some amendments. In particular, I recommend State representation on the Board of Directors of a coal gasification development corporation or on the policy advisory committees established under the legislation.

THE NEED FOR SPEED: S. 1846 COMPARED TO THE ADMINISTRATION PROGRAM

In his June 4, 1971 energy message to Congress, the President announced a doubling of the federal-industry cooperative research effort to advance coal gasification and to expand the number of pilot plants. The President proposed that the Department of the Interior's level of effort be raised to about \$20 million annually (instead of the previous level of about \$10 million per year) in cooperation with the American Gas Association, which will contribute about \$10 million annually in addition. You may recall that Secretary Morton elaborated this program in his testimony before this Committee on June 15, 1971.

In proceedings before the New York State Public Service Commission, gas distributors in New York have testified about their contributions toward this program. They have estimated variously that the \$30 million a year effort may take about 8 to 10 years to reach its goal. We have recently heard informally that the effort may take as little as 6 years.

Sections 3 and 6 of S. 1846 require the building of demonstration plants and, if warranted, full-scale commercial-size coal gasification facilities, within 6 years. We see the urgent need for commercial gasification processes within about 6 years, a need I shall discuss in some detail. While S. 1846 sets a target date and remains flexible about expenditures, the Administration program fixes a target expenditure and leaves indefinite the schedule for achieving success. Because we think the urgency of the project warrants any additional expenditures which may be required, we strongly prefer S. 1846 and its firm timing objective to the Administration's program which sets no goal for completion.

Of course, there are constraints (not excluding bad luck) that may frustrate the purposes of S. 1846. Given the promise of known possibilities for coal gasification, we think that sights should be set on a target date for establishing a commercial gasification process in light of the imminent need for coal gasification.

THE NEED FOR SPEED: THE NATIONAL PICTURE

There has been much debate about natural gas prices and natural gas reserves. I have participated in that debate. I should like to put those issues aside because I believe it is clear, whatever one may accept as to pricing and reserve parameters, that natural gas reserves will be inadequate to satisfy demand by 1980 or before.

The following table, which I have tried to make self explanatory, presents two estimates of the future demand for gas and the related volumes of gas reserves that must be found to balance the demand. The first estimate of demand adopts the 3.6% rate of growth in gas consumption estimated by the Future Gas Requirements Committee of the Denver Research Institute in 1968. The Committee's estimate of a 3.6% growth rate for gas consumption is based in turn on estimates of population expansion, new household formation, furnace conversions from other fuels, and industrial growth. The 3.6% estimated growth rate appears to me to be unduly low in the light of developments since 1968, especially the pressure of recent environmental constraints that have heightened the demand

for gas. In fact, gas consumption in 1970 was 9% above the consumption level of 1969. Accordingly, I have ventured an alternative estimate of gas consumption, which assumes an 8% growth rate in 1971, 7% in 1972, 6% in 1973, and then 5% a year. Of course, either estimate of future gas consumption levels may prove too high if gas (natural or manufactured) is unavailable to satisfy demand.

CASE I

TO SATISFY ESTIMATED U.S. GAS CONSUMPTION GAS FINDING RATES

[In trillion cubic feet]

Year	Estimated U.S. consumption		Needed to maintain reserve-consumption ratio of 10:1		
	Total	Less North American imports	Gas reserves	Finding rate	Cumulative findings
1970	22.0	21.0	1286		
1971	22.8	21.8	218		
1972	23.6	22.5	225		
1973	24.5	23.4	234	16	
1974	25.4	24.3	243	33	
1975	26.3	25.1	251	33	
1976	27.2	26.0	260	35	
1977	28.2	26.9	269	36	
1978	29.2	27.9	279	38	
1979	30.3	28.9	289	39	
1980	31.4	30.0	300	41	271
1981	32.5	31.0	310	41	
1982	33.7	32.2	322	44	
1983	34.9	33.3	333	44	
1984	36.2	34.6	346	48	
1985	37.5	35.8	358	48	
1986	38.9	37.2	372	51	
1987	40.3	38.5	385	52	
1988	41.8	39.9	399	54	
1989	43.3	41.4	414	56	
1990	44.9	42.9	429	58	
1991	46.5	44.4	444	59	
1992	48.2	46.0	460	62	
1993	49.9	47.7	477	65	
1994	51.7	49.4	494	66	
1995	53.6	51.2	512	69	
1996	55.5	53.0	530	71	
1997	57.4	54.8	548	73	
Total					1,232

CASE II

1970	22.0	21.0	1286		
1971	23.8	22.7	227		
1972	25.4	24.3	243	3	
1973	26.9	25.8	258	41	
1974	28.3	27.0	270	39	
1975	29.7	28.4	284	42	
1976	31.2	29.8	298	44	
1977	32.8	31.3	313	49	
1978	34.4	32.9	329	59	277
1979	36.1	34.5	345	51	
1980	37.9	36.2	362	53	
1981	39.8	38.0	380	56	
1982	41.8	39.9	399	59	
1983	43.9	41.9	419	62	
1984	46.1	44.0	440	65	
1985	48.4	46.2	462	68	
1986	50.8	48.5	485	72	
1987	53.3	50.9	509	75	
1988	56.0	53.5	535	80	
1989	58.8	56.2	562	83	
1990	61.7	58.9	589	86	
1991	64.8	61.9	619	92	
1992	68.0	64.9	649	95	
Total					1,274

1 Actual.

Note: Explanation of table attached.

TABLE EXPLANATION

Case I assumes consumption will increase at 3.6% annually, as predicted by the Future Gas Requirements Committee.

Case II assumes consumption will increase at 8% in 1971, 7% in 1972, 6% in 1973, and 5% annually thereafter.

North American imports are estimated at 4.5% of Total Consumption annually, the recent experience.

The 1970 reserve figure is proven reserves as estimated by the American Gas Association. For 1971 and thereafter the figures are the requirements to maintain a 10:1 reserves to production ratio. FPC engineers have estimated that reserves must be roughly ten times target production (consumption) on a national average.

The finding rates are necessary for replacing the annual production and increasing the year's reserves to stated levels.

The required cumulative findings of 271 trillion cubic feet by 1980 in Case I, and 277 trillion cubic feet by 1978 in Case II, exceed the 260 trillion cubic feet which the Potential Gas Committee estimated to be the probable future gas reserves. The total cumulative findings through 1997 in Case I or 1992 in Case II exceed all future gas reserves (probable, promising and speculative) estimated by the Committee to exist in nature within range of presently expectable technology.

Next, I estimated the natural gas to be supplied by imports from Canada and Mexico at about 4.5% of annual consumption, our recent experience. In his June 15 testimony, Secretary Morton reported that the Canadian National Energy Board has forecast that at most, Canada will be able to supply us with not more than 2.3 trillion cubic feet of gas in 1980. My estimates at the 4.5% level run somewhat below the level implied by 2.3 trillion cubic feet of imports from Canada in 1980, but this figure was stated as a maximum. In any event, the difference does not substantially affect the arithmetic of the situation.

If we assume that the remaining demand, after North American imports, were satisfied by domestic natural gas reserves, the volumes of necessary gas discoveries which are implicit in this assumption become so enormous within our lifetimes as to be unattainable. I have estimated the needed inventory of natural gas reserves each year as 10 times the volume of annual consumption. A reserves-to-production ratio of 10 to 1 is what Federal Power Commission engineers tell us is needed to maintain deliverability.

Finally, I have calculated the consequent volume of gas findings that are needed to replace production and build up the gas inventory to necessary levels. As you can see from the table, tremendous volumes of gas must soon be found each year, much more than has even been found in our prior national experience, if we are to satisfy the estimated demand for gas by the discovery of domestic natural gas reserves. Indeed, the finding rate must exceed about 40 trillion cubic feet per year by about 1980 if we are to satisfy the demand with domestic natural gas. Within the past 20 years our best finding rate was about 24.7 trillion cubic feet in 1956. Our best 5 year average finding rate was about 21 trillion cubic feet in the 1955-1959 period. The sharp and continuing expansion in domestic findings would need to take place despite progressive exhaustion of underground supplies.

Even if we were to achieve the high level of annual gas findings that are the minimum necessary if domestic natural gas resources are to satisfy the demand, the cumulative findings of gas (beyond the reserves already in our proved inventory of national reserves) would reach about 260 trillion cubic feet some time in the year 1980 or before. The Potential Gas Committee, a group of experts in the field, has estimated that about 260 trillion cubic feet of natural gas remain to be found in known fields. Another 335 trillion cubic feet are estimated for new fields in hydrocarbon provinces that now produce oil and gas. A final 632 trillion cubic feet might be found in new provinces that do not now produce hydrocarbons, according to the Committee. Thus, by 1980 we must find the equivalent of all our probable new gas reserves; by about the mid 1980's or earlier we must find the equivalent of all probable and promising natural gas reserves; and before the end of this century we would have exhausted the full probable, promising, and speculative domestic natural gas reserves which the Potential Gas Committee thinks may exist.

There may of course be more natural gas than has been estimated by the Potential Gas Committee. That Committee's estimates include offshore territory

out to 1500 feet of water depth, and within that perimeter, all drilling depths to 30,000 feet. The estimate includes the gas in Alaska, which of course is not immediately available to the contiguous states. The Potential Gas Committee's estimate does not include roughly 300 trillion cubic feet of gas that might become available by fracturing tight formations with nuclear explosions.

The U.S. Geological Survey has given a different and larger estimate of natural gas reserves at 2,370 trillion cubic feet recoverable under current technologic and economic conditions. The Survey further estimates another 4,330 trillion cubic feet of marginally economic reserves in the United States. The 2,370 trillion cubic feet estimate would enable us to meet projected demand for about a decade longer than the gas estimate of the Potential Gas Committee, if all the estimated gas were found in needed amounts. The further 4,330 trillion cubic feet would add roughly two decades. I have paraded these estimates simply to demonstrate that even the most generous estimate of potential gas reserves does not take us much beyond this century, assuming that we proceed to find all of the reserves as fast as we need them according to conservative estimates of need (demand). Obviously, we will not proceed directly to find all the estimated gas reserves, and accordingly domestic natural gas discoveries will fail to meet the demand for gas in the United States well before the end of this century. High natural gas prices may speed up the discovery of gas and will help us find relatively more of what is potentially available. However, it seems unlikely in any event that we will be relieved of the need to turn to other sources of gas, in addition to domestic natural gas reserves, long before the end of the century.

Perhaps the salient feature of the estimates of the table I have presented is the annual finding rate that is needed if we are to meet the demand for gas with the discovery of natural gas reserves. We must assume that over the years, as total reserves are depleted, it will be more and more difficult to find gas, absent some exploration breakthrough that we cannot now foresee. Given the estimated limits on our potential gas reserves, it seems unlikely to me that we can soon achieve a doubling of present finding rates or, if we succeed in doubling the finding rate, that we could long sustain such a pace. If we proceed directly to find all probable gas reserves, we may be able to meet the domestic demand for gas into the year 1980 or, assuming more likely demand estimates, the year 1978. At that point we had better be in position to rely on substantial alternative sources of gas.

THE NEED FOR SPEED: THE NEW YORK EXPERIENCE

Our experience in New York has demonstrated to us the urgent need to reach out as quickly as possible to coal gasification and the other promising ways to augment natural gas supplies. Our distributors no longer take on everyone who wants gas service. In order to meet growth needs, and even to sustain present levels of gas deliveries, the distributors in New York State and some of their pipeline suppliers have turned to alternatives such as importing liquefied natural gas from abroad and converting naphtha to gas. Our day to day experience with the gas supply situation makes us conclude that we could use coal gas right now in New York.

Gas distributors in the State of New York have imposed restrictions on gas service to new customers. Five of the large gas systems have filed tariff provisions to restrict the growth of firm gas sales. Additionally, several of the utilities have adopted policies of not taking on any new large interruptible loads. The effective tariff provisions contain policies ranging from the denial of service to consumers whose consumption level would be above a specified amount to some restrictions against the extension of mainline facilities. One gas distributor has filed a proposal (not yet effective) to deny all service, including residential, if the service were to require a mainline extension.

The Commission's awareness of the gas supply problem led it to initiate an investigation into the need for and extent of restrictions on the attachment of new gas customers and on gas promotional practices. The proceeding is presently before the Commission. The hearing examiner found that New York is suffering from a gas shortage, that tariff provisions restricting new service should be filed, and that the restrictions should recognize specified end-use priorities (favoring service first to residential users and certain other consumer categories).

Some New York utilities were recently faced with a curtailment of firm deliveries by a major gas supplier, Transcontinental Gas Pipe Line Corporation.

The 7% curtailment imposed by Transco from June 1 until July 4 of this year posed little difficulty for utilities in meeting their firm requirements because the cutback occurred during the nonheating season. The alleviation of the curtailment by Transco did not result from the discovery of new reserves to meet its demands, but rather from a one-year emergency purchase (from reserves otherwise dedicated to Texas purchasers) to provide temporary relief. Several proposals for such sales are pending before the Federal Power Commission. These temporary measures come at a high cost in which we have acquiesced out of necessity. The sale to Transco was authorized at a rate level of 33½ cents in the Texas Gulf Coast, where the FPC just a few weeks ago set a ceiling for regular new gas nearly 10 cents lower.

New York State receives most of its gas from five interstate pipelines, which in turn receive most of their supplies from the Texas Gulf Coast and South Louisiana, including related offshore areas. The gas reserves underlying the pipelines' commitments to existing and future New York consumers have diminished over the past several years. While gas production has been increasing in these producing areas, reserve discoveries have been decreasing and have been below production levels for the last three years. The immediate consequence is an erosion of reserves dedicated to existing customers and the unavailability of supplies to meet growing demands. The industry is developing methods of making efficient use of available supplies to meet firm demands, but consumers today face a virtual freeze on the volume levels available to New York gas distribution companies.

The interstate pipeline suppliers to New York are seeking alternatives to domestic natural gas supplies to meet consumer demands. Some of the pipelines are participating in gas exploration efforts in Canada. The Columbia Gas System is making advance payments to producers in Alaska, which may amount to \$200 million. Consolidated Gas Supply Corporation and the Columbia Gas System, through affiliates have applications pending before the Federal Power Commission to import substantial quantities of liquefied natural gas at Cove Point, Maryland. Additionally, the Columbia System is seeking authorization from the FPC to sell synthetic, pipeline-quality gas made from naphtha, a composition of liquid hydrocarbons. Naphtha conversion is a proven process, which has been in commercial operation for some time. Although each of these proposals has potential to augment supplies, the costs are high (roughly \$.80 to \$1.10 per Mcf of gas) and the LNG proposals depend upon foreign nations for the resources.

The distribution companies in New York have also been seeking remedies to the gas supply problem. At least two utilities, The Brooklyn Union Gas Company and the Consolidated Edison Company, are looking to imported LNG to meet their requirements. As presently contemplated, the imports would serve the system peaking requirements of Brooklyn Union and provide a source of fuel for the generation of electricity for Consolidated Edison. The New York utilities will purchase the gas from Distrigas, a company owned jointly by Algerian and United States interests, which has applied to the Federal Power Commission for permission to import LNG to Staten Island.

At its annual stockholders meeting, Brooklyn Union announced that it was making studies to evaluate the feasibility of constructing and operating a naphtha plant. In a recent rate proceeding the Company stated that it had completed its feasibility study and has a plan to construct a naphtha plant, subject to obtaining the required approvals of various regulatory bodies. Brooklyn Union's naphtha plant may rely on domestic naphtha.

A key factor in any naphtha operation is the availability of the feedstock, the most expensive single item in the ultimate cost of the synthetic gas. Actual costs will not be known until a plant is in operation, and the unit costs will vary with the amount of gas produced, but I may say that estimates for naphtha conversion plants of which we have information, range from a low of \$1.13 per Mcf for 365-day production using foreign naphtha to \$1.50 per Mcf for 180-day production using domestic naphtha, and perhaps 10% less using imported feedstock.

Brooklyn Union has had an exploration program since 1960 to examine prospects for gas reserves and storage within a reasonable distance of its franchise area. A well was drilled jointly with another party in 1964 and an independent well was drilled in 1968 in the same general area, both of which were unsuccessful. The Company is now planning additional drilling in a new location in partner-

ship with Texas Eastern Transmission Corporation, one of its interstate pipeline suppliers. Success in this area would be important for either storage or possible production.

In addition to exploration in New York State, Brooklyn Union has also been a partner in the drilling of wells, unfortunately proved to be dry, in Louisiana in a known producing area close to the pipelines of two of its suppliers. The last unsuccessful attempt was in the spring of this year. The Company has under consideration now a proposal to participate in a three-year exploration and drilling program in geographic areas which are considered as sources of supply for the New York market.

Additionally, this distributor has contracted with an established oil and gas exploration company (L.V.O. Corporation, formerly Livingston Oil Company) to promote geological and geophysical research off the east coast of the United States from Florida to Canada, which may lead to exploration and development of this potentially large and important area. The other 28 participants in this program are either pipeline companies or major oil companies, none of which has the primary interest of distributing gas to customers in highly populated east coast cities.

In a current rate proceeding before the New York Commission, Iroquois Gas Corporation (the distributor in Buffalo) has petitioned for an allowance to develop a drilling program in New York State. The company indicates that the cost of the first year's program would amount to approximately \$1 million, which would cover drilling of eight wells in two different formations and performing surveys in three major areas. I might add that this case has not yet been brought before the Commission for its decision.

Other ventures are being undertaken jointly by distribution companies and exploration companies to locate either gas reserves or underground storage formations within the State. These ventures are relatively new and, for the most part, are still in their preliminary stages.

All of these efforts by the gas distributors of New York State are on a limited scale due to the limited financial resources of the distributors. It would appear that a consortium of distributors, pooling their financial resources, would, in the long run, benefit them more than individual and uncoordinated efforts. A program such as proposed by S. 1846 is a step in that direction.

Interstate pipeline companies have recently been making substantial advance payments to natural gas producers to tie up any gas reserves the producers might find. The New York Commission was recently faced with requests by Long Island Lighting and Brooklyn Union to join with their major supplier, Transcontinental Gas Pipe Line Company, to make advance payments. Transco proposed that it would supply two-thirds of the funds and the various participating distributors the other one-third. Under the program, those distributors who agreed to contribute one-third of the advanced payments would be entitled to share in one-third of the gas found. Reluctantly, the New York Commission allowed the two companies to participate. Failure to do so might have put Transco in an unfavorable position in its attempts to compete with larger pipeline companies to secure additional supplies.

This joint venture between Transco and the gas distributors collapsed when the staff of the Federal Power Commission announced it would fight any allocation of new gas that favored those distributors which participated in the program. (The FPC staff has not announced that it would fight any allocation or certification of new gas that favored pipelines which make advance payments, although the principle seems to be the same). Transco is proceeding on its own.

The New York distributing companies, through the American Gas Association (AGA), are planning to participate with the Interior Department on coal gasification research. Initially, it is planned that the gas industry's share will be obtained by assessing member companies of the AGA a specific percentage of their profits. The companies have been advised that this would amount to approximately two-thirds of 1% of profits.

COAL GASIFICATION AND THE ALTERNATIVES

The major plausible supplements to domestic natural gas for satisfying the demand for gas into the foreseeable future are coal gasification, imported liquefied natural gas, and Canadian natural gas supplies. Naphtha conversion will also play a part. While all alternatives should be pursued, coal gasification seems the most promising to us.

Briefly stated, a substantial reliance on imported liquefied natural gas carries the risk of supply vulnerability, especially in times of international political tension. The recent experience with the mid-East and North African oil negotiations indicates the substantial possibility of price increases at the foreign sources that would add to an already high price for imported liquefied natural gas. Firm contracts do not seem to provide firm assurance. The supply and price risks of imported LNG do not run evenly across the nation. The most likely market for imported LNG will be on the East Coast and possibly the West Coast as well. If imported LNG constituted a uniform fraction of everyone's gas consumption, the relationships to total national consumption would mean that an interruption of supply might be tolerable. It seems more likely, however, that the dependence on LNG would be concentrated on the East Coast, and that the dependence could quickly grow to the point where an interruption would be disastrous for the East Coast and accordingly for the nation.

We have read reports of an enormous potential for gas reserves in the Canadian far north and in eastern Canada, onshore and offshore. It will of course take years for the discovery and development of the reserves and the building of substantial transportation facilities. Furthermore, Canada itself seems the first likely market for most of the gas. I would expect that, especially in the eastern part of Canada, new gas would displace the consumption of imported oil. Ironically, eastern Canadian gas discoveries may not reach the United States, but instead (by displacing oil imports to Eastern Canada) may increase the export of eastern Canadian oil production to mid-west oil markets. In any event, it apparently will be a long time before Canadian reserves are so substantial as to promise a massive increase in exports of natural gas to the United States.

Naphtha conversion holds promising possibilities, limited by its cost. Britain has had substantial success with naphtha conversion, and naphtha plants are in operation elsewhere in Europe. Besides the cost disadvantages, the process relies on either foreign naphtha, with the risks attendant to foreign supplies, or on domestic naphtha, the supply of which ultimately depends on the limits of U.S. oil reserves. Considering the large volumes of naphtha required, and the pressures which would be imposed on either foreign or domestic resources, I expect that naphtha conversion will play a firm but limited role in meeting the demand for gas.

By contrast, coal gasification rests on enormous supplies of domestic coal reserves. If air pollution controls further inhibit the direct burning of coal in metropolitan areas and elsewhere, coal gasification will have the advantage of helping the coal industry preserve its established place in the American economy. Because so much of our coal reserves are on federal and state lands, coal gasification will provide obvious revenue benefits to government. These advantages do not accrue at all to imported LNG and have a diluted significance for domestic naphtha.

The strongest argument for coal gasification is the potential for cost savings in serving United States' energy needs. Coal gasification holds the promise of dramatic cost advantages that sharpen the need for a nearly development of commercial gasification processes. The cost of coal gas has been estimated at about 80¢. The attained costs will depend upon coal prices, which are subject to increase. The estimate also depends upon calculated processing costs which will surely decline (at least in terms of constant dollars) when the processes have been improved and large commercial plants are in operation. By contrast, the price for imported liquefied natural gas is now over 80¢. That price reflects present shipping costs, though we know the costs of building tankers generally and for the LNG trade in particular are rising rapidly. Furthermore, the present price for LNG reflects a field price of one half of one cent per Mcf in Algeria. Surely the foreign field price will increase above one-half cent, once markets for the LNG have been established.

It seems reasonable to assume that coal gas will attain a 20¢ price advantage over LNG. If commercial coal gasification processes are established before 1980, and an average of three trillion cubic feet of coal gas is produced in the 1980's (displacing the need for importing that much liquefied natural gas), the consumers of America will save about \$6 billion during the decade of the 80's. If fifty trillion cubic feet of coal gas are manufactured in the 1980's the savings would amount to \$10 billion. Considering the size of the stakes involved, there is every reason to force the pace of research in order to bring commercial coal gasification to early realization.

Coal gasification has important collateral advantages. It would create American jobs, and would generate property taxes and other taxes for local and state governments, as well as income taxes for the Federal Government. By contrast, the importation of LNG would impose a substantial burden on our balance of trade and balance of payments. Only a portion of the profits on that trade would accrue to the American corporations which participate in the importation. Much of their profits would be taxable by foreign governments, and the foreign taxes would be creditable against U.S. income taxes. The conversion of imported naphtha to gas holds the same cost, employment, foreign trade, and tax disadvantages as importation of LNG.

STATE REPRESENTATION

I am not prepared to testify about the pros and cons of establishing a separate coal gasification development corporation, although I am prepared to say that, as it has been organized, the Federal coal gasification effort has not met its promise. If a corporation is established, I recommend that the states be accorded a place on the Board of Directors. The states are closest to the consumers, and consumers look to us when they have reason to complain. As regulators of the gas distributors, which will sell coal gas along with gas from other sources, we are aware of the rate and service problems associated with the ultimate sale of the gas. We think we have a role to play, and we hope that our presentation here today has demonstrated that to you.

RESOLUTION FAVORING ESTABLISHMENT OF A COAL GASIFICATION DEVELOPMENT CORPORATION

Whereas, The demand for gas is growing and will continue to grow for the foreseeable future; and

Whereas, Natural gas pipelines have curtailed gas deliveries to various markets and may in the near future be unable to meet their present contractual delivery obligations, let alone accommodate the growing demand for gas; and

Whereas, Government and industry efforts to increase the exploration for natural gas cannot guarantee adequate supplies of natural gas to meet demand either in the long or short run; and

Whereas, The importation of natural gas in liquified or gaseous form is costly and not entirely reliable for reasons of existing and potential international political tensions; and

Whereas, Coal is our most abundant energy resource and promising processes exist for the gasification of coal into pipeline quality gas; and

Whereas, The President has recently recommended doubling the pace of Federal and industry efforts to achieve commercial coal gasification; and

Whereas, There is a need for prompt development of commercial coal gasification processes; now, therefore, be it

Resolved, That the National Association of Regulatory Utility Commissioners hereby supports the enactment of appropriate legislation to establish a Coal Gasification Development Corporation; and be it further

Resolved, That the President or other representative of this Association is hereby requested to present testimony in favor of such legislation at any hearings thereon and that the General Counsel of this Association is hereby requested to furnish copies of this Resolution to the members of the Committee on Interior and Insular Affairs of the United States Senate.

Adopted by the Executive Committee of the Association on July 8, 1971.

Senator Moss. I regret the noon hour came upon us and my colleagues didn't remain. I assume they would have additional questions to ask you.

I could think of many more, too. Your statement is clear and I am certainly pleased that you came to give us the benefit of your experience based upon your present position in New York, and also with the National Association of Commissioners.

We are in recess now until 2 o'clock, and we will resume our hearings then.

(Whereupon, at 12:25 p.m., the hearing was recessed, to reconvene at 2 p.m. this same day.)

AFTERNOON SESSION

Senator Moss. The hearing on S. 1846 will be resumed.

Our next witness is Prof. E. J. Hoffman, of the College of Engineering, University of Wyoming.

We are very glad to have you, Professor Hoffman. We heard several Wyoming witnesses already. We look forward to hearing from you.

**STATEMENT OF PROF. E. J. HOFFMAN, COLLEGE OF ENGINEERING,
UNIVERSITY OF WYOMING**

Mr. HOFFMAN. Thank you, Mr. Chairman. We almost constitute a quorum.

Senator Moss. Very good.

Mr. HOFFMAN. First I would like to amplify some of my remarks that I have submitted to you in the formal presentation.

Senator Moss. All right.

Mr. HOFFMAN. I would like to point out, first of all, that the very fact that it has been necessary for the Federal Government to initiate a coal gasification corporation or other means to promote the synthetic fuels industry, I feel that this means that the private sector, the private fuels industry, has abdicated its responsibilities in this area.

I feel that it is possible that the long-range consequences could lead to a nationalization of the fuels industry. Now, the reason or reasons that the private sector has not lived up to its responsibilities may be related to the need of an energy policy at the national level. It may be through fear of antitrust complications, I don't know.

I think these are matters that need to be looked into. Now, the present thinking in this endeavor is that a joint effort could be created between private industry and the Government. Now, this may work very well for the gas segment of the fuel industry, but if I might dwell briefly, we ordinarily consider that the gaseous fuels is broken up into three parts. The gas distributing companies which sell directly to the consumer; there are the gas transmission companies from which the distributing companies purchase their gas; in turn, these gas transmission companies buy from the major or independent oil and gas producers.

Now, the transmission industry and the distributing industry are subject to Government regulation and they are—well, they will not be too inhibited about a joint venture with the Government, but the independent and major oil and gas producing companies ordinarily shy or try to stay clear of Government regulation and they constitute by far the bulk of the capital outlay in the fuels industry, so we may miss out on an important segment here by their reluctance to enter into an agreement with the Government.

They are also concerned that any Government enterprise will make all information proprietary. This is one reason that the oil and gas companies are not anxious to enter into an agreement with the Government.

I should also like to add that in my opinion overreliance on any particular process should be avoided. That is, any process for gas synthesis, gasification of coal, is not at a state of technology where it can be relied upon. We are still in an early stage so it would behoove us to show as much imagination as action at this time and consider in detail alternate ways for this coal gasification.

Finally, there still remains the problem of plant investment capital. We are talking about a multibillion-dollar industry. There may eventually be required nearly 200 synthetic fuels gasification plants, and each of these might cost several hundred million dollars.

The question is: Where is this capital going to come from? This is a new high-risk industry and the question will be: Will this money come from the Government or will it come from the private sector?

In connection with the private sector, I would like to mention that if private investment were encouraged by tax incentives or as yet undeveloped concepts, the traditional inventiveness and enthusiasm of private enterprise might yet be brought to bear on this problem.

Thank you.

Senator Moss. Well, thank you very much Professor Hoffman.

In saying that there has been an abdication by industry, is that because of the high-risk factor? They just haven't been willing to go ahead and spend the money?

Mr. HOFFMAN. Well, there are a number of factors. One is that the oil and gas industry, for instance, traditionally thinks in terms of these materials. When you start talking about conversion of a solid such as coal, sort of a paralysis sets in. They don't like to think about this. But they are going to have to.

I think another item to consider is the terrific cost of developing this new fuels industry and how it might tie in with the existing oil and gas industry as it stands.

This is, of course, the gas part of it is subjected to Federal regulation which effectively sets the price and they would hate to make a large commitment to coal gasification, say, when the gas price might be—the props might be taken out from underneath them.

Senator Moss. Would you think the fact that they would be developing a competing fuel take some of the enthusiasm out of the other sources of energy, such as petroleum and companies that work in that field?

Mr. HOFFMAN. In principle, it is the same fuel. In the case of gas, methane is the principal constituent of natural gas as well as the synthetic gas, but it is in a sense a replacement industry. They will not be generating really any new markets when they develop a synthetic fuels industry. They will just be replacing the natural gas producing industry, so to speak.

Ordinarily, when a company puts out new capital, it likes to think it is generating a whole new line of business. Here they will just be replacing their source of natural gas.

Senator Moss. I assume you heard Mr. Freeman testify. He said there would be 2 to 3 years more of pilot plant experiments needed before a demonstration plant could be built.

Do you think that that is a realistic length of time?

Mr. HOFFMAN. If these pilot plants are successful. I would say so. It is sometimes hard to distinguish when a pilot plant operation is successful.

In my opinion, the demonstration plant that follows will also be an experimental unit.

Senator Moss. Do you think the experiments in pilot plants have not reached the point yet where we could start building now a regular demonstration plant full scale?

Mr. HOFFMAN. That is right. This brings up a contention of mine. There seems to be a communications gap in many of these companies between the middle-level management people and the ones at the very top. Top management, for instance, sometimes think they can go out tomorrow and contract for the construction of a synthetic fuels plant. This is simply not so. They think that once the crisis is developed, all they have to do is go out and see an engineering contractor and get a coal gasification plant built. This is not so. The technology is not there yet.

There are certainly ways to convert coal to gas, but what we need is the most efficient, the most economic, or as the theorist would say, the most elegant way to convert coal to gas. If we use the old method, Wyoming would be covered with coal gasification plants.

Senator Moss. Do you then see any advantage to going to this corporation that is to be composed of Federal and private industry representatives rather than retaining the present experimental R. & D. work that is going on in the Department?

Mr. HOFFMAN. I am neutral on the creation of this coal gasification development corporation. I can see the pros and cons. However, the present program in coal gasification development is not strong enough, not urgent enough, and I think this certainly needs to be supplemented.

My own feelings are that private industry should be encouraged to enter this picture more strongly than they have been so far. In other words, there are some of us that like the security of working for someone else. Others like to be entrepreneurs.

Senator Moss. Thank you, Professor Hoffman.

Senator Hansen is here and he is another Wyoming man, so we will see if he would have any questions.

Senator HANSEN. Thank you, Mr. Chairman.

I am delighted to here and to be permitted to hear my good friend, Dr. Hoffman, testify before this committee on this very important subject. I know I need not apprise the committee of his background. It is a varied one that represents a broad spectrum of the industry.

He is a highly competent and highly regarded scientist and has contributed much to a better understanding of the whole field of supplying energy. I have read his statement ahead of his delivering it and know what he had prepared.

I must say that I find myself in very strong agreement with him of the points he makes. I share his feeling that it is unfortunate that we haven't had present the combination of circumstances which would have given, I think, the necessary encouragement to industry to move forward in this field. We may not agree precisely on all the points, but essentially it seems to me that insofar as my thinking goes that the incentives must be largely economic. There aren't very many businesses

in this country that are going to go out and put their dollars into experimentation work unless they have good reason to believe that there will be an economic return.

I suggest that that is probably the one main reason that we haven't seen industry participate to a greater degree than has been the case.

I would like to ask you: Do you share that feeling?

Mr. HOFFMAN. Yes.

Senator HANSEN. Do you think it may also be concluded that one of the ways that that incentive would have been presented in a more meaningful fashion to the industry would have been for the price of gas in this country to have been priced more realistically—that is, with respect to supply and demand rather than by the arbitrary pricing mechanism that resulted from FPC regulation?

Mr. HOFFMAN. That is so. I heard the company representative state that even if the price moves up now, there will be much more incentive for them to go into synthetic fuels in the coal gasification. The majors, for instance, as has been brought out before, have long considered gas as just a byproduct of their operations.

In fact, for the majors I think it comprises less than 4 percent of their dollar volume of business. But if this price were to go up, I believe that private industry indeed would be encouraged into this area.

Senator HANSEN. Is it your feeling that because of the lateness of the hour and because of the acuteness of the impending emergency that it might be indicated to take steps we would normally not want to take if other factors were more in a proper relationship one with another?

Mr. HOFFMAN. Yes, sir; I think that we have a crisis situation staring us in the face, and that it almost has reached the level of our considerations even for national defense.

Senator HANSEN. As a member of the Interior Committee, it has been my pleasure to work with our distinguished chairman and with the distinguished chairman of the subcommittee on a number of subjects. Though I certainly don't presume to speak for him, I can say that in many areas of concern I find my thinking and his not contradictory, but with respect to a specific point of view, I would like to ask you: Do you share my view that to increase the depletion allowance on coal might be one way in which Government could give greater incentive and encouragement to technology breakthroughs that could result, as you so aptly put it, in finding the best way by which natural—by which gas could be produced from coal?

Mr. HOFFMAN. I think so. This falls into this classification of tax incentives and other devices which would stimulate the private sector for interest in this activity.

Senator HANSEN. I have introduced a bill to bring about that result. I also an sponsor of a bill which would permit a rapid write-off of the investment in plant and processes which would bring about the gasification of coal and the production of oil from oil shale.

I know that the distinguished chairman of the subcommittee has a real interest in oil shale. It occurred to me that this may be another mechanism by which we could give encouragement.

Do you share enthusiasm for that approach?

Mr. HOFFMAN. That is correct. I think this is another technique for encouraging private capital.

Senator HANSEN. I know of your great interest in the resources of the West because of your presence on the University of Wyoming campus now, and I would simply like to underscore, Mr. Chairman, if I could, Dr. Hoffman's statement wherein he says: "Another factor, in my opinion, is that over-reliance should not be made on any given processes."

Do I infer correctly what you are saying there is that if the ingenuity of the mind of mine, backed up with dollars supplied by industry on the one hand and possibly Government on the other, could be turned loose and free, we might explore simultaneously several different approaches to a solution of this problem and find one mechanism, one way of doing it that could be better than any of the others?

Mr. HOFFMAN. That is correct. I think what is needed is a breakthrough. Private enterprise traditionally supplied this imagination and drive to produce such breakthroughs.

Senator HANSEN. Well, I don't think I have any further questions, Mr. Chairman.

I do want to compliment you again for your leadership in recognizing the seriousness of a problem before many people have in this country. As a matter of fact, it is distressing to me even today to read statements by some people that they are glad to know about the energy discoveries that have been made in this country. I heard this said with reference to the oil discoveries on the North Slope up in Alaska. Now that we know where they are, their suggestion is that we cap them and 50 years from now if it should develop that this country needs them, we will know where to go to get them.

This bothers me because I recall what you said many times and what the chairman of the full committee said earlier today when he observed that we do have a serious problem in this country. A number of problems.

One of them certainly is the deterioration of the quality of our environment. If we are going to clean up that mess, and many people would characterize it as nothing less than a mess, it will take a lot of energy. It will take a lot of power to make this country as clean as we would like it.

It is not a case of simply shutting down powerplants and stopping trains and halting cars. It is trying to keep people living. They tell me if you stand on top the Empire State Building—the chairman and I were in New York City a couple of weeks ago looking over a proposal to expand recreational opportunities for those persons living there—some 1.2 million of the families in the view radius from there don't even own an automobile. If we are going to take care of the people in that area and I am told there are some 25 million people living within the periphery of your horizon from the top of the Empire State Building—if we are going to keep those people active and alive and healthy, we are going to require more, not less, power. We are going to require better, speedier transportation, not less. We are going to have to do everything more efficiently and in a cleaner fashion than we have been doing it in the past.

I think that despite the smug self-assurance that some people find might be the situation as they look at it through their euphoric glasses, it occurs to me that the real problem is to meet this crisis.

I think you made a very significant contribution in spelling out some steps that we should keep in mind.

Again, Mr. Chairman, let me compliment you on your leadership.

Mr. HOFFMAN. In this connection, I would like to add, Senator Hansen, that much of our waste is organic materials which are carbonaceous, just like coal is, and can be gasified in the same fashion that coal is. This is a spin-off from coal conversion.

Senator HANSEN. A very important point.

Senator MOSS. A very good point to make.

Thank you very much for your testimony. We appreciate it.

Our next witness is Mr. James Garvey, executive vice president of the National Coal Association, and president of the Bituminous Coal Research, Inc.

Needless to say, we are most happy to have you here.

STATEMENT OF JAMES R. GARVEY, EXECUTIVE VICE PRESIDENT, NATIONAL COAL ASSOCIATION; AND PRESIDENT, BITUMINOUS COAL RESEARCH, INC.

Mr. GARVEY. Thank you. As you pointed out, I am executive vice president of the National Coal Association which has offices here in Washington, D.C. I am also president and director of the research of NCA's research affiliate, Bituminous Coal Research, Inc., which is located at Monroeville, Pa.

I have been associated with coal research activities for the past 25 years, and as a result of this I hope I can contribute to this committee's consideration of the proposed "action program" for joint participation by industry and Government to develop the technology for using the Nation's vast coal reserves to supplement our rapidly dwindling supplies of natural gas.

In opening my remarks, I want to congratulate Senator Jackson on the excellent statement he made in introducing S. 1846 on May 12, 1971, wherein he very clearly described the need for greater interest on the part of the Federal Government in developing the best uses of all energy forms. For too long that interest has disproportionately favored the development of atomic power and has, for the most part, ignored our total resources and uses of energy producing fuels.

Energy policy of the past—perhaps I should refer to the lack of energy policy—has resulted in Federal Government research expenditures of billions of dollars on atomic power development, contrasted with only a few hundred million dollars on fossil fuel research. The fallaciousness of this disparity is apparent when we consider that from atomic fuel we can only produce electricity. But electricity cannot operate our transportation vehicles, displace all our oil and gas heating, nor substitute for fossil fuels in our many industrial processes.

The cold fact is that in 1970, of the 57.3 trillion B.t.u.'s consumed in the United States, only 5.2 trillion or 9.1 percent was in the form of electricity. We do not question the development of atomic power, although we have some strong reservations about the overpromotion of the use of light-water reactors which portends to consume most of our low-cost atomic fuel before the breeder reactor is developed and thereby deprive the Nation for decades of the real value of atomic power.

In listening to the discussion this morning, I would like to add that the coal industry was way out in front of the regulatory agency with regard to the waste of natural gas years ago. We always opposed this feeling was a waste of a natural resource.

In March of 1967, I testified before the Appropriations Committee regarding the Office of Coal Research appropriations and predicted if we continue at the same rate of utilization of gas and projected growth at that time, which was about 6 percent, we would run out of gas before the year 2,000, and therefore we should get humping on coal research conversion to gas.

We, in the coal industry, are in favor of realistic atomic research to develop the highly efficient breeder reactor because the projection for growth in energy demand is so great that all potential sources of producing energy in a usable form at maximum efficiency should be pursued. But we should not, however, be so enamored with what may appear to be a new glamour fuel that we overlook the fact that this new fuel cannot now, nor in the future, displace the hydrocarbon fuel—coal, oil, and gas—which, even excluding their use for electric generation, supply 91 percent of our energy demands.

The United States is fortunate to be blessed with an abundance of fuel resources in the form of coal. The 1,605 billion tons of recoverable coal estimated by the U.S. Geological Survey constitute 74 percent of the total ultimately recoverable fuels of our Nation; and, unlike atomic fuel, coal can be converted to meet our energy needs in all forms—it is not limited to the production of electricity.

Coal cannot only be used directly to produce electricity, but can also, with further improvements in existing technology, be converted to synthetic liquids and gases, the nonelectric energy forms so much needed by our Nation. Our national energy policy and the research and development programs which spring therefrom should not therefore be so myopic and restricted to one fuel, but should consider the reserves and uses of all fuels and strive to perfect the technology for the most effective use of each of them.

The most immediate energy concern is the supply and demand for natural gas, a concern which has been well documented in projections made by officials of the Bureau of Mines and the gas industry, and many of the witnesses who appeared this morning to testify.

There is not only a short-range shortage of productive capacity in the natural gas industry, but also for the long-range, the total resources of this clean and versatile fuel may be exhausted by the end of this century.

Commercial development of the technology which will enable coal to be converted to a synthetic pipeline gas is therefore essential to meet our future energy demands for this fuel form. To achieve this goal a major effort must be made in two areas.

One, the coal-to-gas research projects currently underway by several organizations, with sponsorship by Department of the Interior, must be expedited. These projects, each of which embodies a different approach to the development of a commercial process, are all now either in or approaching the pilot scale research stage.

Two, planning should be done now for incorporating the most promising results from this pilot stage research in full scale demonstration plants to finalize commercial feasibility.

It is the latter step—erection and operation of demonstration plants to which I believe S. 1846 is directed. But to avoid any misunderstanding and possible duplication of effort, I feel it pertinent to bring to this committee's attention the need for a definition of what constitutes a demonstration plant as distinguished from a pilot plant. For the committee's consideration, I suggest the following definition:

A demonstration plant is one which incorporates all steps in the process chain in sufficient size that subsequent plants of greater capacity can be designed and erected. Further, the demonstration plant must produce a product in such quality and quantity that it is salable to commercial users in the same manner, although in possibly lesser quantity, as any subsequently built commercial plant. In short, the plant will truly demonstrate the process feasibility sufficiently for extrapolation to any size.

Under the foregoing definition, it is logical for industry and government to join in financing the erection and operation of such plants. On one hand, the risk is so great that, as Senator Jackson pointed out in his May 12, 1971, statement:

The development of a technology for coal gasification presents a financing problem that is becoming increasingly common in the energy field. Stated simply, research and development must be carried on at such large scale and at such enormous costs that it is impossible for any single company, even large energy or utility companies, to assume the risks involved within the limitations upon management practices and financial capabilities.

On the other hand, the possibility that a commercially salable product can be produced to offset the experimental costs is an incentive for inducing industry participation. To my knowledge, this was the effective procedure followed in the development of commercial atomic powerplants. The Federal Government subsidized the financing of the initial plants and the utilities realized a return on their share of the cost through the sale of electricity.

The research on coal gasification has not as yet reached the point where an installation meeting the suggested definition of a demonstration plant is possible. But through the efforts—I might add under-financed efforts—of the Department of the Interior substantial advances have been made.

Coal gasification processes currently under development and sponsored by Interior are in the pilot plant stage of research, an essential stage of development which must precede demonstration plants. But the rate of effort is such that we are at least two and perhaps as much as five years away from a demonstration plant.

However, it is wise to plan now for a joint industry-government demonstration plant program. The coal industry therefore endorses the principle of a Government plan such as the proposed "Coal Gasification Development Corporation" to accomplish this. But we hope that in establishing such a plan, careful consideration will be given to the ongoing work of the Department of the Interior and the plans and commitments already made by the Department for the future.

Unless this work is continued, there is grave danger that much of the effort already put in gasification work will be lost. With the supply of natural gas rapidly diminishing, we can ill afford any interruption in gasification research.

Thank you, sir.

Senator Moss. Thank you, Mr. Garvey.

Do you agree with Mr. Freeman that a demonstration plant couldn't come for two or three more years as yet, because the pilot plants have that much longer to be worked on?

Mr. GARVEY. Yes, sir; I would say the minimum is 2 years, and it may be as much as 5 before all of the processes, and there are six or seven—I won't go into the details, but you are aware how many are under development. Before some of these will reach the point—it is five years before we will have enough data. It might go faster.

Senator Moss. Based on that, would you feel the proposal in this bill that the corporation to be formed of only 6 years of life is too short?

Mr. GARVEY. I would say it is premature to set up the corporation with that short a life because you will probably run out of—not be able to—you will run out of time before you will construct the plants. I don't think the basic information will be available that soon.

Senator Moss. How much of a target date or how much of an urgency point ought to be put in front of this new corporation to make sure that it moves with the maximum degree of speed?

Mr. GARVEY. I don't see how anyone with the present degree of knowledge can set a date. I am talking as a technical man now. Realizing what the state of the technology is at the present time. I think it should be so phrased or so worded that the utmost urgency is stressed, to do this just as fast as is possible, and to be financed to the degree necessary to move as fast as is possible.

Senator Moss. Do you think the announced increase of funding, R. & D. funding, in the Department of Interior is enough of a crash program to accelerate this development process we are talking of?

Mr. GARVEY. From what I know of it, and I don't know all the details, I believe Mr. Clay, representing the American Gas Association, will present these tomorrow, but I feel that this initial step is sufficient, the funding is sufficient. Whether it will be saying the same thing a year from now, or 18 months from now, I don't know.

Whatever the organization set up to administer this, in having a board or some kind of advisory committee or advisory group combining industry talent and government talent, it should be up to them to determine whether the rate of progress is sufficient, are they moving fast enough, do they have enough funding, and report back to the Congress periodically as is required in the proposed act.

Senator Moss. Does the coal industry look upon oil shale as a competitor in the energy market?

Mr. GARVEY. No, sir. At the present time, as I said in my statement, we don't believe that the breeder reactor research or oil shale or anything else will be a competitor in the sense that we won't be able to find our place. There will be a competition for the market, the energy market on the basis of cost, but the demand for energy will be so great that there will be a great deal of incentive for all fuel industries and all fuel producers to do their utmost to reduce the cost and produce as much as they can as efficiently as they can.

Senator Moss. The technology that would apply to coal gasification would not be applicable to oil shale, I would expect, not being a technical man myself, but would there be any objection to having a similar type of corporation created for shale in order to move it along?

Mr. GARVEY. I see no reason why we shouldn't explore this as our second largest potential source of fuel after coal in this country.

Senator Moss. Well now, if this accelerated R. & D. work goes on within Interior, would it be an overlapping or conflicting thing in any way to have this corporation also set up to accelerate gasification?

Mr. GARVEY. Our greatest reservation on setting up this corporation now ties in with the testimony we presented in connection with Senate Resolution 45 on the National Energy Policy. One of the reasons we feel we need a national energy policy is that we right now have too many agencies dealing with energy problems. This has created problems for the coal industry as well as for other industries, and we heard from some of them this morning. We would suggest not that this be completely closed off as a possibility, but that the other approaches such as the combining of various agencies into the National Resource Department—I must say I am in agreement with what Mr. Freeman said this morning—to see if this would not enable the accomplishment of the same thing without creating another agency which would be new and would have to be staffed and financed and so on.

I, like he, feel this thing might be kind of out in limbo and there might be a better way of doing it. Certainly we have seen the result of this proposal. I feel this has expedited the actions by the administration in getting this program started that they have which was described by Mr. Freeman this morning. I think Congress would be wise to continue this type of thing to see what is the best way to bring commercial gasification processes to fruition.

Senator Moss. President Carl Bagge, in his speech to the American Bar, called coal-oil shale the only near term hope of adequate energy supplies.

Is the fact that it will take 2 to 5 years yet in pilot work still within the near term description?

Mr. GARVEY. As far as the development of our indigenous fuel resources, I think we would have to describe it that way. It will be closer than, say, the breeder reactor as far as we can determine. This is certainly somewhere in the late 1980's before the first commercial breeder will be available. We can't depend on the current light-water reactors to supply our demands for the future. We may not have enough uranium to do that.

We feel the development of these two fuels, coal and oil shale, offers the opportunities to supplement the existing supplies of oil and natural gas.

I think it shouldn't be overlooked that our oil situation is very nearly as critical as our gas situation.

Senator Moss. Thank you, Mr. Garvey.

Senator Hansen?

Senator HANSEN. I don't think I have any questions, Mr. Chairman.

I want to compliment Mr. Garvey on his excellent statement. I think it is obvious that he understands the acuteness of the problem and I certainly think his advice deserves serious consideration and reflection. Thank you very much.

Mr. GARVEY. Thank you.

Senator Moss. We do thank you very much, Mr. Garvey.

Mr. William E. Lloyd of the National Wildlife Federation. I believe he will be accompanied by Mr. Pickelner.

**STATEMENT OF JOEL M. PICKELNER, NATIONAL WILDLIFE
FEDERATION; ACCOMPANIED BY WILLIAM E. LLOYD**

Mr. PICKELNER. There was a slight mistake in the witness list. I am employed by the National Wildlife Federation. Mr. Lloyd is accompanying me.

Senator MOSS. All right. We will have Mr. Pickelner speak on behalf of the Wildlife Federation, and then Mr. Lloyd. You are separate. You each have a statement. All right, who wants to go first?

Mr. PICKELNER. I will start off first.

Mr. Chairman, I am Joel M. Pickelner, legislative information specialist for the National Wildlife Federation which has its national headquarters at 1412 16th Street, NW., here in Washington, D.C. I am accompanied by Mr. William E. Lloyd.

Ours is a private organization which seeks to attain conservation goals through educational means. Affiliates of the National Wildlife Federation are located in all 50 States and the Virgin Islands. These affiliates, in turn, are made up of local groups and individuals who, when combined with associate members and other supporters of the Federation, number an estimated 3 million persons.

We welcome the invitation and opportunity to comment upon coal gasification.

The National Wildlife Federation long has been concerned with protection and enhancement of the environment. We are, therefore, limiting our comments to the potential environmental impacts of coal gasification.

As far as the general idea of extracting methane gas from coal is concerned, we support it since it will produce a cleaner burning fuel than the various hydrocarbons now being used. In addition, gas produced by this method can be transported and possibly produced with less environmental degradation. We are, however, deeply concerned with the effect that the processes proposed so far will have on the environment around the plant. In this vein, we would like to suggest that when S. 1846 is considered by this committee that it be amended to contain adequate environmental safeguards in the production of this gas.

First of all, we suggest that section 3 be amended to require the Coal Gasification Development Corp. to look into environmental considerations in addition to economic and technical considerations when determining the feasibility of the process. More often than not, in the past the most economically and technically feasible method has also been the dirtiest. In this sense, we could be doing little more than trading off one pollution for another. We could be helping to clean up our cities and urban areas with a cleaner fuel while proceeding to pollute the relatively pollution-free areas where the coal for these processes would be found. In order to prevent this from happening, strict environmental controls must be placed upon any process tested or deemed commercially feasible.

In addition to environmental considerations, the bill should be amended to allow for citizen access and input opportunity to the plans being studied by the corporation. These are vast numbers of individuals and organizations which are concerned both about the

energy and environmental crises now facing the Nation. A number of these people and groups have knowledge and skills which could be put to valuable use by the corporation in seeking the most feasible method. In order to tap this knowledge, the public must have access to the information being considered and must at least have an opportunity to have their suggestions heard.

In order to clarify S. 1846 as far as the National Environmental Policy Act is concerned, it would be helpful if it contained a clause requiring that the corporation comply with the act, particularly the filing of an environmental impact statement under section 102(2)(c). This would insure that the environmental considerations are covered.

As Mr. Freeman said earlier this morning, I am sure they had every intention of complying with the act.

In addition to air and water pollution, it must be assumed that these plants will be using coal that has been strip mined. Strip mining has long been a problem but has only recently come to the forefront.

Vast areas of land in a number of sections of this Nation have been ripped apart and now remain as eyesores on the face of the earth. Strip mines are obviously an economical and necessary method for mining certain grades of coal, but in order to prevent the environmental degradation that accompanies a strip mine, the operators of the mine should be required on a day-by-day basis to rehabilitate the land and return it to its original state or an acceptable alternative.

Mr. William F. Lloyd will now go into some of the more technical aspects of the pollution inherent in the coal gasification processes. Mr. Lloyd is a chemical engineer now working as a patent attorney in the Washington area. He has recently worked with the National Wildlife Federation in evaluating the pollution prospects of the various coal gasification processes.

Thank you for the opportunity of making these remarks.

Senator Moss. Thank you.

We will hear Mr. Lloyd, and then if we have questions we will ask them of either one of you.

Go ahead.

Mr. LLOYD. My name is William F. Lloyd. I am a practicing patent attorney in the Washington area.

In my work with the National Wildlife Federation, I have conducted a study of the environmental impact of the coal gasification processes available.

The National Wildlife Federation would like to suggest that some amendments be made to S. 1846 to reflect an interest in insuring that the coal gasification processes studied, and eventually the processes utilized are not detrimental to the environment. Coal gasification is inherently a dirty process. Large amounts of both particulate and gaseous pollutants are byproducts of the process. Thermal pollution, as well, is quite significant. Coal may contain up to about 20 percent ash and 5 percent sulfur, both of which are detrimental to the environment.

Thus, we would suggest that the present bill be amended to reflect a desire to alleviate such problems by requiring that all processes studied and/or utilized, be designed to at least meet all Federal and/or

State air and water quality standards. Preferably, we would hope that the processes be designed so that advantage is taken of the latest technology in these areas, and particularly with respect to fly ash and hydrogen sulfide removal and treatment.

Hydrogen sulfide may be converted to either sulfuric acid or elemental sulfur by known economic processes, but such processes also present pollution problems. One of the most significant of these is the emission of a mist containing oxides of sulfur. When such mists are emitted in an area having particulate pollution, the oxides are absorbed into the surface of the particles and in the presence of moisture, even atmospheric moisture, the particles seem to enhance the tendency of the oxide and water to react and produce, at least, some sulfuric acid, thereby producing what could be called a sulfuric acid rain, when the moisture falls to earth. Thus, control of sulfur containing materials is of great importance to the environment.

Fly ash, as can be seen from the above, must be removed when the sulfur content of the coal is to be treated at the gasification site. While fly ash may be useful, for example, for inclusion in cinderblocks, this may not be economical.

One alternative, proposed previously, is to return the recovered ash to the mine or mines supplying the fuel for deposition in worked out seams or sections. This is in line with our thinking, since a large amount of the coal supplied to such a plant would possibly come from strip mining and we are strongly of the opinion that strip mines should be required to return the worked out land to its original condition or to repair the damage produced by the mining operation in some other manner.

In light of this, we would suggest that amendments regarding the environmental policy of the proposed corporation also indicate a desire to have the corporation consider the source of the fuel in determining the processes to be developed, and, in particular, to minimize environmental damage that may be caused by the mining operations.

From the data currently available to us, the following commentary appears appropriate as to the general subject of coal gasification, as well as to the specific processes presently being studied. These comments are limited to the environmental effects of these processes, without considering the economics thereof as considerably more data would be necessary to complete definitive economic studies.

Each process for coal gasification presents distinct problems relating to the environment. However, there is a common thread that links all of these problems. All of the processes inherently produce sulfur containing compounds, ash, and slag. The coals utilized in the studies made available to us contained up to 4.5 percent sulfur and up to 19.5 percent ash. These pollutants can in no way be ignored in view of their detrimental effects. Also, all of the processes require the use of high temperatures at some point, and thus care should be taken to avoid thermal pollution.

Sulfur is often emitted in the form of hydrogen sulfide which may be converted to either elemental sulfur or sulfuric acid, by way of the production of oxides of sulfide, and sold on the open market. Where sulfur oxides are emitted, the hydrogen sulfide to sulfur oxide step is eliminated but the other considerations remain the same.

The use of coal containing 4.5 percent sulfur would result in significant emissions in all of the processes, even those where most of the sulfur remains trapped in the slag and ash refuse.

Further, the nickel catalyst utilized in the methanation step of the processes is poisoned by hydrogen sulfide. Thus, it appears imperative to include provisions for hydrogen sulfide removal and treatment in any nickel catalyst using process to be studied. Several methods for such action are available, including cold methanol scrubbing and hot carbonate scrubbing.

However, at present we have not seen any suggestion that the coal gasification processes adapt a magnesium dioxide system, as used by the electric power industry. Such a system has a net negative cost when considered in the overall picture, and should be easily adapted to coal gasification processes.

When it is desired to produce either sulfur or sulfuric acids from the hydrogen sulfide, one step is the production of sulfur oxides; for example, the Claus process and the numerous variations thereon that are currently available.

These oxides easily form a mist when absorbed in solvents, and this mist must be controlled or the effluent oxides may unite with atmospheric moisture to form acids. This reaction, further, seems to be promoted by the presence of particulate pollutants such as ash, and is, of course, enlarged in rainy areas. Thus, effective means of control of sulfur oxide emissions appears imperative.

A classic example of the effects of allowing emission of sulfur containing compounds occurred in Copperhill, Tenn., during or shortly after World War I where an area quite a few miles in diameter surrounding the plant was completely denuded of foliage by these pollutants, when a plant was allowed to operate without adequate controls.

Fly ash presents another problem. Some of the processes do not present significant problems of ash emissions, while others do. In any event, if a coal containing 19.5 percent ash is used, the resultant possibility of fly ash emission should be considered, and its collection and disposal should thus be a factor in the design of each of the processes.

If, for example, a plant is constructed to utilize 2,000-tons-per-day of coal, it is conceivable that up to 300-tons-per-day of fly ash could be released into the atmosphere if no controls are used.

At present, it appears that particulate matter may be efficiently removed from gaseous effluents in most processes by, for example, a combination of a high-efficiency or multiple cyclones followed by a fabric filter. We would strongly recommend that a system such as this be included in processes where such emissions could occur, and that this be a part of the economic evaluation of the overall process.

Economically, the best location for the plants may well be near the coal source, since pipeline shipment of gas in large quantities may be cheaper than shipping of coal by rail in the same relatively large quantities. Thus, we would suggest that both ash and slag refuse be dumped in worked-out areas of the mines supplying coal for the process.

In particular, since low grade coals may be utilized and strip mines may provide large percentages of the supply, the solid waste presents a good source of material to rehabilitate the mined-out areas. This is of

major concern to us since the destruction of useful uninhabited land is not something that our present society can readily stand. Therefore, as to solid waste, we feel that provisions for plant siting where the solid waste may be usefully utilized is of great importance.

Lastly, the atmosphere is capable of disposing of small amounts of pollutants itself, and the building of very large plants presents problems as to the possibility of pollution no matter how well the processes are regulated. Even a relatively clean plant may produce unacceptable amounts of pollution.

Thus, we would suggest that serious consideration be given to the location of the plants and that studies be conducted and made public concerning the ability of the atmosphere in the vicinity of the proposed plant to absorb the amounts and types of pollutants which may be emitted by the plant.

While smaller plants may not be as economical as large ones, there is no reason to overburden one given area to a point where the environment is ruined. Therefore, it is felt that emphasis should be placed on providing economical clean small plants, as opposed to a single gigantic unit.

These, we feel, are the generic considerations as to the interplay between the environment and coal gasification processes. As to the specific processes, some comments—which are attached to the written statement—based on available data, appear pertinent. No attempts were made to evaluate the processes themselves as opposed to environmental considerations, as significantly more data than was available to us would be required to do so and our concern is the environmental impact of the processes.

Thank you for the invitation to appear and make these remarks. We would be glad to answer any questions that you may have.

Senator Moss. Thank you very much, Mr. Lloyd.

The attachments will, of course, appear in the record following your statement. We are pleased to have them.

(The documents referred to follows:)

CARBON DIOXIDE ACCEPTOR PROCESS CONSOLIDATION COAL

The carbon dioxide acceptor process is by far the dirtiest of those that we obtained information about. The process produces sulfur oxides which may be emitted to the atmosphere for direct production of the above acid rain, as well as having the ash and slag problems discussed with relation to all of the processes. Further, the carbon dioxide acceptor process is not, at present, useful for all types of coal, but must use lignite.

In the coal crushing and drying portion of this process, there are three points where venting to stacks is utilized. All of these appear to be directly from cyclone separators. These separators, while quite effective for particulate material of sizes greater than about 2 or 3 microns, lose much of their efficiency when used to separate smaller particles. These crushing and drying operations would produce significant amounts of coal fines below 2 microns, and a multiple cyclone system will probably remove 70% of the 2 micron particles but significantly less of the smaller particles. Therefore, we would recommend that further filtration, for example, fabric filters, be added at this point.

Also, some of the smaller particle size coal is burned to preheat gases for drying and other purposes. The ash produced from these furnaces should be disposed of in a manner that does not create environmental problems.

In the gasification steps, provision is made at two points for dumping ash in ponds. This merely provides an unsightly contaminant producing mess, and provision should preferably be made for more useful disposition of this waste. Fur-

ther, water from the devolatilizer step spray tower is to be disposed of, and provision should be made for removal of contaminants, such as sulfur compounds, from this effluent as well. Sulfur dioxide removal from the regeneration area is provided for, but no showing of the steps taken are known to us at the present time.

As to the purification steps, water disposal is again provided for, and the quality of this water should be controlled. Further, although the content is not known, the carbon dioxide vent probably would contain some pollutants, and therefore analysis and control may be required.

As shown, the methanation section appears to be relatively clean, assuming that the water removed prior to compression of the process gas meets acceptable water quality standards, particularly with respect to thermal pollution, which is an important consideration throughout this process. The water separated after compression of the gas will, also, probably be relatively clean.

THE HYGAS PROCESS INSTITUTE OF GAS TECHNOLOGY

The Hygas process, like the carbon dioxide acceptor process, crushes and sizes coal prior to processing and thus safeguards with regard to fines should be incorporated into this process as well. Also, as noted in the generic comments above, control of ash emission and removal should be included.

The suggested removal of hydrogen sulfide and conversion to sulfur should be effected, with care taken to minimize if not eliminate hydrogen sulfide, and sulfur oxides emission.

Further, particular attention should be paid to the electrothermal gasifier section in view of its high operating temperature (1800-1900°F) and thus the significant problem of thermal pollution of the atmosphere.

THE B.C.R. TWO-STAGE SUPERPRESSURE PROCESS, OFFICE OF COAL RESEARCH— DEPARTMENT OF THE INTERIOR

This process has as its principal by-products slag and saleable sulfur. There should be adequate provision for the disposal of the slag, as well as for the protection of the atmosphere from emission of sulfur containing gases, as noted in the previous discussions. Removal of particulate material and hydrogen sulfide have been considered in the process variations studied. Our data, however, was not sufficient to evaluate the environmental impact of the process, as development is still continuing, and the flow charts available indicated that product gases are burned.

SYNTHANE PROCESS, THE BUREAU OF MINES

Here, minimizing or eliminating pollution has been the subject of considerable work in developing the process. However, the problems of ash and slag disposition, as well as sulfur containing gas containment remain. Again, the data available to us was not sufficient to make a complete analysis of the process, and thus the full environmental impact could not be determined.

Senator Moss. Both of you gentlemen are concerned about the environmental impact of the gasification process, and rightly so. I think it is implicit. If it is not implicit, it will be very explicit in the legislation that every possible step be taken to avoid degradation of the environment.

Certainly, as Mr. Freeman pointed out, there would be a requirement to comply with the Environmental Policy Act, to file a section 102 statement on any of these gasification plants.

If there is one thing that we seek as much as the energy that must be developed, it is also to protect and preserve our environmental

purity. If this is not one of the features of the gasification, why, it may be put off for some time because we have learned we cannot tolerate additional degradation of the environment. We must find ways of preserving what we have.

Now, there have been some proposals advanced that there might be a way of conducting the gasification right in the ground in a process. If that were possible, that would accomplish in large part your environmental concerns; is that right?

Mr. PICKELNER. In Mr. Lloyd's study with us he has gone through many of the systems that have been proposed so far, the processes, and although environmental considerations weren't contained in many of them, there are distinct possibilities that it could be a self-contained unit and therefore not release the oxides and the ash into the air. So, the system itself, though it is inherently dirty, can easily be cleaned up with, I would say, a minimum of cost actually.

Senator Moss. And there is some feasibility that this might be possible to do beneath the surface. Do you think so, Mr. Lloyd?

Mr. LLOYD. At the present time it is my understanding that one method of removing petroleum from the ground is by setting explosions or injecting oxygen into a given well to force petroleum materials to another well so that it may go up. In this operation you do paralyze the petroleum. In so doing, you may at the same time produce at least a certain amount of methane for use in this type of operation. There is an inherent limitation there in that you don't have a whole lot of control over your process at all.

The processes that we have studied do require significant temperature and pressure controls as well as sulfur—hydrogen sulfide and particulate removal to conduct the methanation step from synthesis gas. This could not be, as far as I know, done in the earth without removing it from some source and then actually—you couldn't do it underground. You could do it by removing the paralyzed gas and possibly doing it, but your efficiency would be significantly decreased.

Senator Moss. Well, thank you, gentlemen, very much.

We have concerned ourselves more with the techniques of the process here than we had expected to do at this hearing. We are really talking about the structure of how we should go about getting a demonstration plant erected, under what method, but we are very pleased to have your comments and to have called to our attention the necessity of protecting the environment.

Thank you very much.

Mr. John H. Morgan was listed for tomorrow, but will be called up now if he is ready to testify. He is president of Great Western Pipeline Corp. We will also call Mr. Clarence Justheim, president of Justheim Petroleum. Both of these men are from Utah.

I know them very well, they have long experience in this field. I am very pleased that they came on to appear before the committee and to contribute to our record.

I will ask Mr. Morgan if he will go first, and then we will hear from Mr. Justheim.

STATEMENT OF JOHN H. MORGAN, JR., PRESIDENT, GREAT WESTERN PIPELINE CORP.; ACCOMPANIED BY CLARENCE JUSTHEIM, PRESIDENT, JUSTHEIM PETROLEUM CO.

Mr. MORGAN. I don't know whether you can see this or not.

Senator MOSS. I can see it rather well, yes.

Mr. MORGAN. I will take just a minute to explain to you, then I will turn it around so that the others can see it.

May I begin by saying how much we do appreciate this opportunity to come and appear before this committee and explain our program.

This is the Pacific Northwest pipeline system, and it shows the areas where the gas presently comes from that takes it to market, up in the Pacific Northwest. It also shows the method by which it goes into California, the pipeline system.

The only problem is that they are running out of gas in each one of these gas fields. I will go more into this in my statement, but I wanted to point out the tremendous market that we have here and the real serious supply that we have here for the whole western part of the United States.

I wanted to point out in Utah we have such tremendous reserves of just the kind of coal that is needed to gasify these hydrocarbons—that is, very small amounts of ash and sulfur, and high B.t.u. content in the coal, you see. I will go into that more in my statement, but I wanted to point that out.

Senator MOSS. I am glad to have you show again that pipeline system.

Mr. MORGAN. I am John H. Morgan, Jr., president of Great Western Pipeline Corp., and I would like to express my appreciation for the opportunity of appearing before this committee and presenting our views regarding Senate bill 1846, for and on behalf of Great Western Pipeline Corp.

As I understand it, we have been asked to respond to the question as to whether we believe there is a need to intensify the coal gasification efforts in order to speed up the initiating of a coal gasification industry. To answer this question, we must really address ourselves to the inquiry as to the natural gas requirements and demand, and our ability to meet these requirements now and in the future.

Inasmuch as we are applicants in the divestiture proceedings before the Federal court in Denver, Colo., to acquire the assets and the gas reserves of the Northwest Division of El Paso Natural Gas Co., with special emphasis upon delivery to the California market, our studies center primarily upon the western United States—the gas supplies and requirements, and our present and future ability to meet these gas requirements.

El Paso Natural Gas Co. furnishes the great majority of the gas to the west coast, along with Transwestern Pipeline Co. and Pacific Gas and Electric Co. Most of the gas comes out of Texas and the San Juan basin, with good portions of it also coming from Canada, as indicated on the large map showing the gas fields and the gas lines to market.

Evidence was presented to the court by the Federal Power Commission and El Paso Natural Gas Co. Without contradiction, it was estab-

lished that El Paso has only a 3 year deliverability life, that is, it can deliver gas to its present customers at present rates for only 3 more years. El Paso cannot even compete for any additional gas customers in the California market at this time, because it simply does not have the gas. And neither do the other suppliers of gas have any additional gas for sale in this market—which is probably the fastest growing market in the country.

As a matter of fact, the research work done by the California Public Utilities Commission and others indicate that by the year 1975, the west coast will be short of gas some 2.2 billion cubic feet of gas per day. It will be short 3.5 billion cubic feet of gas per day by the year 1980; 5.2 billion cubic feet per day by 1985; 7.1 billion cubic feet of gas per day by 1990; 9.0 billion cubic feet of gas per day by 1995; and 11.1 billion cubic of gas per day by the year 2000. These figures were presented by El Paso Natural Gas Co. to the court in July 1970, and have not been contradicted.

This recognizes that this is the supply picture, and the projected demand picture. I wanted to make that plain. You can see what a terrible situation we find ourselves in in natural gas. We have got to do something about it.

Now, as you will note from the map, the Pacific Northwest relies for its gas upon the San Juan Basin gas, the Big Piney gas and the Canadian gas, primarily. But the projected demand figures, and the projected supply figures of the west coast show these deficits, unless huge new supplies of gas are somehow forthcoming.

Colorado Interstate Gas Co. buys about 115 million cubic feet of gas per day from the Pacific Northwest pipeline—El Paso Natural Gas Co.—for the Denver area—that shows blue on the map—and the Mountain Fuel Supply Co. buys some 75 million cubic feet of gas per day for the Salt Lake City area—all from the same pipeline.

You can see that the entire west is depending upon gasfields whose reserves are being drastically reduced each year, and in fact each day. The overwhelming demand for gas in the entire West, and the scarcity of supply is a fact of life today, which must be recognized, and a course of action must be determined upon to solve, or help solve this critical gas supply situation in which we find ourselves.

You see, gas is the wonderfuel. It is clean. It is efficient. It is a non-pollutant. And we all know how important this is to our country at this time. It is in huge demand. And its supply is so limited. We must take action now to find the gas—right here in the west—so that we can meet the gas crisis in which we find ourselves.

May I take just a minute to tell you about our background in this natural gas picture?

In 1938 my father, John Morgan, Sr., and his associate, Mr. Clarence Justheim, joined together in the initial exploration of the Big Piney gasfield, shown on the map. Together, they acquired some 250,000 acres of leases, and drilled the initial exploratory wells to prove up a great potential gasfield. It was this gas which we believe was the deciding factor—or one of the deciding factors—in the Federal Power Commission's decision's to choose the Pacific Northwest Pipeline Co. to build a transmission line into the Northwest, and serve this great market.

Mr. Ray Fish, President of Pacific Northwest Pipeline Co., had to prove sufficient gas reserves to the Federal Power Commission to warrant the building of the line, and the Big Piney Gas was a most significant factor. As you know, the Pacific Northwest Pipeline Co. was absorbed by El Paso in 1957, and the Supreme Court has ruled that this merger violated the antitrust laws because it stifled competition in the California market, and El Paso must therefore divest itself of these properties.

The entire pipeline, as you can see, is now connected to the entire Western United States. The market is fantastic. But the supplies of gas are dwindling. This includes Big Piney, as well as the other gas fields. We know this because we are associated with Big Piney and we know it is going down.

It is true we get a good portion of our gas from our good neighbor to the north. But the Canadian Government is becoming much more reluctant to grant any further rights to export their gas into this country. The gas reserves are not as big as we all anticipated, and there is such a hungry market in the midwest and eastern portions of our country, that the Western United States must compete very vigorously for every cubic foot of gas which comes from Canada. Furthermore, the Canadians now believe they should hold this gas for their own industrial development and domestic use, and the outlook for future Canadian gas in the Western United States is not good.

Where can we go to supply this great western market with gas now and in the years to come? Obviously, the rate of finding new gas fields will never keep up with the demand, perhaps we can go to foreign sources of supply. But Algeria and the Middle East and Venezuela—where the gas reserves are primarily located—are not the most stable governments. We just cannot rely upon them, and should not rely upon them, to meet our increasing gas demands. They could cut us off at any time. And what is more—this gas is very expensive—probably in the neighborhood of 75 cents to \$1.00 per Mcf.

Where can we go? Where should we go to get the gas to meet this tremendous demand, and how should we go about it?

To our company, and to our group, the answer is obvious. We have huge coal reserves here in Utah—right up against the pipeline, and I know Wyoming does, too, and the fine statement by the Congressman this morning illustrates this. He was plugging real hard for the Wyoming picture. Certainly he did a beautiful job. We are plugging real hard for the Utah picture because we have analyzed this coal and we know that it is ideal for the making of pipeline gas from the Utah coals and we have huge reserves to back that up, too. Anyway, we will get into this in a second.

This coal is high B.t.u., high volatile, low ash and low sulfur—just ideal for recovering pipeline gas from coal. Our company and group have under lease or option or application some 250,000 acres of these coal lands. A great deal of geological and exploratory work must be done further in order to prove up total tonnage of coal in this whole area. But based upon the geological work we have already performed over this entire area—in the Sunnyside area of the Uintah Basin—we have every reason to believe we have vast reserves of coal which contain huge reserves of pipeline gas.

We have a very simple process and formula to accomplish this task. It involves the "in site" recovery of the gas from the coal, through the use of the right kind of explosives—non-nuclear, so we don't have the environmental problem—to create the proper conditions of permeability. Then we anticipate the injection of the proper amount of superheated steam, under the right conditions of temperature and pressure, to create the methane in place, and force it up the production holes at the surface, to be recovered as high B.t.u. pipeline gas in huge quantities.

This is no small undertaking. We realize this. No one company is really big enough to accomplish this great task on such a big scale. Our effort and aim and goal is to produce 2 billion cubic feet of gas per day by the year 1975. This is what we will be short even on that west coast market.

Such a task will require the great cooperative effort of free enterprise, working harmoniously with the Federal Government, and also with the State government—there is a considerable amount of Utah State land scattered throughout the 250,000 acres, referred to. And Great Western Pipeline Corp. holds leases on most of these State lands.

But, with free enterprise, the Federal and State governments, working harmoniously and cooperatively together toward this great goal, we are convinced it can be accomplished.

To have the Federal Government try to do this alone would be socialism, and noneffective. To have free enterprise try to do it alone is not really realistic. Free enterprise has not shown the initiative to really go after this effort. Frankly, it is just too risky. And no one company, or even a group of companies, would really risk it without Federal participation at this point.

We don't look upon Government as something evil. We look upon Government as a partner, with whom we can work cooperatively toward a great end. We can't think of anything which is more important to the American people—and particularly to the West today—than to find a new huge source of gas, right up against the pipeline, which can bring this wonder-fuel to all this Great Western market.

How, exactly, can this be accomplished? The concept of a corporation involving free enterprise input and Government input, under these circumstances, just makes sense. As a starter, may we suggest that free enterprise invest \$5 million and the Federal Government invest \$5 million into this corporation, giving it an initial capitalization of \$10 million. We realize this will not do the whole job; but we do believe it will start the job. This foundation will at least be sufficient to acquire the initial facilities, and other preliminary engineering work, geological, and other work to prepare for a full scale plant, which will be producing 2 billion cubic feet of synthetic pipeline gas per day by the year 1975.

If free enterprise puts in \$5 million and the Federal Government invests \$5 million, how should this interest be allocated? It must be on a competitive, business basis. The stock of the corporation must be apportioned out according to the investment of each investor. A plan must be drawn up, which will be the result of the cooperative effort involving representatives of free enterprise, in accordance with their in-

vestment, and the Government, in accordance with their investment. The plan, of course, must be approved by the nine-member board of directors, as prescribed by Senate bill 1846. This is a good procedure.

Such an approach tends to reduce the risk of free enterprise, because of the Government investment, and yet it accomplishes the purpose of providing a blueprint for developing a great pipeline gas industry for the consuming public.

It is contemplated that after 6 years, the Government will withdraw from the operation, because the project should be on a paying basis at that time. Within the 6-year period, it will no doubt require an investment, perhaps up to \$250 million on the part of the Government, and \$250 million on the part of free enterprise.

At the end of the 6-year period, when the Government terminates its interest in the project, the question is: How will the interest be allocated at that time? The Government really will have accomplished its purpose by achieving a new pipeline gas industry and a new huge source of gas for the consuming public. What about the investment of free enterprise in this venture?

The American free enterprise system has always rewarded those who were willing to take the initial risk, and develop something great. Because this is a highly risky venture, it follows that those who would be willing to take this risk, should have an opportunity to gain a reasonable financial success from the venture. Therefore, when the Government terminates its interest at the end of 6 years, it would be reasonable to suggest that the remaining free enterprise entity would have the option of acquiring the Government interest at a very reasonable figure. Perhaps cost, less depreciated value, and the depreciation should be figures on an accelerated basis, so as to give free enterprise a fair break on the analysis.

The whole idea will be to work together in a cooperative and harmonious manner, so that a reasonable reward can be returned to those who are willing to assume the initial and continuing risk in the matter.

With regard to the patents which are developed through the corporation, there is really no argument that these patents should belong to anyone who chooses to use them—the American public.

But any patents which have been acquired by free enterprise in their own right must, of course, be protected.

On the whole, we believe the general provisions of Senate bill 1846 have real merit, and we commend the authors for using vision and imagination to help solve a very real problem before the American people, that is, to develop a great new source of natural gas in the form of pipeline gas from high volatile, low sulfur coals, and in such a way as not to disturb or injure the environment in any way.

Again, I appreciate very much the opportunity to appear and present this statement to this committee.

Senator Moss. Thank you very much, Mr. Morgan for that statement.

I notice that you estimate it will cost perhaps \$250 million by the Government and the same amount by free enterprise. That is half a billion dollars in the 6-year period to develop this gas recovery system out of coal beds that you mentioned.

Is this just an estimate, or has this been engineered out some way? In other words, how hard is that figure?

Mr. MORGAN. Well, I will tell you, I have seen how other companies go about it. You know, some of the major oil companies, what their estimates have been on similar kinds of projects. This is about, on a major project for the development in this case of 100,000 barrels of oil a day, and this was somewhat comparable, on an in situ recovery basis for the whole system, for putting it in and for developing the whole thing, this is the kind of money it actually runs into.

Senator Moss. Well, I think we all have to agree that the in situ method is ideal and certainly if it will work it ought to take precedence over any other system that has above ground extraction because of the environmental consideration.

To what extent has this been tried out? Has it been done in any small scale production yet?

Mr. MORGAN. I am not an engineer, Senator, but my studies show me that when coal which has been broken up which you mix with steam, you know, under certain conditions of pressure and heat, that you bring methane. It is a chemical reaction.

Well, we are dealing with some of the most advanced people in knowing how to create this permeability in the coal through the proper kind of explosive, you see, and then the theory is that you just, through this pressure and through this temperature, you create the methane right there in place. I don't know that it has been done or is being done, but on the laboratory theoretical situation is that it just can be done and very efficiently. You avoid all the mining and hauling and the disturbing of the environment altogether on the top. This thing can actually chemically take place right in the ground.

Senator Moss. Is it expected that it would be able to utilize nearly all of the coal, not just skim—

Mr. MORGAN. Not just skim a little portion of it. No. Our understanding is this utilizes the great majority of hydrocarbon in the coal and converts it into methane gas through the right mix of temperature and pressure. It has to be pretty hot to do this.

Senator Moss. Is the Department of Interior in its R. & D. directing its attention toward this process?

Mr. MORGAN. In gasification, I don't think so, Senator.

Senator Moss. Well, it is tremendously interesting, and certainly if it is feasible that would be the answer. It would solve the environmental problem; and if it is in an area where pipelines are already in existence, it wouldn't be hard to connect on and carry that gas.

Mr. MORGAN. Right.

Senator Moss. Well, we certainly do appreciate your testimony and your pointing out the tremendous need to find replacement gas because of the dwindling reserves of natural gas in the Western United States. The same thing, I am sure, applies in other parts of the United States.

Mr. MORGAN. It sure does.

Senator Moss. Now we would like to hear from Mr. Justheim, if he would like to be heard at this time.

We are pleased that you came, Clarence, and we will hear your statement.

Mr. JUSTHEIM. Thank you, Senator. Frank, for short; I have known you for 50 years, so—

Senator Moss. You are giving both our ages away.

Mr. JUSTHEIM. —it is about time I called you Frank.

This situation today—well, first of all, I gave you a copy of this, so you won't have to type this down. This is a one page written, and then I will give you some off the cuff.

Senator Moss. All right.

Mr. JUSTHEIM (reading).

HON. HENRY M. JACKSON,
Chairman, Senate Interior and Insular Affairs Committee,
Senate Office Building, Washington, D.C.

DEAR SENATOR JACKSON: You and Senator Moss, having introduced Senate bill 1846, should intensify this Senate bill 1846 for a coal gasification industry, for all you possibly can. The reason being, we are behind schedule in the production of natural gas, which by 1975, unless a miracle can be accomplished, will leave us short all over our country, and on the west coast alone, to the extent of 2.2 billion cubic feet per day; and unless this miracle takes place, this west coast of ours will be short 11 billion cubic feet per day by 2000 A.D.

I believe your Senate bill 1846, wherein the U.S. Government joins with private industry and the State, is the best possible combination of joining money, time, and effort; that is, the U.S. Government private industry, and the State, pooling their necessary time, money, and effort, should have joined this common effort several years back, and we wouldn't be swallowing with effort now. We still have a short time of grace, if the united effort goes ahead now.

Trying to get united effort now is more difficult. However, if this united effort now, wherein industry puts up half the money, isn't forthcoming, as of now, it would be a sad situation. All of this predicated upon the fact that industry and the housewife have become used to this clean, antipollutant heat or energy.

I believe we can lick this potential situation, because of the fact that the Institute of Gas Technology has made a beautiful product of methane—pipeline gas; putting through 80 tons of coal per day and producing 1,500,000 cubic feet of pipeline gas, in this pilot plant, above ground; which if we put all of this knowledge into the ground, under an in situ project of sufficient magnitude, this natural gas crisis which confronts us can be licked.

To do this is a matter of money, time, effort, and cooperation.

Sincerely yours,

CLARENCE I. JUSTHEIM, *President,*
Justheim Petroleum Co.

That is the one page which I wrote to the committee.

Now, off the cuff, I would say that any project like this can be licked if enough money can be produced, because every process, there is an economic point. For example, Kennecott Copper put through 108,000 tons a day at their Bingham plant. At 50,000 tons a day in Kennecott, they have made no money. But from 50,000 tons on up to 108,000 tons a day is where the money is made and where the economics come in.

Now, in this point here, first of all, you build a prototype plant, a pilot plant, and a commercial plant. You must do all of these things.

Now, we have patents—is it OK to go into this? It seems the rest of it I don't have to—

Senator Moss. Well, we don't want to get into really the technical process, but if there is a process in existence, of course, mention it.

Mr. JUSTHEIM. I would say, Senator, that the process that will work—I am an MIT man from way back, class of 1922. Chemistry was my art, and metallurgy under a bachelor of science.

Today, IGT, Institute of Gas Technology of Chicago, has produced enough chemical equations to make this process a success. Now, of course, IGT—I will submit this, 1 to 14—with every chemical reaction of which hydrogen is a significant part.

Now, the reason that hydrogen is a significant part in the production of this prototype pilot plant, and commercial plant which would be necessary because of the fact that hydrogen reduces the oxygen, nitrogen, and sulfur, and gets rid of them as product gases which will go to the atmosphere.

Also, hydrogen has to be used in the IGT 14 pamphlets, which shows every reaction, of which methanation is the outstanding feature to produce pipeline gas, or CH_4 or methane.

Now, carbon monoxide plus 3H_2 molecules given methane, CH_4 , plus water vapor. Carbon dioxide plus a molecule of hydrogen produces carbon monoxide, and a molecule of water vapor, leaving methane C_2H_6 , plus a molecule or two molecules of hydrogen giving methane.

In other words, hydrogen, the wonder gas, has to be used—and it will be found out to be it has to be used—to make a successful product of pipeline gas which is a substitute or a synthetic product of natural gas of which we are in a crisis.

If we don't get going and get on our horse, we are going to be in sad straits, Senator, because every minute that we are talking here we are getting behind. By the year 2000, we are going to be 11 billion behind just on the west coast alone.

Now, as John Morgan has told you, we have a potential of pipeline gas under Great Western Pipeline Corp. which, as shown on the map, we are fighting for a place at the table in Judge Schultz's court whereby this pipeline, Pacific Northwest pipeline, runs right through the greatest deposit of carbon in the world.

Now, our patents are in situ, in places, in the ground, distillation and hydrogenation of any carbonaceous material.

Now, as I said, Senator, if we have enough money we could start tomorrow and we could lick this deficit that we have.

Senator Moss. How much money do you need?

Mr. JUSTHEIM. It will take a lot of money. To guess at it, that would be ridiculous. It will take a lot of money.

Now, Tosko, which was and is the corporation which has made oil from oil shale, spent \$30 million without batting an eyelash, \$30 million right there, and they are the ones that have mined it and crushed it and heated it and have produced a product, but it is too expensive, too polluting.

We are trying to get away from pollution. This in situ gets away from pollution, produces pipeline gas and you have to use just Heim's patents to be a success. I have lived too long not to know this. I am not bragging.

We have a heat exchange media of which we can use any process. We can use nuclear, which is too costly. Here is our nuclear, helium cooled, fast breeder reactor, where you produce a product which can be sold back to the Government for \$9 a gram, U^{238} , but it is still too expensive. And we have the patents right here and in Canada as well.

Senator Moss. Now, I take it you have done this in the laboratory in order to be able to get a patent, but how—

Mr. JUSTHEIM. I would like to leave this.

Senator Moss. All right. We will be glad to accept those in the files of the committee.

(The material 1 to 14 referred to by Mr. Justheim was retained in the committee files.)

Mr. JUSTHEIM. And the fossill fuel, which is the cheap method, will issue on August 10—the letter from the patent office—Canadian Patent 832829 issued a year ago where you use fossill fuel, and you have seen this before.

Senator Moss. Yes.

Mr. JUSTHEIM. Whereby fossill fuel or coal or any medium of heat where you can exchange the heat to hydrogen, which at 850° F. produces the shale and chemicals, hydrogen, oxygen, sulfur, nitrogen—and you have a method which is probably within reason, although I mentioned the nuclear because you never know what will happen. They may take over before we are through. Right now it doesn't look so, because of the expense.

Now, Babcock and Wilcox of New York City have built a pebble heater, a fossill fuel machine, and patented it and it has run out. Now, in this idea of ours, the Babcock and Wilcox pebble heater, of which they say—this is from Babcock and Wilcox—I mention all this because we are looking to save our necks because the housewife will be awful mad at the people that should have done this.

Senator Moss. You are right, but I want to know now: Do we need this corporation to do this, or will this be picked up by the department and simply R. & D. down there?

Mr. JUSTHEIM. I think it is a great system like I said in my letter. I think it is a great system, but you have to say something radical to wake up industry, because I have written every one of them and they haven't awakened yet—something has to wake them up.

Now, we fellows went out, and John Morgan, Sr., our partner, went out and we have 220,000 acres of low sulfur high B.t.u., low ash coal which has to be relinquished—the coal has to be released from the oil shale reserves by Presidential order.

If such a thing can happen fast enough, and we get the money fast enough, we won't be embarrassed. Otherwise, we are going to be embarrassed because we are going to get up to about 55 stories of the tallest building in New York and turn a switch on and nothing will happen, and we will have to walk down 55 flights to get to the street and we won't have the guts enough to go back up by foot. Now, that is what you call energy failure.

Now, I won't say any more. I could keep on because you have a lot to do, but I have said enough to frighten you, Senator—

Senator Moss. You are right. I am ready to go.

Mr. JUSTHEIM. And if we can get the money, we have the patents and we have the land and we have the idea of how to do it. Sink a shaft, scoop out a room, put in the pebble heater, exchange heat from the pebble heater to hydrogen and you are in business.

Senator Moss. That is what I want to see tried out. If that works—

Mr. JUSTHEIM. And you are in business, Senator. And we better get excited and wake up. We better, because we are late.

Senator Moss. You are right there, too, sir.

Mr. JUSTHEIM. Thank you very much. I will leave some of these papers with your office.

Senator Moss. Yes, we need them in the file so we can follow up. Certainly this idea appeals very much to me, if it will work, why we are on our way.

Mr. JUSTHEIM. All we need is money.

Senator Moss. All right.

Mr. JUSTHEIM. And the Government behind us.

Senator Moss. Well, obviously it will take a considerable investment of capital. You say a lot of money can't give us an exact figure, and I can understand why you can't—

Mr. JUSTHEIM. I am only 75, you know, but I came all the way from Salt Lake City with my wife who wasn't feeling good to get you fellows out of the doldrums.

Senator Moss. Very good. I think you have done it, Clarence, and I appreciate it. In fact, I hope you can be here tomorrow and hear some of the other witnesses.

Mr. JUSTHEIM. Thank you very much, Senator.

Mr. MORGAN. Thank you, Senator.

I would add the thought that where free enterprise is willing to make the investment, I think as I understand the bill, 1846, that the Government—I don't know what the ratio is with the bill—

Senator Moss. 60-40.

Mr. MORGAN. Sixty on the part of the Government?

Senator Moss. Yes.

Mr. MORGAN. Well, I was actually thinking in terms of 50-50, because that would test whether free enterprise was really willing to come in and go after this thing. I think it is important that free enterprise be willing to put in a good substantial part of this. If I had a suggestion, it would be to go 50-50 on this.

Senator Moss. Well, we have that recommendation. We will consider that when we mark up the bill.

Well, this completes our witnesses for today. We will resume tomorrow right here in this room at 10 o'clock.

(Whereupon, at 3:45 p.m., the hearing was recessed, to reconvene at 10 a.m., Wednesday, July 28, 1971.)

COAL GASIFICATION DEVELOPMENT

WEDNESDAY, JULY 28, 1971

U.S. SENATE,
SUBCOMMITTEE ON MINERALS,
MATERIALS, AND FUELS OF THE
COMMITTEE ON INTERIOR AND INSULAR AFFAIRS,
Washington, D.C.

The committee met at 10 o'clock, a.m., in room 3110, New Senate Office Building, the Honorable Frank E. Moss, presiding.

Present: Senators Moss, Anderson, Fannin, Hansen, Bellmon, Stevens, Gravel, and Jordan.

Also present: Mary Jane Due, staff counsel; Charles F. Cook, minority counsel; and Thomas Nelson, assistant minority counsel.

Senator Moss. The subcommittee will come to order.

We have delayed just a few minutes to see if there were other members of the subcommittee. I understand they will join us shortly, but we have a very full list of witnesses today to be heard and I want to get this hearing moving.

The Senate is in session this morning and we may have interruptions. I want to see if we can get our work done early if possible. My colleague from Utah, Senator Wallace F. Bennett, has prepared a statement to be placed in the record. Without objection it will be placed in the record at this point.

(The statement referred to follows:)

STATEMENT OF HON. WALLACE F. BENNETT, A U.S. SENATOR FROM THE STATE OF UTAH

Mr. Chairman: I appreciate this opportunity to testify in full support of S. 1846, a bill to establish a Coal Gasification Development Corporation, which I have had the privilege of co-sponsoring.

This legislation, which would create a Government-industry corporation to develop on a commercial scale at least two alternative methods for the production of gas from coal would help to meet our need for supplemental gas supplies in the 70's and 80's. Action is needed at once since it is anticipated that it will take from 6 to 10 years to bring coal gasification into commercial operation.

In 1950, the Bureau of Mines did some early underground experiments in Alabama on oil gasification but then "put them on the shelf." Today, the process appears much more feasible with the stringent new requirements of the Federal Mine Safety Act of 1969. In addition, underground gasification requires few workers; there is no problem of ash disposal; and a low-sulfur gas is recovered.

As you know, coal is the most abundant fossil fuel in the nation, much more plentiful than petroleum and natural gas which together presently furnish more than 70 percent of the energy consumed domestically. Western coals, with less than one percent sulfur content, are particularly suitable for gasification and production of low-sulfur gas.

We all realize that to meet our present goals of economic growth without undue disturbance to our environment research must move forward. Since financing of a coal gasification pilot project on such a scale is impossible for any

single company, it is proposed that financing would be shared by Government and industry. The corporation would be managed by an entity responsible to a Board of Directors made up of representatives of industry and Government with the ratio of financial support used as the basis for division of membership on the board. Since the corporation would have a time limit, it is felt that it would attract personnel who would be ready to move on to the further commercialization of coal gasification when the mission was accomplished.

Because of the urgency of the fuel crisis in the near future, the beneficial aspects of gas in relation to our environment, and the economic benefits to our country from the better utilization of our vast coal reserves, I urge your Committee to report this legislation favorably to the Senate so action may be taken on it in this session of Congress.

Senator Moss. Our first witness today on S. 1846, a bill to establish a Coal Gasification Development Corporation, will be Walter Rogers, president of the Independent Natural Gas Association. I have known Congressman Rogers for a long time. He served with distinction on the Hill here and has been president now for some years of the Independent Natural Gas Association. We miss you over on the House side but are glad you are in town and that we get to see you occasionally, Walter. We welcome you before the committee this morning and look forward to having your testimony.

STATEMENT OF WALTER E. ROGERS, PRESIDENT, INDEPENDENT NATURAL GAS ASSOCIATION OF AMERICA

Mr. ROGERS. Thank you, Senator Moss. It is always a distinct pleasure to serve with you and enjoy participating in the great things that you did for your great State of Utah and the entire West, especially in the mining areas and in the reclamation programs.

Now, realizing the situation that you are faced with in the Senate, with your permission, if my statement can be included as if read, I will proceed to summarize it and try to get to the points as quickly as possible.

Senator Moss. That will be in order. We will appreciate that. It is a complete statement and we want it all in the record, to be sure, and if you could summarize and emphasize the parts that you think you would like to make orally before the committee, that would suit us very well.

Mr. ROGERS. Thank you, sir.

Mr. Chairman, the first point I would like to make is with regard to a treatment of the basic problem involved here. That is, the energy supply situation, as such. That is, the lack of energy in the overall picture.

Now we know that in the last 100 years man has consumed more energy than he did in the previous 2,000. I made that statement not too long ago and a fellow said: "How can you prove it?" I said: "Well, I would prefer that you disprove it. I think all we have to do is look at our present reserves of energy. If people before us had used as much as we have in the last 100 years, there would not be any energy left for us today." I think this proves that statement.

Now what we are confronted with in this country at the present time is a situation where our reserves are dwindling in all deliverable fuels at the present time and unless we do something about it, our supply of energy is going to put us in a position where we will be

challenged seriously for world leadership. I don't think anyone could agree to that procedure.

I do think we ought to add a commendation, as I have in my statement, to both you and Senator Jackson for your efforts in pointing up the energy situation and the need for something to be done about it now. I think the introduction of this bill did more to bring this matter into focus in the minds of many people than anything that has been done for sometime. I want you to know we appreciate it.

Now at the present time the energy consumption of the country is in the general area of 68 quadrillion B.t.u. 75 percent of that is provided by oil and gas, 20 percent by coal, and the remainder in hydro sources and nuclear power.

It has been estimated that by 1980 the energy requirements will increase to 95 quadrillion B.t.u. and by the year 1990 this country will require 146 quadrillion B.t.u. This simply means that by the turn of the century, if these estimates are low, our energy consumption by the year 2000, will be triple what we have now. I think it could safely be said that this will come about if we use past history as a yardstick.

Now, of course, what we have to answer at this time—and what this committee is interested in—is: Where is this energy coming from?

In the case of oil, it has been estimated by the year 1980 this country would be required to depend upon foreign imports of oil for over 50 percent of our requirements.

I might point out that at this time that 50 percent of the total use of liquid fuels on the east coast comes from imports.

Now the overall problem in this particular picture with relation to oil and gas I think was summed up very well by Dr. Richard Gonzales, a renowned consulting economist, in a paper that he presented to the Brookings Institution in April of this year styled "Energy, Economic Growth and the Environment." I want to read the statement of Dr. Gonzales. He said:

Energy requirements for the next 20 years have already been determined in large measure by decisions on where we live, work and shop, by the fuels used in plants that will be in operation for many years, and by the long time lag in bringing about a major change in energy use. If sufficient petroleum supplies can be made available at prices that remain attractive relative to rising real incomes, consumers would probably double their use of oil and gas within 20 years. In that case, potential use for 1971 to 1990 would be 165 billion barrels of oil and 660 trillion cubic feet of gas, or . . .

And this is the important part:

. . . several times presently known U.S. reserves, even including those of the North Slope.

Now let us turn to natural gas as one of the sources. I think several things could be said about natural gas. Natural gas at the present time provides approximately 32 percent of the energy needs of this country. Now the projection into the future as to what contribution gas will make could be misleading. It is estimated that by 1980 the percentage of contribution to the national energy picture of natural gas will be reduced by several percentage points and that by 1990 that reduction will be to 20 percent of the national requirements.

Now this does not mean that this is a lessening of demand for gas. It simply means there is a deficiency of supply. In other words, although the projections would indicate an increase of approximately 5

trillion cubic feet annual consumption by 1990, the percentage contribution to the national energy requirements would be reduced.

Now it is obvious that the decline in the percentage of contribution to gas in the future, both as to domestic and foreign supplies and including the North Slope of Alaska, is due entirely to estimated deficiencies in supply. It could confidently be said that if the supply of natural gas was available and deliverable, the contribution to the national energy requirements in future years would substantially exceed 50 percent.

Now the reason for that is very simple. Gas is—and I want to throw in a few words on behalf of gas at this time—the most efficient fuel; it is the cleanest fuel; and I might say that it has the least possible contribution to detrimental impact on the environment of the country. This is something that the people have awakened to, let us say, in the last year or two and great attention is being paid to this. But I think when we stop and think about natural gas as such, we fail to realize that it makes a great contribution to many things in our economy.

For instance, the production of natural gas creates no environmental problems; no pollution. The transportation of that gas creates no problems; no pollution. It is in a pipeline. It does not create any noise. It does not create any pollution of the air. It does not create any pollution of the water. It is all underground; it has not disturbed anyone. When you get it to the burner and use it, you burn it up with the greatest efficiency of any fuel known. I think it would be to our interest to pay as much attention as possible to the future development of every possible source of supply of natural gas.

Now let us turn to hydroelectric power. Understand there will not be any great contribution of hydropower to this country in the future because we used up all the sites and there are not any left there. This contribution, percentagewise, because of the increase in the demand, is decreasing, and will be, I think, in 1990, somewhere in the general area of between 2 and 3 percent contribution.

So we go to nuclear power. This is a very touchy subject because, as I recall, I had understood—maybe I misread somewhere—that by 1970 nuclear power was going to pick up a large part of the energy requirements of this Nation. 1970 has come and gone and we are still talking about less than 1 percent contribution to the energy needs of this country from nuclear power. Now we are told that they are going to step up the development of technology but I still go back to Dr. Seborg's remarks at the Brookings Institution—and if my memory serves me correctly, he was talking then about a 10-year-leadtime period before we could expect any measurable help from nuclear power.

If that occurs and it is developed and is successful, by 1980 it is estimated that nuclear power will, at that time, contribute 10 percent to our energy needs. Then we look at 1990, and if this continues to be successful, we are talking about a contribution of 25 percent.

Now in the overall picture, I do not know whether we can take the risk of depending on that, but we turn to what other sources there are. This is, of course, oil shale, which I think should be considered and is considered in the oil picture that we are talking about. The other is geothermal steam. A lot has been said about it but there just is not any

possibility of it making any measurable contribution to the energy needs of this country for a number of years to come; not even, really, in my opinion, as a supplemental source. So we come back to coal, which has been saved for last here because it is the subject matter of this pending bill. We do know that we have the greatest resources insofar as energy is concerned in coal. We have plenty of coal. We talked about coal resources that will last 500 or 600 years, I do not know, but I do think that something must be done at the present time to try to work out a possible utilization of these resources, because if we do not, we are going to miss the opportunity to use this source of energy as one of the major contributors to our energy needs in the future.

Now, the possible solutions to our overall energy problem: We could produce more oil if we could find it, but we cannot depend on it. At the rate we are using oil at the present time, I do not think you could find enough oil, no matter how hard you searched, to meet the energy requirements of this Nation.

Now I think the same thing could very well be true with relation to gas. I think that we need to continue our efforts in this regard but I do not think we are going to find enough to meet this requirement.

I think with regard to nuclear power, we have already seen what the situation is, and even if it is developed successfully, we are talking about 23 percent.

Hydropower and geothermal steam, of course, are also out of the picture.

So we go back to the basic proposition. I think it is this: Is it necessary at this time to intensify our efforts in the development of coal gasification processes?

I think the practical answer to that question is yes. We know that our energy supplies are decreasing. We know that the demand is increasing. We know we must depend on present sources for approximately 10 years. We know that if we do not develop additional sources, we could be in serious trouble as to our energy requirements in the 1980's. We know that even if we are successful in developing a coal gasification process that is commercially feasible, several years will be required to translate such success into a measurable contribution to the Nation's energy requirements. We know that our coal resources are the greatest fuel resources we have at the present time and that the development of a feasible method of utilizing these resources could provide not only a measurable contribution to our peacetime energy needs but could be the essential backstop for us in case of war.

Hence, it seems that the objective is clear. The commercialization of coal gasification should be pursued with the greatest diligence.

The next question is: What methods should be used in this pursuit? Now as the chairman and the members of this committee well know, efforts to gasify coal have been in existence for a number of years. No doubt, substantial progress has been made. I do know that we have a substantial base in this undertaking at the present time that has cost a lot of money.

It is my understanding that at the present time there is a joint program between the Department of Interior and the American Gas Association, which joint effort contemplates basic research of pilot plant

evaluation over a period of approximately 4 years. It is my understanding that this program will be explained by the American Gas Association and hence I do not undertake to treat it further here.

I am also aware of the fact that there are presently in existence four research centers, staffed and active, in coal gasification work; to wit, the Institute of Gas Technology, the Bureau of Mines, Bituminous Coal Research, and Consolidation Coal Co. These are the facilities which will be available in carrying out the present plans of the department and of the Government.

Now since the efforts and the activities above referred to concern pilot plant evaluation, I presume that you, Senator Moss, and Chairman Jackson, as well as others who have sponsored the bill, S. 1846 had such activities and programs in mind as the basis for the demonstration plant proposed in S. 1846 and that S. 1846 could serve as the vehicle for the final move from the pilot plant stage into the demonstration plant stage, and then, of course, to full commercialization. This would seem to me to be an effective and a most appropriate way to pursue the prime objective, to wit, the commercialization of coal gasification with the least possible delay.

Now I know the committee is interested, because of some differences of opinion, as to the method being pursued, wanting alternatives. I do not know of any alternatives to offer but I do have a few suggestions that I think should be made with relation to S. 1846.

First, I would suggest that some consideration be given to a revision of section 3A to the end that the corporation not be forced to select two methods or be confined to two particular methods. I think the flexibility would be helpful to the board of directors of the corporation.

Second, in Section 3B, I feel that some consideration should be given to a priority call on the commercially produced gas by those nongovernment participants in the program. Such priority could be based upon the percentage participation of the nongovernment participant. There would be no priority call on the percentage allocated to the Government.

No. 3, in section 6, it would seem appropriate that at the time of the dissolution of the corporation, the assets thereof should be divided on a pro rate basis between those who participated in the undertaking, both Government and nongovernment.

In conclusion, Mr. Chairman, I want to say we feel that intensification of a commercialized coal gasification program is essential. However, we do not believe that people should be misled into thinking that success in this undertaking will be an answer to the energy requirements of the country. At very best, it could only be supplemental. The heavy burden of our energy requirements must be carried on by oil and gas, and the efforts to find more must be substantially increased.

I thank you, Mr. Chairman.

Senator Moss. Well, thank you very much, Mr. Rogers, for a fine statement and the full text that you have submitted, which will be in the record.

You made reference to the fact that there is a program now under way in which the department is participating, among others, including the Natural Gas Association, in developing pilot plants to determine

how to do this gasification on a commercial scale. Do you believe that program can continue and the proposed corporation could accelerate the program, or would there be conflict and overlap?

Mr. ROGERS. Senator, I do not know. I think, really, it could be used. My concept of this situation in developments of this sort has always been on a three-stage development: A pilot plant, demonstration plant, and then the commercialization plant.

In reading S. 1846 I concluded, because the term "pilot plant" was not used, that the committee had taken into consideration. I believe since 1960, that there has been a program in being working toward the development of pilot plant evaluation and that this has been stepped up by a substantial contribution from private industry with which they hope to trigger additional activity that will develop something very soon.

Now my feeling, Senator Moss, was this—maybe I was wrong about it; if I am, I apologize! In viewing this from this standpoint, since the first appropriation provided in this bill was \$5 million, I assumed that this was for the purpose of setting up the mechanics of moving forward in the demonstration plant area and that it was thought that by the time this came into being during the first year—of course, \$5 million, in my opinion, would be just a drop in the bucket to what will be required to develop this program. This was the thinking, that you get this set-up and the work that is being done by the Department of Interior at the present time may be fruitful by the time the mechanics of this operation were really in being.

Senator Moss. Mr. Freeman, yesterday, in his testimony, said that it would be 2 or 3 years yet before the pilot plant experiment had proceeded far enough to move to the demonstration plant. Do you think that time can be accelerated or that it might be accelerated if we created this corporation?

Mr. ROGERS. Actually I thought that is what you had in mind; to accelerate it by this legislation.

Senator Moss. We really do have that in mind. I wondered if you thought we were correct in thinking we might speed it up.

Mr. ROGERS. This was my thought when I first read the bill.

Senator Moss. The thing I really wanted to get your views on: We have started the development of the pilot plant work. It is going along. But what we are confronted with is really a crisis situation just around the corner in energy, and the question is: By pinpointing responsibility in corporation and giving it certain specific things to do such as welding the Government and industry together on the corporate board, can we move it ahead enough to make all of this worth while? Is it worth doing it this way?

Mr. ROGERS. Well, of course, I think this: I think the prime objective is that we have to find the energy. I think with coal as the major resource of energy that we have, we have got to move forward on it and have to move forward fast. The vehicle that we use to do that with, I feel, is a matter that ought to be left up to the expertise of Congress.

I know that there are a number of merits to permitting it to be done by a Government department. I know there are probably an equal number of merits to have it focused under a quasi-government

corporation, but I think what we are confronted with here is something in the very nature of a crash program. How this is going to be done, as I say, ought to be left up to the expertise of Congress to decide just which avenue you follow to pursue it.

The organization that I represent, the Independent Natural Gas Association of America, which hauls 90 percent of the gas that is hauled interstate, is going to work with you, whatever you do, in trying to reach the objective you are searching for.

Senator Moss. The intention of this bill is to have the costs divided roughly 60-40. Is there any question about the willingness of members of your association to participate economically in this?

Mr. ROGERS. No; I do not think so at all. Of course, you understand, Senator Moss, that the American Gas Association represents most all of the distributors and the group that I represent are primarily the long lines—what you call the long lines—plus a number of producers plus a limited number of distributors.

I think that you are going to get help from all of these people in moving forward in this project to gasify coal. Of course, you must realize this: Some of them would not profit too much from gasification of coal because it could be a regional situation. But you go back to the old theory that if you put something in over here, it will relieve the pressure over here.

I think I could sum it up by saying that we are all interested in trying to get something to meet the energy needs of this country.

Senator Moss. Thank you very much.

Senator Anderson?

Senator ANDERSON. You are familiar with the plant in Chicago?

Mr. ROGERS. The IGT plant? The Institute of Gas Technology Plant at Evanston, Ill.?

Senator ANDERSON. There are three or four places under development.

Mr. ROGERS. I do not know; I am not familiar with that, Senator. As a matter of fact, I think the AGA will be able to bring you up to date more on that. I could not.

Senator ANDERSON. In the New York area, Consolidated Edison—

Mr. ROGERS. It is the Consolidated Coal Co. that has that contract. These are the—

Senator ANDERSON. The utility plant is pretty well established out there, isn't it? Didn't Chuck go out there to work with the people there?

Mr. ROGERS. I cannot hear you. The microphone is not working right.

Senator ANDERSON. I have some trouble which makes it difficult. I realize that.

Mr. ROGERS. I can understand you but it is not getting out here.

Senator ANDERSON. I am trying to say that apparently in the Chicago area some very good work has been done on nuclear energy. In the New York area too.

Mr. ROGERS. I would yield to the Senator on nuclear energy. I do not think there is a greater expert in the world than Senator Anderson on nuclear energy, with the background that you had in it.

Senator ANDERSON. Thank you.

Senator Moss. Thank you. What you say about Senator Anderson is absolutely correct. He knows this nuclear energy field forwards and backwards. We all defer to him.

I think the point Senator Anderson was trying to make is that we are going ahead pretty well in nuclear energy. He thought maybe you had not given that quite enough emphasis, perhaps, in your statement.

Mr. ROGERS. My whole reference to nuclear energy has to do with the situation that has been developed. They say that if it is not successful, then we are going to be forced to depend on fossil fuels on into the 21st century.

I want to say this: If that nuclear development is successful—and I sincerely hope it will be, and I think it will be—I think most of the success can be laid at the doorstep of Senator Anderson for what he has done in the past.

Senator Moss. We all agree with that and we are hopeful this breeder reactor can be brought along because it offers the greatest hope of production of energy from nuclear sources.

But I think your testimony was that even predicting full success, it is still only going to take a quarter perhaps—

Mr. ROGERS. Twenty-three percent is what they estimate we have to have by 1990.

Senator Moss. Senator Fannin?

Senator FANNIN. Thank you. I commend you for an excellent statement and fine testimony. I was very pleased to learn about the work being done by your association.

As a matter of curiosity, I wonder about the economics of coal gasification. I do not know how far along you are, whether you would know how that would meet, for instance, with the liquified natural gas that we are bringing in now from some of the countries that El Paso Natural Gas has been working with. They are spending several billions of dollars over years to accomplish this objective. How will the economics compare as far as your liquified natural gas with the coal gasification program?

Mr. ROGERS. Well, Senator Fannin, of course, there are estimates all over the lot about this, but I think if we get this down into a focus of say—I believe the estimate is 80 cents to \$1 an Mcf, which I think is a good accurate measure in this. Now I think the lng and the coal gasification could very well, so far as I know, be in the same economic ball park.

Senator FANNIN. Of course I feel that we should strive to assure a domestic source while we are still going after a foreign source of supply, but this would be methane or ethane—what is your end product in coal gasification? Methane or ethane? How would you qualify it against natural gases?

Mr. ROGERS. You mean economically? It will be pipeline gas.

Senator FANNIN. So it would be methane or ethane. Very little propane or butane or anything like that.

Mr. ROGERS. I do not know enough about the coal gasification process—

Senator FANNIN. I was wondering about the handling of it. If it is methane or ethane, you will have it under very high pressures. With

propane or butane, you get into lower pressures. I was wondering about how that would compare.

But that is fine; you gave me the answer I want from the standpoint of the economics in comparison with lng. We are investing so much money in that program that, by comparison, we are certainly not investing anywhere near that amount in gasification, as I understand it; is that correct?

Mr. ROGERS. That is my understanding at the present time. I am like you Senator. I think we ought to try to develop our domestic reserves as soon as possible.

Senator FANNIN. Well, you have given us some valuable information here as a guide and I certainly know we all appreciate it. Thank you very much for your testimony.

Senator MOSS. Senator Hansen?

Senator HANSEN. Thank you. I have a couple of questions.

First of all I want to compliment you on your very excellent statement this morning. I understand, from the few conversations I have had with industry people, that there are those who believe that enough now is known about the state of the art as to make feasible coal gasification, assuming that the price might be moved upward so as to make it feasible economically. That is, as far as the processes go, there are those who think that a considerable amount of gas could be injected into our lines now to meet the increasing demand.

Recognizing that no process is ever perfect or is ever incapable of being further improved, do you think that this legislation might tend to deter the early completion and bringing on-stream of coal gasification plants by private industry? Would there be reason to believe that the technology that could be developed through this approach would make obsolete their plants that otherwise might be brought into being at the present time?

Mr. ROGERS. Well, Senator, I do not think so because I think, really, what we are talking about in this overall picture is not the gasification of coal—maybe I am wrong about that, but my understanding is that we know how to gasify coal. What we are talking about is commercialization of gasification.

I think that private industry or anyone else would be very well satisfied with any method that could be devised to get coal into an economic situation where it is competitive with other fuels. I think there has to be a lot of money spent and there has to be a lot of work done. I think the quicker that this is attended to, the better off this country will be in finally getting gasified coal.

I do think this: I think it ought to be pointed out that even if these processes are successful, we are not talking about a tremendous amount of natural gas as compared with what our requirements are. When we are talking about 250 million cubic feet of gas produced a day, that will not answer much of the requirements of the American public.

Senator HANSEN. Well, one further question. What do you think should be the role of the FPC in continued price regulation of gas? Would it be your feeling that there should be complete decontrol of gas made through this coal gasification process as contrasted with gas supplied from oil and natural gas fields?

Mr. ROGERS. Well, I was in the middle of the fight over in the Interstate and Foreign Commerce Committee of the House back in 1956 when we tried to decontrol the price of gas at the wellhead. I think that if we had been successful finally in that situation, I think we would be in a much better posture today. Whether it would be a satisfactory posture, I do not know.

Senator HANSEN. I share your feelings.

Mr. ROGERS. I know you do. Let me make this other statement: I was very impressed by the statement of David Freeman yesterday when, in answer to your questions, he said that very serious consideration ought to be given to deregulating future gas.

Now I think that we have proven by what could be maybe realistic one year and unrealistic the next that Government control and regulation of the gas situation has caused a lot of trouble. I think that what we are getting into right now, insofar as energy is concerned, is a situation where the marketplace, itself, is going to determine the price that people pay for energy.

Senator HANSEN. Don't you think it should set the priorities of use? It is my understanding at the present time that, because of the impact of interstate regulation, there are gas sources of supply presently being committed interstate to uses that I think could be supplied as well by other sources of energy, and that situation tends to deny the critical areas of the country the natural gas that they should be receiving and would be using if it were available.

Mr. ROGERS. Yes, Senator Hansen, I think marketplace economics would take care of that situation very quickly.

Senator HANSEN. Thank you.

Senator Moss. Thank you, Senator. We have a vote on in the Senate so we will be in recess for 10 minutes while we vote.

(Recess.)

(The prepared statement of Mr. Rogers follows:)

STATEMENT OF WALTER E. ROGERS, PRESIDENT, INDEPENDENT
NATURAL GAS ASSOCIATION OF AMERICA

Mr. Chairman and members of the committee: My name is Walter E. Rogers. I am President of the Independent Natural Gas Association of America and appear here today on behalf of that organization. The Independent Natural Gas Association of America has a membership made up of substantially all of the major interstate pipelines engaged in the transportation of natural gas in the United States; it also has among its members a group of producers of natural gas and a group of distributors of natural gas. It is a non-profit industry organization.

First, let me express the appreciation of this organization to you, Mr. Chairman, and to Mr. Moss, your co-author of this legislation, for your vigorous efforts in pushing forward toward a solution of the energy supply problem. A problem that could very well develop into one of the most serious in the history of this republic. Your activities in this regard, including the introduction of the measure now before the Committee, have served to alert the people of this nation that now is the time for action.

Let me begin my testimony by addressing myself to the basic energy problem of which the subject under discussion is an integral part. It should be pointed out that man has consumed more energy in the past one hundred years than in the previous two thousand. There is no reason to believe that this continuing increase in demand will lessen. Only a few years ago many experts were guardedly talking about the possibility that energy demands might double by the year 2000. Now many are confidently predicting that energy demands will probably

triple by the turn of the century. In either event, this country is going to need a lot of energy, a lot more than we have deliverable at this time. A supply of energy that we must find or develop unless we are prepared to yield our position of world leadership. Certainly, the latter is unthinkable!

At the present time, the energy consumption of this country is approximately 68 quadrillion Btu. 75.2% of this demand is provided by oil and gas; 20.5% by coal; 4.1% by hydro sources; and 0.2% by nuclear sources. It has been estimated that by the year 1980, the energy requirements will increase to 95 quadrillion Btu., and by the year 1990, this country will require 140 quadrillion Btu. Assuming the accuracy of these figures, we must ask ourselves the next question, "Where is it to come from?"

OIL

In the case of oil, it has been estimated that by the year 1985 this country would be required to depend upon foreign imports for 50% of its needs. At the present time imports provide nearly 50% of the total use of liquid fuels on the East Coast. The over-all problem with relation to oil and gas was summed up in excellent fashion by Dr. Richard J. Gonzalez, a renowned consulting economist, in a paper presented to the Brookings Institute in Washington, D.C., on April 20, 1971, styled "Energy, Economic Growth, and the Environment." In this statement Dr. Gonzalez stated:

"Energy requirements for the next 20 years have already been determined in large measure by decisions on where we live, work, and shop, by the fuels used in plants that will be in operation for many years, and by the long time-lag in bringing about a major change in energy use. If sufficient petroleum supplies can be made available at prices that remain attractive relative to rising real incomes, consumers would probably double their use of oil and gas within 20 years. In that case, potential use for 1971-90 would be 165 billion barrels and 660 trillion cubic feet, or several times presently known U.S. reserves, even including those of the North Slope."

NATURAL GAS

With relation to natural gas, several observations should be made. In the first instance, gas now provides approximately 32% of the energy needs of this country. It is estimated that by 1980 this percentage will be reduced to 27.9% and by 1990, to 25.5%. These projected reductions do not indicate a lessening of demand for gas, but a deficiency in supply. In other words, although the projections would indicate an increase of approximately 5 trillion cubic feet annual consumption by 1980, the percentage contribution to the national energy requirements would be reduced. The projection to approximately 36 trillion in 1990, although reflecting an increase in demand of some 15 trillion cubic feet annually, reflects a resulting decrease in the percentage of contribution. However, in this respect it should be pointed out that the present consumption of natural gas in this country is confined almost entirely to domestic sources. The projections for the future, of course, include some measurable contributions of liquefied natural gas imported from various overseas sources. Hence, it is obvious that the decline in the percentage of contribution of gas in the future, both as to domestic and foreign supplies (and including the North Slope of Alaska), is due entirely to estimated deficiencies in supply. It could be confidently said that if the supply of natural gas was available and deliverable, the contribution to the national energy requirements in future years would substantially exceed 50%. This is, of course, due to the fact that natural gas is the cleanest, most efficient fuel available and makes the least possible contribution to detrimental impacts on the environment, including its production, its transportation, and its final use.

HYDRO-ELECTRIC POWER

The contribution of hydro-electric power cannot be expected to measurably increase for the simple reason that practically all of the sources of such power have already been tapped and are being utilized.

NUCLEAR POWER

It is anticipated that this source of power will be developed to the point that by 1980 it will be providing 10% of the nation's needs and by the year 1990, it will be providing approximately 23% of the nation's needs. However, in this

respect it would be well to remember that only a few years ago it was estimated that by 1970 nuclear power would be making a substantial contribution to the energy requirements. 1970 has come and gone, and nuclear energy was providing less than 1% of the energy needs of this country in that year. Of course, I would hope that nuclear technology will be able to fulfill its promises on schedule, but if it fails, our dependence on fossil fuels will continue to increase measurably into the twenty-first century.

GEOTHERMAL

Although power from geothermal steam would be a most welcome addition to the energy sources of this nation, at the present time it does not appear that a measurable contribution can be expected from that source for some years to come. Every effort should be made for its continued development, but we cannot depend upon it as a major or even a supplemental source in the near future.

COAL

Reference to coal has been saved for last in mentioning our fuel sources, for the reason that it is the subject of the pending bill and for the further reason that it provides by far the greatest reserves as a domestic energy source. If properly utilized, it could very well assume a much greater role in contributions to the national energy requirements than it has in the recent past. It could very well be the major factor in helping to meet the increased demands that are inevitable. In any event, the proper refinement of known processes to gasify coal could provide a substantial backstop should the anticipated development of nuclear technology fall short.

POSSIBLE SOLUTIONS

The discovery and production of substantially greater quantities of oil in the continental United States and offshore areas would be of great help. The quest for this source of energy will no doubt continue as long as appropriate incentives are present, and it can be expected that additional supplies will be found. However, we must realize that oil is a depletable asset, and under present circumstances, it would be folly to think that an additional amount sufficient to meet the ever-increasing demands of our economy could be found. Hence, oil alone could not be expected to answer the problem.

The discovery and production of a great deal more natural gas would be the most desirable solution. And every effort should be made to tap every possible source for this most desired of fuels. It has been said that if gas had not been subjected to government domination, unrealistic regulatory practices, and gross underpricing, we would not today be faced with the fast declining gas reserves picture and the developing shortage crisis. Whether or not this statement is correct, is of little consequence. The fact is that we are faced with a natural gas shortage that is going to grow worse unless we do something about it. There must be recognition of the fact that investors will not risk their money in a venture where the possible return is much less than in a non-government dominated industry. It must be recognized that the search for natural gas found and produced at on-shore depths of 15,000 feet and below and offshore activities that must be conducted in water depths of 200 feet plus, will cost much more than exploration for natural gas that has been produced in the past in this country at depths of 1,500 feet to approximately 8,000. It is my belief that if the check reins that have so encumbered the natural gas industry can be loosened, much can be accomplished by this industry, especially in the area of meeting a greater percentage of the energy demands during the next fifteen to twenty years that may prove to be a transitional period for this country in energy sources and uses.

Of course, everyone still has high hopes for some measurable relief from nuclear power. However, it must be remembered that the advance billings of the potential of nuclear power have fallen flat to date, and we are now faced with the advice that we are looking to a ten-year period of technological development before such relief may be expected.

As pointed out heretofore, we cannot depend on hydro-electric power for any substantial increase in its contribution. At the present time, we cannot expect help from the geothermal steam source.

So we come back to coal and ask ourselves the question, "Is it necessary at this time to intensify our efforts in the development of a coal gasification process?"

I think the practical answer to that question is "Yes." We know that our energy supplies are decreasing. We know that the demand is increasing. We know that we must depend on present sources for approximately ten years. We know that if we do not develop additional sources, we could be in serious trouble as to our energy requirements in the 1980's. We know that even if we are successful in developing a coal gasification process that is commercially feasible, several years will be required to translate such success into a measurable contribution to the nation's energy requirements.

We know that our coal resources are the greatest fuel resources we have at the present time, and that the development of a feasible method of utilizing those resources could provide not only a measurable contribution to our peace time energy needs, but could be the essential backstop for us in case of war.

Hence, it would seem to me that the objective is clear. The commercialization of coal gasification should be pursued with greatest diligence. The question is what methods should be used in this pursuit.

As the Chairman and Members of this Committee well know, efforts to gasify coal have been in existence for a number of years. No doubt substantial progress has been made. Whether or not greater progress would have been made in an emergency, I do not know. I do know that we have a substantial base in this undertaking at the present time. It is my understanding that there is presently in being a joint program between the Department of Interior and the American Gas Association, which joint effort contemplates basic research of pilot plant evaluations over a period of approximately four years. It is my understanding that an explanation of this program and these efforts is a part of the Department of Interior presentation before this Committee and also that of the American Gas Association. I am also aware of the fact that there are presently in existence four research centers staffed and active in coal gasification work—to wit, the Institute of Gas Technology, the Bureau of Mines, Bituminous Coal Research, and Consolidation Coal Company—the facilities of which will be available in carrying out the present plans.

Since the efforts and activities above referred to concern pilot plant evaluations, I presume that the Chairman and Mr. Moss, as well as others who sponsor the bill S. 1846, had such activities and programs in mind as the basis for the demonstration plants proposed in S. 1846. And that S. 1846 could serve as the vehicle for the final move from the pilot plant stage into the demonstration plant stage, and then to full commercialization. This would seem to me to be an effective and a most appropriate way to pursue the prime objective—to wit, commercialization of coal gasification with the least possible delay.

ALTERNATIVES

Although I do not have any particular alternatives to offer, I do have a few suggestions with relation to S. 1846:

1. I would suggest that some consideration be given to a revision of Section 3(a) to the end that the corporation not be forced to select two methods or be confined to two particular methods. I think the flexibility would be helpful to the Board of Directors of the corporation.

2. In Section 3(b) I feel that some consideration should be given to a priority call on the commercially produced gas, by those non-government participants in the program. Such priority call could be based upon the percentage participation of the nongovernment participant. There would be no priority call on the percentage allocated to the government.

3. In Section 6, it would seem appropriate that at the time of the dissolution of the corporation, the assets thereof should be divided on a prorata basis between those who participated in the undertaking, both government and non-government.

CONCLUSION

In conclusion, Mr. Chairman, we feel that intensification of a commercialized coal gasification program is essential. However, we do not believe that people should be misled into thinking that success in this undertaking will be an answer to the energy requirements of this country. At very best, it can only be supplemental. The heavy burden of our energy requirements must be carried by oil and gas, and the efforts to find more must be substantially increased.

Senator Moss. The hearing will come to order. Our next witness is Arthur T. Woerthwein, vice president of the ITT Corp. for the

Gas Appliance Manufacturers Development Corp. We are pleased to have you, Mr. Woerthwein, and your associate. We look forward to hearing your testimony.

STATEMENT OF ARTHUR T. WOERTHWEIN, VICE PRESIDENT, ITT CORP., FOR GAS APPLIANCE MANUFACTURERS DEVELOPMENT CORP., ACCOMPANIED BY HARRY A. PAYNTER, MANAGING DIRECTOR, GAMA

Mr. WOERTHWEIN. The industry I am representing today appreciates being given the opportunity to present its views on a very important matter—the total energy shortage and the contribution that research and development in coal gasification can be expected to make to the solution of the problem.

With me today is Harry Paynter, managing director of GAMA. Today, I am representing more than 500 manufacturers. These manufacturers produce more than 90 percent of all the gas appliances and equipment sold in the United States. Our association, the Gas Appliance Manufacturers Association, most frequently referred to as GAMA, has been the voice of the gas appliance industry before Congress for many years.

Our industry has been studying the current fuel shortage and the prospective shortages of the future for quite some time. That the problem is a matter of deep concern to us must be quite obvious, but if it is not obvious, I hope that this statement will make it so.

The vehicle for this study has been GAMA's Gas Availability and Supply Committee, of which I am the chairman. I will speak to our study in more detail a little later.

We are aware, of course, of current activities in coal gasification, and we are also aware of the joint arrangements under discussion by segments of the gas industry and the Department of the Interior. These, of course, should continue and should be encouraged. The need to demonstrate concepts through pilot plants and prove the feasibility of commercial-sized facilities once pilot plants have succeeded in demonstrating concepts, would appear self-evident. Government and industry should work together in attempting to solve the problem. It is in this context that we find S. 1846 interesting. GAMA wants to work with all who share the problem, and this would include the Coal Gasification Development Corp. should it be established.

The advantages of natural gas are very concisely set forth in section 1 of the bill. It is largely because of these advantages that the demand for natural gas can be expected to exceed the supply available in future years. Being clean and efficient and economical, supply could be expected to have difficulty in keeping up with demand even in the absence of an across-the-board energy shortage. This shortfall of supply in comparison with projections of demand can therefore be expected to exist even though all the means now being considered for supplementing the domestic supply are fully exploited. Among the means of developing alternate sources of supply now under consideration are the following:

- (1) The transmission of natural gas from the Arctic,
- (2) The importation of liquefied natural gas, and
- (3) The gasification of coal.

Of these three alternatives the production of natural gas through the gasification of coal offers advantages that apply to it alone. With our truly tremendous reserves of coal, we would have a source not subject to the restrictions that are always possible in international trade. The reserves would be ours, and be under our control. Also, a new industry would be created providing a major new source of employment. And, developing gas from coal could lead to further technological breakthroughs with respect to the conversion into gas of other hydrocarbon materials, such as shale, known to be in abundant supply. The comparative advantages of coal gasification in relation to other alternative sources of supply are additional reasons for proceeding with coal gasification without delay.

Having indicated the need to proceed with all deliberate haste, it follows that one of my purposes today is to underscore the urgency of the matter. We simply must pursue aggressively all avenues that hold the prospect of leading reasonably to an increase of the availability of natural gas.

I want, during this presentation, to make it clear that the shortage of natural gas already manifest in a few regions has had a serious and adverse effect on the sales of gas appliances and equipment in all regions. And make no mistake, the effect has been most serious. In fact, unless solutions are found to the basic problem to which the bill addresses itself—the need for more gas—the harmful consequences of the shortages will affect not only the manufacturers of appliances and gas burning equipment but will also affect the other segments of the gas industry (the producers, the transmission companies, and the local utility companies); will adversely affect the entire economy; and will deprive us of the most immediate means of improving our air environment.

The balance of my statement will be an expansion of the foregoing conclusions, but in order that I will not sound like a harbinger of doom let me speak for just a moment in a more positive tone.

GAMA believes that the total energy problem in general, and the natural gas availability and supply problem in particular, can be solved. The problem is manageable. There are a variety of approaches. But, if we are to manage the problem, and avoid the serious possible consequences to which I alluded a moment ago, action on all possible fronts must be taken promptly. Every avenue—every approach that can reasonably be expected to contribute to the solution must be pursued aggressively. Time is very much of the essence, and we must use it wisely and not waste it. We may not be able to overcome the consequences of delay.

We have found much to encourage us in recent weeks. The President's energy message to the Congress is most encouraging. The recent actions of the Federal Power Commission in providing incentives for producers to develop new reserves is also encouraging. The action taken by the Department of Interior to accelerate its leasing schedules should bear dividends. And, the fact that these hearings are being held with view toward accelerating progress in producing gas from coal is still another very encouraging sign.

To provide you with the basis for our sense of urgency, let me tell you of some of the ways the industry I represent has so far been hurt by actual shortages—and even by anticipated shortages.

First, in those regions where the gas shortage first appeared, we have seen the sales of gas burning appliances and equipment decline substantially. As an example, in one major industrial application—the direct-fired makeup air heating application, an area very important to environmental considerations—sales this year compared with last are off as much as 40 percent. In such regions, our industry has lost and is continuing to lose markets.

One reason for this loss, as you might expect, is the effect that actual shortages have in raising apprehensions in the minds of consumers who are prospective purchasers of gas burning equipment. Our consumers need to be reassured, need to know that the problem is manageable, need to realize that something can and is being done to assure the long term availability of adequate supplies.

Another reason for the loss is that those utilities which have gas, but not sufficient in quantity to supply all existing or potential customers, can be expected to allocate, when possible, available gas to those able to pay the highest rates. The effect of such allocation is that new commercial and industrial applications which are subject to the lowest rates are discouraged. The result is that the most efficient industrial equipment, utilizing the cleanest of all fossil fuels, may disappear from the market, if the market, because of real and anticipated shortages of gas, is not sufficiently attractive to justify equipment production.

Up to now, I have spoken to the effects in the few regions in which there have already been shortages. Let me turn now to the effect in regions where there have as yet been no shortages—and that represents a major part of the United States. Here, we see what I might call a spillover effect. Bad news seems to travel, and as a result we find market apprehensions and market losses in regions where there never has been, and, we hope, never will be a shortage of natural gas.

Manufacturers are not going to produce for nonexistent or weak markets. They are going to apply their energies and skills to the better markets. When sales drop 20 to 40 percent, you can expect changes to be made in corporate planning. Therefore, it is not at all surprising that changes in plans have been made, or are under consideration, by many of the manufacturers I am representing today.

One area of change deserves special mention—the area of research and development in gas technology. The money usually spent for gas research and development is beginning to dry up. That money, not surprisingly, is being channeled into other than gas technology research. Again, the long term effect of this can be very serious. Once you fall behind in a technological competition, it is not easy to catch up. If this trend is permitted to continue, it could lead to the loss by the gas industry of its hard-earned and well-deserved progressive image. It is not too late to reverse this trend, and actions such as those contemplated by the bill under consideration are bound to be helpful in this regard.

This trend in research and development is important in yet another sense. The President, in his energy message emphasized the need to use our available energy more wisely. Many applications in service today are old, and are less efficient than they need be. The updating and modernizing of industrial equipment could result in the use of less gas to accomplish a given purpose. That is true even with today's state of the art. But how do we sell on such a basis in the face of consumer appre-

hension—whether it is warranted or not—with respect to gas availability?

And, I am absolutely convinced that research and development can lead to technological improvements which would still further economize in the use of our cleanest energy source.

The problems I have outlined for you, Mr. Chairman, are, in my judgment, serious. Accelerating the arrival of the day when we are producing and distributing natural gas made from coal is, therefore, a most important objective—even a vital one so far as our industry is concerned.

I shall not attempt to comment on the relative merits of proposals set forth in S. 1846, on the one hand, and on the joint Department of the Interior and gas industry plan of coal gasification on the other. Both approaches address the same basic problem—the need for more gas. Both envisage industry participation, and GAMA would hope to be able to support the efforts of either or both. The important thing is that timely action be taken because the need is great, and the time to take all possible actions is now.

In making this presentation today, I have been reporting to you the results of a position statement on the natural gas available and supply problem as developed by the GAMA committee of which I am chairman. This position statement has been approved by GAMA's board of directors, and was adopted by the GAMA membership in April of this year. Thinking that it may be helpful to the record, I have appended it to this statement.

On behalf of the industry, and on my own behalf, I express my appreciation for the opportunity to appear before you. If my remarks have stimulated questions, and I hope they have, I shall do my best to answer them.

That concludes my statement, Mr. Chairman. Thank you.

Senator Moss. Thank you very much, Mr. Woerthwein. The pending part of your statement will appear in the record as part of the statement. We are very pleased with it.

I note you confined your statement largely to the need for more gas, showing its impact on the Gas Appliance Manufacturers Association, whom you represent, but you did not want to choose between the corporation approach and the research approach now being carried on by Interior and others. Do you believe that both ought to be fostered and pushed at this point? Both the corporate approach along with the departmental and corporative effort are being made now.

Mr. WOERTHWEIN. I think it would be good if they were both continued.

Senator Moss. It is a big enough crisis that we ought to put every leverage we can behind it. Would you agree with that?

Mr. WOERTHWEIN. Yes, sir, Senator Moss.

Senator Moss. I only have one or two questions.

Section 2B calls for: "To encourage utilities to insure the most efficient use of the available supply." Will the gas appliances be made more efficient or will inefficient appliances be replaced? Could you elaborate on how this might be done?

Mr. WOERTHWEIN. I can tell you what we are trying to do at the present time. That is, working through the American Gas Association

and the gas utilities, we have sent out brochures suggesting that old and inefficient equipment be replaced.

Senator MOSS. I see. This has a consumer impact, too, I suppose. If you have an inefficient unit, which wastes gas, it is, therefore, more expensive.

Mr. WOERTHWEIN. The new one would cost less to operate.

Senator MOSS. One ominous thing, as you indicated, is that funds are beginning to dry up in research as far as gas appliances are concerned. This would tend to stabilize the efficiency level at where it is now rather than continue to try to improve it, is that right?

Mr. WOERTHWEIN. That is why we hope that this goes through.

Senator MOSS. Is this recommendation about replacing their old equipment for more efficient equipment going out both to industrial and domestic users?

Mr. WOERTHWEIN. Primarily industrial.

Senator MOSS. Primarily industrial. But you would make the same recommendation, I assume, to domestic users of gas appliances.

Mr. WOERTHWEIN. Yes.

Senator MOSS. Thank you very much.

Senator FANNIN, do you have some questions?

Senator FANNIN. Thank you, Mr. Chairman.

I notice in your statement here that you talk about the alternate source of supply now under consideration. As far as our domestic sources, you feel gasification offers the greatest opportunity; is that your feeling?

Mr. WOERTHWEIN. Yes.

Senator FANNIN. An assurance of supply, but naturally, if we bring natural gas from the Arctic that would be the ideal situation. I am just wondering when you talk about the conversion of equipment, or even the improvement in equipment, isn't this mostly pertaining to water heating or refrigeration? I notice that now gas refrigeration is coming forward quite rapidly. Do you know what increase there has been in this commercial gas refrigeration equipment? I am talking about the type of water cooled units that—

Mr. WOERTHWEIN. It is really not great.

Senator FANNIN. There was quite a concentration on the increase in utilization of gas refrigerators. I do not know whether that subsided or not.

Mr. WOERTHWEIN. It is still coming up but is really not great.

Senator FANNIN. Does your association enter into that activity?

Mr. PAYNTER. Our manufacturers are involved in all the industrial and commercial applications of gas, not only in the appliances but across the board.

Senator FANNIN. We are talking about cooking. That is minor as far as the—many utilize gas for cooking but as far as the supply is concerned, that is a minor source, is it not?

Mr. PAYNTER. That is right.

Senator FANNIN. This gasification brings out a product that can be placed in the lines with the other gases, is that true?

Mr. PAYNTER. Yes.

Senator FANNIN. It is not like propane or butane. You can still have it flow through the same line without any conversion of equipment?

Mr. PAYNTER. Yes sir. It is a pipeline quality gas.

Senator FANNIN. Then your heating and industrial uses would really be where the volume would be utilized. Of course, that is where you can make the saving so far as improved equipment, is it not?

Mr. WOERTHWEIN. Yes sir.

Senator FANNIN. Thank you very much.

Senator MOSS. Senator Hansen?

Senator HANSEN. I do not have any questions.

I want to compliment you on your excellent statement. It was very realistic in the recommendations you made.

Mr. WOERTHWEIN. Thank you.

Senator MOSS. Senator Bellmon?

Senator BELLMON. No questions.

Senator MOSS. Thank you very much, gentlemen. We appreciate your appearance and your statement for our record.

(The appended statement of Mr. Woerthwein follows:)

GAMA POSITION WITH REGARD TO THE ENERGY CRISIS AND NATURAL GAS SUPPLY

NOTE

This "position" is based upon the consensus of numerous discussions by GAMA committees, the results of our late 1970 Natural Gas Supply Study, published items and articles, an awareness of the importance of energy availability to the national economy and well-being of American consumers, and a recognition of the importance of natural gas to maintenance and growth of industrial, commercial and residential America.

POSITION

The Board of Directors and the more than 500 manufacturer members of the Gas Appliance Manufacturers Association recognize that the sky-rocketing demand for energy in the United States of America is rapidly creating a major crisis for all energy sources. Particularly we are aware that in many areas current supplies of natural gas are insufficient to meet the increasing demand.

It is also our belief that the overall energy supply emergency has not received the widespread publicity to which natural gas has been subjected.

The effects of this publicity have already been felt by manufacturers of gas appliances and equipment, for sales have declined not only in those areas where the supply is critical, but in those areas where an adequate supply exists for growth and expansion.

We (GAMA) submit that the shortage of natural gas is not national in scope, but is a multiplicity of local shortages and should be approached with that thought in mind.

We further submit that the problems are not insoluble, and while we recognize solutions cannot be effected overnight, we urge that the gas industry—as an industry—adopt a more realistic and positive viewpoint in presenting the facts to their consumers. This would involve an effort to have local gas companies clearly identify their consumer communications and public announcements regarding curtailment of service to specific areas, types of service, and duration.

As an example, we cite a series of gas company announcements which stressed the shortage of natural gas and asked gas customers not to purchase new gas appliances and equipment. Their press releases and announcements to both customers and dealers were picked up by the press and publicized in unaffected areas. These situations have developed in many areas of the country. While the emergency actions were local, the negative results of the accompanying publicity were often wide-spread. This type of publicity can and should be avoided by the adoption of a few "fair-play" procedures which will be presented later in this paper.

It is also a matter of record that the sales of industrial gas equipment have been seriously affected. Numerous gas companies have already refused to supply

additional gas to existing plants or permit the use of natural gas in new industrial structures.

As a result, the declining industrial equipment sales of the present encompass many problems, including the need for manufacturers to re-evaluate the gas orientation of the equipment they currently produce. Additionally, government and the gas industry seem agreed that it will be five years before the natural gas supply becomes adequate for a return to normal growth patterns.

It is highly questionable that the gas industry will be able to return to a period of normal growth in the industrial, commercial or residential areas if it:

1. loses the support of gas appliance and equipment manufacturers;
2. forfeits its image as a progressive industry;
3. directly or indirectly urges consumers to utilize other fuels; or
4. if it does not take realistically constructive steps to maintain markets for the equipment which utilize the fuel.

It is clearly predictable that manufacturers are fast reaching a point of decision in some vital areas, including the answers to these questions:

1. Do we continue to spend Research and Development dollars on gas equipment?
2. Do we continue to promote gas equipment either singly or cooperatively?
3. Does our future lie with the manufacture of equipment utilizing those forms of energy which are more plentiful, or which are not publicized as being in short supply?

We (GAMA) are aware that solutions to current problems created by the energy shortage in general and the natural gas supply in particular, will not be found in activities of any single group, no matter how well conceived and implemented. We believe that government, industry, industry organizations and the fuel interests must work in concert if adequate solutions are to be forthcoming.

Let us apply this reasoning to our own industry and specifically to the alleviation of the shortage of natural gas supplies and to the correction of the adverse publicity which has had a negative affect on current sales and questions our future growth and service to the public, as well as our contributions to the national economy.

RECOMMENDATIONS

The Gas Appliance Manufacturers Association Board of Directors, acting on Behalf of its Members, Hereby

1. Urges that the proper agencies of the U.S. Government:

- (a) permit fair and equitable pricing to make more gas available at the wellhead;
- (b) adjust the depletion allowance provisions to more favorable levels; (Either one or both of these steps must be taken if independent producers are to be induced to re-enter the field of exploration and drilling.)
- (c) act promptly so as to encourage enlargement and extension of existing and new gas transportation and supply facilities; and
- (d) change federal leasing agreement terms to permit principal sums of lease payments to be based on gas produced rather than as prepayments, hopefully in such a way that these funds could be used for immediate exploration and development.

2. Asks the American Gas Association to conduct a campaign among its members to encourage their adoption of the following courses of action so long as the gas shortage exists:

- (a) adequate and equitable allocation of existing supplies among residential, commercial and industrial gas customers to assure long term retention of markets;
- (b) encourage utilities to strengthen existing marketing efforts and to intensify sales and promotional efforts in gas appliance and equipment replacement markets to insure the most efficient use of the available supply;
- (c) that with specific regard to industrial equipment each gas company continually inspect such equipment and make an all-out effort to promote replacement with modern, more efficient and economical gas equipment; and
- (d) recommend that gas utilities make sure that any public notification of a gas shortage be specific as to the area covered, the class of service affected and the duration. In addition, the notification should clearly specify the areas and types of service not affected.

3. Directs the GAMA Headquarters staff, with the guidance of the Gas Availability and Supply Committee, to:

(a) actively seek out areas of cooperation with the American Gas Association, other associations of the gas industry, and agencies of government, toward the end that all possible steps be taken to alleviate the natural gas supply shortage, and that markets for gas appliances and equipment be continually developed so that they might be made to yield the maximum of business attainable; and

(b) actively cooperate with all recognized associations representing fuels other than gas, or equipment using such fuels, so as to permit a maximum input to the solutions to the overall energy problems.

4. The Board of Directors further directs the Headquarters staff to:

(a) transmit the foregoing to the concerned parties; and

(b) transmit them, also, to the membership and establish the procedures for keeping the members informed as to the progress of the implementation.

NOTE

The membership of the association, at its meeting on April 23, 1971, gave its full endorsement to this position.

Senator Moss. Dr. Thomas H. Chilton, chairman of the National Academy of Engineers will be our next witness.

We are very pleased to have you, Dr. Chilton, and we look forward to your statement.

STATEMENT OF DR. THOMAS H. CHILTON, CHAIRMAN, NATIONAL ACADEMY OF ENGINEERS

Dr. CHILTON. Thank you for your invitation.

To introduce myself let me say that I retired in 1959 from the Du Pont Co. of Wilmington, Del., where I had served as technical director of that company's engineering department. Since that date I have had a succession of appointments as visiting professor at a number of universities in this country and abroad, lecturing generally on chemical plant design and process evaluation.

I want to make it clear I am not chairman of the National Academy of Engineers, though I am a member. Actually I am only serving as chairman of an ad hoc Panel on Evaluation of Coal Gasification Technology of the National Academy of Engineering—National Research Council Committee on Air Quality Management set up under the Division of Engineering of the National Research Council at the request of the Department of the Interior.

It is that circumstance, naturally, which prompted the chairman to invite me to present my views before you today. I want to have it clearly understood, however, that I am presenting my own views, as a chemical engineer, based, indeed, on oral and written reports by the principal groups active in coal gasification. My statement is not to be taken as reflecting the consensus of the ad hoc panel, which has not yet completed its deliberations, or as in any way representing the position of the National Academy of Engineering, which will be set forth in a report which will be issued after appropriate review.

Let me say at the outset that I am generally favorable to the objectives which the bill, S. 1846, seeks to accomplish. My reservations have to do with the matter of timing, and the need for an understanding of the financial commitments that will eventually be involved.

For these last 50 years I have been hearing recurrent dire predictions of impending shortages of natural gas, and of other petroleum

products, so that after so many cries of "wolf," it has become difficult to take such predictions seriously. Unexpected discoveries have kept reserves ahead of consumption until recently, that is. Whether as a result of regulated low prices of gas transported interstate, or the increased cost of exploration to deeper levels, or for whatever reason, the rate of discovery has fallen behind, in the face of increasing demand, and I am convinced that the impending shortage is this time a reality. What are the alternatives? Palliatives would include gas brought in from the farther reaches of Canada and from Alaska and imported liquified natural gas, but even at best these will not come anywhere near taking care of the predicted shortages.

We turn, of course, to coal, of which the United States is fortunate enough to possess abundant, though not inexhaustible, reserves. "City gas" of former days, technically known as carburetted water gas, ran 550 British thermal units per cubic foot. When, in the 1920's and 1930's, natural gas became available by pipeline, it gradually took over the market, and burners in homes and factories were adjusted to the higher heating value which it affords, approximately 1,000 British thermal units per cubic foot. The whole distribution system, long-distance and local, was built up to supply the ever-increasing demand, on the basis of gas of this heating value.

I would not go so far as to say that it would be impossible to reverse this evolutionary process and go back to a gas of lower heating value (a gas of maybe 450 British thermal units per cubic foot might be made by a modification of available technology). But it would be difficult, to say the least, and opposed on all sides, I am sure.

It is thus that the problem arises, of supplying the millions of consumers now dependent on natural gas with a supplementary source of fuel of approximately the same quality, referred to in the bill, S. 1846, as "substitute natural gas."

Technology for the large-scale production of gas of this specification does not now exist, and thus needs to be developed. Development work toward that end is under way at several centers, and four or five processes, differing somewhat in concept, have been proposed, and one or two are nearing pilot plant stage operation. It is my judgment that there is enough merit in several of these processes that they should each be tested on such a pilot scale before a decision is reached, 3 or 4 years hence, as to which one, or which ones, should be tried on a demonstration plant, employing units of the largest practicable size. Problems involving the handling of solids at high temperatures cannot be solved with assurance except on the scale that will finally be commercially adopted. There are other formidable and engineering problems that will likewise have to be overcome.

It should not surprise anybody to learn that gas made from coal, which is already as costly as natural gas per unit of heating value, if not more costly, is going to be more expensive than natural gas at present wholesale prices. There will thus not be the incentive to provide a substitute gas that there was 40 years ago when natural gas came to be the replacement for "city gas." A large investment will be required for any full-scale plant for manufacturing substitute natural gas, and without such an economic incentive, government financing will obviously be called for at the start. In this respect I go along with the provisions of the bill, S. 1846. It may be difficult to secure the

40 percent participation from private sources that the bill calls for, though industry has contributed toward the development cost of the processes now under study.

You have heard testimony to the effect that industrial groups will continue to participate.

Such information as I have had access to indicates to me that the emergence from the pilot plant testing stage to a demonstration plant is several years away at best, and it is my feeling, therefore, that the timetable contemplated in the bill as drawn is somewhat premature. Only research and development work will be justifiable for the next few years, I would not like to specify how many, and the immediate setting up of a coal gasification development corporation is not called for, as against continued liberal funding of the work being prosecuted for the Department of the Interior, on the scale mentioned yesterday of \$20 million plus \$10 million from private sources, making a total of roughly \$30 million a year.

Eventually very large sums will be needed, and the dollar figure mentioned in the bill gives no hint as to these amounts. While in the present state of process development no reliable estimate can be made, demonstration plants, which I feel are a necessary final step before commercialization of a gasification process for substitute natural gas, will each cost not less than \$100 million, maybe a good deal more. Dozens of such units will eventually be called for, as the shortage of natural gas becomes more acute. The problem of coal gasification should be viewed in the light of costs of this magnitude. These points have already been brought out today and yesterday.

To turn to a closely related problem, that of low B.t.u. (less than pipeline quality) gas, it appears that coal will continue to be consumed in increasing quantities for the generation of electricity, if we are to avoid "blackouts," for the next several decades. But the combustion of coal creates problems. Uncontrolled, it pours smoke and soot into the atmosphere; and its sulfur content (all coals contain some sulfur) is converted to sulfur oxides, a menace to health and to vegetation. Ways are being sought to cope with these problems, and will be found, I feel sure for large industrial uses, including central station powerplants, though it begins to look as if the expense of cleaning up the stack gases will be pretty high. From the standpoint of sulfur pollution, some way of removing sulfur from the fuel before it is burned ought to be sought. One such method would be to gasify the coal. That is one of the benefits expected from the coal gasification program. It would be easier to deal with the sulfur, then in the form of hydrogen sulfide, in a relatively smaller volume of gas, than to remove sulfur dioxide from the much greater quantity of combustion products. A European system for producing such a fuel gas is available but is not presently ideally applicable to American powerplant practice. The capital investment and operating cost may be high because of the multiplicity of small units. Fuel economy, or efficiency, would be low because of the needed carefully sized coal feed; the inevitable fine coal fraction cannot be used. For best thermal efficiency a hot gas sulfur removal system is required but has not yet been developed.

Simplified versions of the substitute natural gas processes, including one based on the European process, promise to eliminate these

difficulties. With a relatively small extra effort this could be an extremely beneficial "fall-out" from the substitute natural gas development program. Not only would this provide a solution to the sulfur problem, but it would facilitate the use of the gas turbine for producing electric power; and a combined gas turbine and steam turbine cycle offers promise of markedly reduced fuel consumption per kilowatt-hour and a great reduction in the heat rejected to cooling water ("thermal pollution").

This technology, which would provide sulfur-free gas for electric power station or other large-scale local consumption, produces gas of a low heating value, but as the consumption is local, no transmission cost the end result could be a relatively low-cost solution in the future to the powerplant environmental pollution problem. "Relatively" is used advisedly. No solutions will be cheap.

Senator Moss. Thank you Dr. Chilton. I am sure we have several questions.

Dr. Chilton, in your statement you say on page four that only research and development work will be justifiable for the next few years and the immediate setting up of a coal gasification development corporation is not called for as against continued liberal funding of the work being prosecuted by the Department of the Interior. I wonder whether or not you think that the urgency of the gas crisis doesn't justify some extra risks and, therefore, speeding up the building of the pilot and then demonstration and finally a commercial plant more rapidly than normally would be justified in this research effort.

Dr. CHILTON. Certainly the timetable needs to be shortened as far as practicable and efficient, but my own view is that the creation of the corporation at this juncture would not materially speed up the development program. That is my own view.

Senator Moss. You would tend to agree with Mr. Freeman. I do not know whether you heard him—

Dr. CHILTON. Yes, and I second his feelings in this matter.

Senator Moss. He indicated it would be 2 or 3 years yet before the pilot plants experimenting could be completed before you could start on to demonstration.

Dr. CHILTON. I might interject my own viewpoint that a continued period of operation of a pilot plant of maybe a year might be desirable before a commitment is made to a demonstration plant. All sorts of problems can arise and will require solution.

Senator Moss. Now you indicated that the National Academy of Engineering had taken on an assignment for the evaluation of coal gasification technology. Is this an established professional organization? Just what is this council of the National Academy of Engineers?

Dr. CHILTON. The National Academy of Engineering functions as the parallel organization to the National Academy of Sciences, and the National Research Council is the operating arm of these two academies. This committee on Air Quality Management is set up by the two academies in the National Research Council to consider these problems as they arise, and the one that we have undertaken at the present juncture, at the request of the Department of Interior, is to consider the possibilities for coal gasification and to advise them on the course of their research and development program. We are in the midst of that review at the present time.

Senator Moss. Have you arrived at any preliminary conclusions as yet that you could talk about?

Dr. CHILTON. I should not attribute any conclusions to the panel because our deliberations are not completed. My own feeling is, as stated in the write-up that you have, that several processes should be carried forward in order to determine which is the most free from troublesome engineering difficulties and which offers the best hope of early commercialization.

Senator Moss. Is there any pilot project that looks to you ready to go into demonstration?

Dr. CHILTON. Well, no. It is ready to go into the pilot demonstration. There is one process that is now going into the pilot stage and others which are just emerging from the laboratory stage and they should be carried along as well.

Senator Moss. Now we had some testimony yesterday about a possible in situ process of gasifying the coal underground. Is that being looked into by your group as well?

Dr. CHILTON. Only a cursory examination has been made of that possibility. On the basis of previous work in this field, it does not look promising for the production of pipeline quality gas.

Senator Moss. And it would be ideal if that would work, wouldn't it, as far as pollution problems are concerned?

Dr. CHILTON. Sure.

Senator Moss. Well, thank you very much. My colleagues would undoubtedly like to ask you some questions.

Senator Anderson?

Senator ANDERSON. No questions.

Senator Moss. Senator Jordan?

Senator JORDAN. Thank you, Mr. Chairman.

Dr. Chilton, you mentioned a European system for producing a fuel gas that is relatively sulfur free. Would you expand that a little bit? I understand that from your remarks here in your statement, it could be built in a number of places, a multiplicity of plants, and the cost might go up, but what are the essential features of this European system that we might adapt to our American use?

Dr. CHILTON. It would produce a gas of a low B.t.u. heating value, and for that purpose it has been well developed in Europe and is in use in Europe and in South Africa. But the capacity of the individual gas fires is low.

Senator JORDAN. Is it a costly process by reason of being on a small scale?

Dr. CHILTON. It is a relatively costly process on account of the relatively small output of each of the gas fires. The conversion of the gas produced to pipeline quality has not yet been worked out.

Senator JORDAN. But is it not possible to have economy by increasing the size of the plant? It does not adapt itself to great efficiency by increasing the size?

Dr. CHILTON. Well, that is the general objective of the work that is going on at the present time, to supply gas fires of larger capacity, but they are not likely to be developed along the exact lines of the German equipment that is now in use.

Senator JORDAN. Do you think that investigation is as far advanced as any that are working in this field?

Dr. CHILTON. Well, as far as the production of fuel gas for local consumption, it is beyond the point of investigation. It is in operation, with European coals and pretty high labor costs and pretty high investment costs.

Senator JORDAN. Are European coals essentially different from American coals in sulphur content and other chemical—

Dr. CHILTON. Well, they all contain sulfur but the European coals to which this process has been applied do not swell up and cake like most American coals or many American coals do. The European process is not applicable in its present state of development to handle caking coals.

Senator JORDAN. What would it take to develop it? More research?

Dr. CHILTON. The Bureau of Mines has a research program to do that. I think that should be encouraged. That is one of the programs of the bureau.

Senator JORDAN. Thank you, sir.

Senator MOSS. Senator Gravel?

Senator GRAVEL. No questions.

Senator MOSS. Senator Fannin?

Senator FANNIN. Thank you, Mr. Chairman.

We very much appreciate your testimony, Dr. Chilton. I notice you have given a great deal of thought to this problem.

When you talk about carbonated water gas, isn't that what we used to refer to as artificial gas?

Dr. CHILTON. City gas.

Senator FANNIN. I know in my home city that we did have the artificial city gas. It is not as clean a burning fuel as your natural gas. Perhaps the equipment would make a great deal of difference. In the days we had it, we did not have the efficient equipment. I am just wondering if that is the most efficient utilization of our natural resources.

In other words, looking at it from the standpoint of pollution—and certainly that is a great consideration, and must be—can't we, on site—for instance, in the Four Corners area, you are probably familiar with the plants planned there, and they held up on those plants because of the problem of pollution and are now trying to develop equipment that will efficiently do what is needed to control the burning of that coal in order that it will not have the oxides you are talking about. Can't that be done better on site, and more efficiently done, than by transporting that to another area and then utilizing it for conversion?

Dr. CHILTON. Well, it would be cheaper at the site where it is produced to produce a gas of maybe 450 B.t.u. and this would solve the pollution problems all right. To produce pipeline quality gas, there is a technical problem involved in the production of methane from what would otherwise be known as synthesis gas.

Senator FANNIN. Well, I understand, of course, your propanes or butanes and all, of course, are above the methane, and then your ethane, of course, has practically the same B.t.u. content as your natural gas that we are using today. That is mostly ethane, isn't it?

Dr. CHILTON. The natural gas produced and distributed is mostly methane.

Senator FANNIN. Methane and ethane.

Dr. CHILTON. Not much ethane.

Senator FANNIN. I see. When you talk about conversions, though, wouldn't you complicate your whole distribution system if you came out with a 450 B.t.u. gas?

Dr. CHILTON. Of course. That is what I alluded to. That is not contemplated under the heading of "Substitute Natural Gas." It would be a cheaper solution at the source but the question of distribution and utilization would complicate the problem.

Senator FANNIN. In other words your recommendation, as I understand it now, would be that you do this in an area, and by converting to that fuel in a certain area, maybe for large commercial utilization, would you say—

Dr. CHILTON. Large commercial and power plants. Especially for power plants, for the reasons I brought out, that gas of an even lower B.t.u. content would be equally applicable to the production of electric power by means of a gas turbine, and a gas turbine plus a steam turbine combined cycle has promise of very economic applications in the production of electricity.

Senator FANNIN. I would hope that we could develop a fuel at a price that would be economical and still get away from the pollution problems you are talking about that would be adhered to if you did lower your B.t.u. content to 450.

Of course, we realize a shortage of fuel exists today and when you talk about the different conversions, I was wondering if you wouldn't be doing something less efficient than perhaps your power development on site, such as they are doing in the four corners area.

Dr. CHILTON. Well, I urge that that be considered for large uses but I think it is impractical to think of putting a gas of lower heating value into the pipeline. There are two distinct problems.

Senator FANNIN. Yes, just as you can't put the higher B.t.u. gas, your propane or butanes—

Dr. CHILTON. I mean the higher B.t.u. gas, which is methane.

Senator FANNIN. Natural gas. Mostly methane.

Dr. CHILTON. Mostly Methane.

Senator FANNIN. Thank you very much.

Senator MOSS. Senator Hansen?

Senator HANSEN. Is it your feeling that of all of the other sources of energy available to us at this time, coal gasification offers the best promise of helping to solve the energy shortage in this country?

Dr. CHILTON. Well, I have been forced to the conclusion that on a long range basis it offers the only solution. Not only the best, but the only solution.

Senator HANSEN. Thank you.

Senator MOSS. Senator Bellmon?

Senator BELLMON. Dr. Chilton, I was a little surprised at your conclusion at the top of page 4 that only research and development work would be justified for the next few years. When do you feel we would be justified in setting up such a corporation as this legislation calls for?

Dr. CHILTON. Well, I have been in the research business for many years and if we knew what the answer would be, we would not do the research. I would hesitate to set a quantitative figure. I think Mr. Freeman said 1 to 3 years and I have no better basis for making a judgment.

Senator BELLMON. My question was not so much a matter of time, but what remains to be found by research before we should go into such a program?

Dr. CHILTON. Just how best to operate a gas fire, and the equipment required to produce methane. A gas fire produces essentially hydrogen and carbon monoxide and carbon dioxide, and the carbon dioxide has to be removed. The carbon monoxide has to be converted to more hydrogen and the hydrogen and remaining carbon monoxide catalytically methyated—this sounds technical but these are the facts of life.

Senator BELLMON. The statute is not presently adequate to justify this kind of investment. That is what you are saying.

Dr. CHILTON. Exactly.

Senator BELLMON. That is all.

Senator MOSS. Thank you very much, Dr. Chilton. We appreciate your statement and your answers to our questions.

We will go on to the next witness, who is Herbert D. Clay, president of Iroquois Gas Corp. and chairman of the American Gas Association Government Relations Committee.

I must explain we may run into an interruption, Mr. Clay, but I would like to proceed as far as we can before the bells begin to summon us over to the Senate floor. We are going to have some votes shortly. You may go right ahead. Would you identify your associates?

STATEMENT OF HERBERT D. CLAY, PRESIDENT, IROQUOIS GAS CORP., NATIONAL FUEL GAS CO., CHAIRMAN, AMERICAN GAS ASSOCIATION GOVERNMENT RELATIONS COMMITTEE, ACCOMPANIED BY GEORGE H. LAWRENCE, A VICE PRESIDENT OF THE AMERICAN GAS ASSOCIATION AND DIRECTOR OF GOVERNMENT RELATIONS, AND DOUGLAS T. KING, DIRECTOR OF RESEARCH AND ENGINEERING, AMERICAN GAS ASSOCIATION

Mr. CLAY. Yes, I would like to do that. Due to the complexity of this question, I have asked two of my associates to join me, particularly to assist with answering questions that might be too technical for me to answer.

On my left is Mr. Lawrence, a vice president of the American Gas Association and director of government relations. On my right is Mr. King, who is director of research and engineers for the American Gas Association.

Senator MOSS. Welcome gentlemen. We are glad to have you here.

Mr. CLAY. I, of course, submitted a complete statement of what I expect to say. However I have tried to summarize it and shorten my presentation a bit. I believe the committee members have copies of this somewhat shortened presentation.

Senator MOSS. Yes, sir; we do. We have the long statement and the shorter reading copy. The full statement will go in the record and also whatever you want to give us out of the reading copy.

Mr. CLAY. This is so important a subject and the bill is so important that I am afraid I am going to have to read most of it.

Senator Moss. All right, go right ahead.

Mr. CLAY. I am appearing today on behalf of AGA and the National Fuel Gas Co. Both organizations are greatly concerned about the domestic natural gas supply situation.

We appreciate very much this opportunity to testify on S. 1846 and we are most encouraged by the understanding of the natural gas supply problem and the willingness to suggest specific steps to alleviate it demonstrated by you, Mr. Chairman, as cosponsor of S. 1846, and Senator Jackson, sponsor of the bill. In our testimony today, we would like to accomplish the following:

(1) State briefly for the record in these proceedings the seriousness of the gas supply problem as viewed by AGA and efforts directed toward its solution.

(2) Review the AGA experience in the area of coal gasification research, including the recent sharply accelerated pace.

(3) Describe the joint Interior Department-AGA research program to evaluate various known processes through the pilot plant stage as part of the establishment of a commercial coal gasification industry.

(4) Express our views on the Coal Gasification Development Corp. as the vehicle to own and coordinate operation of the first demonstration plant to confirm ultimate feasibility of coal gasification.

First, a word about those for whom I speak.

National Fuel Gas Co. provides retail gas service to over 635,000 customers in 468 communities with an estimated population of 2,300,000. The business and industrial centers of Buffalo and Niagara Falls in New York State, and of Erie and Sharon in Pennsylvania, are key markets in the service area. Since we are somewhat near the "end of the pipeline" from the principal producing areas in the Southwestern United States, and in view of the relative proximity to the substantial coal reserves of the Appalachian area, my own companies have a special interest in a timely and successful coal gasification research effort.

The American Gas Association is a nonprofit trade association, representing some 300 distribution and transmission member companies. The distribution companies serve the gas requirements of about 92 percent of the ultimate gas consumers in this country. Gas is an essential fuel for thousands of industrial processes. It is a highly important and consistently preferred fuel for many commercial uses. It is a premium, economical, clean, safe fuel for major household uses. Gas powers 43 percent of industry in the United States, including some 28 percent of the Nation's electric power. Gas presently serves more than 42 million meters through 900,000 miles of pipelines in all 50 States. This national network of pipes and mines, with a total investment of \$46 billion serves some 150 million of our population. The use of gas for space heating, water heating, and cooking to mention only the important residential uses, is vital to the comfort and health of these people.

We submit, therefore, that the gas industry—the Nation's sixth largest in terms of investment in facilities—is important to this Nation, its consumers, its economy, and its environment. For these reasons the gas industry is most concerned with adequacy of supply and service to cus-

tomers. This is a concern emphatically expressed by the American Gas Association in its letter of December 16, 1968, to the Federal Power Commission, citing the need for incentives to increase domestic exploration and drilling for natural gas. Over the past 2½ years, AGA has reaffirmed this plea in presentations to Congress, the Interior Department, the Federal Power Commission, and in various public forums. Numerous spokesmen from the public and private sectors have joined in.

The gas supply problem and the public interest in alleviating it have now been widely acknowledged by public officials, industry spokesmen, the financial, industrial, and academic communities, environmentalists and consumers. Indeed, the introduction of S. 1846 on May 12 was accompanied by an excellent summary of the problem.

How to supply existing and future demands for gas is a question that deserves high national priority. However, in our opinion, it is a problem which can be solved by the combined effects of several steps, all of them significant and necessary. These are as follows:

The quickest and most economic step toward solution is to sharply reverse, and accelerate upward, a 15-year downward trend in exploration and drilling for conventional domestic natural gas supplies. There are in turn, three specific steps which can hasten the development of this potential:

(1) More realistic field price levels to restore badly needed incentives for exploration and drilling;

(2) More frequent and regular public land lease sales including offshore areas; and

(3) More stability in sales contracts of producers committing new supplies to interstate markets.

We would describe these steps in more detail when this committee conducts hearings pursuant to Senate Resolution 45.

Again, while these steps to stimulate domestic exploration provide the most timely and economic contribution toward solving the gas supply problem, it is accepted fact that they cannot aid the huge new supplies necessary to meet demands which have increased at an average rate of 7 percent per year during the past years, and could have been much higher but now for the restraint of the impending shortage. National air pollution concerns alone provide a continuous upward pressure on the demand for this cleanest burning of fuels. However, there are outstanding additional potential sources to meet these demands.

One such supply source is the North Slope of Alaska where the estimated potential is over 300 trillion cubic feet. It is in the overall public interest that these supplies be made available to the consuming centers of the lower 48 States as soon as possible. As AGA pointed out in a recent statement to the Interior Department, it is essential that the proposed Alaska oil pipeline be placed in operation promptly to enable oil production which is the necessary forerunner of production and delivery of gas reserves. Other major sources of new gas supplies are pipeline imports from Canada, including those from the potentially prolific Canadian Arctic area, imported LNG by tanker from various parts of the world, and certain hydrocarbon

reforming processes. Numerous gas companies now have concrete projects under way to effect new deliveries from all of these sources. These are being encouraged in the marketplace and should be encouraged by public officials. In addition, nuclear stimulation of tight formations to unlock otherwise noncommercial domestic gas reserves in the Rocky Mountain area has been conducted by the Federal Government and supported financially by gas companies with encouraging results to date. This research should be continued.

This brings us to the additional potential source for new gas supplies which in all probability offers the greatest long-term contribution; namely, establishment of a new coal gasification industry which would utilize the Nation's virtually unlimited domestic coal reserves. The gas industry and Government working together have confirmed the technical feasibility of this source of gas and are working on the initial stages of confirming commercial feasibility. Coal gasification would become a new industry contributing greatly to our economy and one which would not depend so heavily on the producing segments of the gas industry, that is the petroleum industry, for the vast capital requirements as does conventional exploration and drilling. The transmission and distribution segments of the gas industry should provide the bulk of this new capital. The Government's role in supporting this accelerated research program is vital and should be encouraged. The subject legislation establishing a Coal Gasification Development Corporation could become a most significant step in this accelerated research program. Before offering further recommendations in this regard, I believe it would be appropriate to describe the status of research efforts to date.

AGA experience in the field of coal gasification research dates back to 1946 and encompasses a broad gamut of activities including the annual funding of related research programs of the Institute of Gas Technology in Chicago, Ill. During the early 1960's AGA funded specific engineering feasibility studies.

As a result of these and other investigations, in July 1964, the Office of Coal Research, Department of the Interior, and the Institute of Gas Technology under the sponsorship of the AGA entered into a contract for the operation of a small laboratory size pilot plant which would utilize the HYGAS process for coal gasification.

Such preliminary investigations combined with the operation of the small scale HYGAS plant led Interior's OCR and AGA to amend the 1964 HYGAS contract in 1967 for the purpose of funding a larger scale pilot plant operation.

In 1966, AGA sponsored the First Synthetic Pipeline Gas Symposium. Two subsequent symposiums were held in 1968 and 1970.

In July 1969, the Research, Engineering, and Development Executive Committee of the AGA Board of Directors (REDEX), authorized studies to evaluate reserves of coal and water to support this new industry and to enable possible site selections for the first demonstration plant.

A formal presentation of a program to accelerate coal gasification research was made to the AGA Executive Conference in June 1970, and to the AGA Board of Directors on September 11, 1970. The board appointed a special committee to work with REDEX to establish a

firm plan of action and on December 11, 1970, the AGA Board of Directors approved the plan. The board also established a Coal Gasification Finance Committee.

This served as the authorization for a proposal to the Department of the Interior for a joint Government-industry effort to establish a coal gasification industry by an accelerated pilot plant and demonstration plant research program. This was transmitted by AGA President, G. J. Tankersley's letter of January 22, 1971, to Hollis M. Dole, Assistant Secretary for Mineral Resources, Department of the Interior. A copy of this proposal is attached as appendix A, which I would ask be included in the record.

Senator Moss. It will be included.

Mr. CLAY. Thank you.

The following excerpts are relevant to S. 1846:

This proposal seeks to initiate a joint government-industry effort to establish a coal gasification industry which can serve a vital role in helping to solve the energy and pollution problems facing the nation today. This can best be accomplished by converting coal to clean burning gas for distribution in our existing networks of transmission and distribution lines. . . .

This proposal recommends a research and development program to accelerate the development through the pilot plant stage of coal gasification methods presently under active study and to construct and operate a technically feasible demonstration plant in the shortest possible time. The best process may prove to be one presently under development, but it is more likely that it will consist of an optimum selection from various process elements developed at the pilot plants proposed here. * * *

To achieve large-scale commercial success in the United States, the gas industry believes that high-capacity systems capable of handling a broad spectrum of coals are needed. Extensive laboratory and small scale pilot plant work has yielded a good understanding of the chemistry of coal gasification and studies have established processing routes which promise the potential high-capacity operation. Accelerated large-scale pilot plant development work is warranted based on the results of these studies. Joint government and industry funding sufficient to support such a program is urgently needed if the coal gasification approaches which merit immediate large-scale pilot plant testing are to be brought to a commercial level as soon as possible to help meet the gas supply problem. The difficulty of converting coal to pipeline quality gas at economically competitive prices has required new and sophisticated engineering techniques. Proper development of them requires large-scale pilot plant investigation to establish the optimum design of a commercial demonstration plant.

All of the known coal gasification methods have been evaluated for their suitability for inclusion in this accelerated program. The methods which have been chosen are:

HYGAS-electrothermal, Lurgi gasifier, HYGAS-oxygen, CO₂ Acceptor, Synthane, Steam-Iron Hydrogen, BCR Super Pressure Process. * * *

It is possible that the best process route will be created from a combination of individual process elements which are now under development by the various investigators. For this reason, the gas industry should establish a vigorous research and development program which will bring the best of these process elements to a proven stage as quickly as possible and then to integrate these elements into the best possible configuration for the first commercial-size demonstration plant. * * *

The program proposed involves the construction of two new pilot plants, one new partial plant, modification of three plants and operation of all seven processes through 1973 and the construction and operation of a feasible demonstration plant through 1978. Certain of these pilot plants will be complete gasification processes, while others will contain only some elements of a process. This will minimize duplication without losing valuable development time. The goal is, at the end of 1973, to establish the best process elements for a feasible commercial demonstration plant. In the period from 1974 through 1978 the resulting process would be utilized in a plant designed to produce 80 million cubic feet per day of pipeline quality gas. * * *

The pilot plant work should be carried out by four research centers which are already staffed and active in coal gasification work. These are the Institute of Gas Technology, the Bureau of Mines, Bituminous Coal Research, and Consolidation Coal Company. * * *

The goal is to complete the program in eight years; four years for the pilot plant phase and five years to design, construct, and operate the demonstration plant.

A principal benefit to be derived from this proposal is not only to accelerate research on each of the most feasible known methods, but to conduct it in a coordinated manner which would permit maximum time and money being devoted to those components of all the processes which test results confirm as offering the greatest contribution. Likewise the less desirability or technically condemned components can be laid aside at the earliest time. This would simply enable more efficient concentration of the research effort.

Following the AGA proposal of January 22, to the Interior Department, there were numerous discussions between industry and representatives and officials of the Interior Department and other offices of the executive branch. This led to the general agreement on a modified version of the AGA proposal as described in the President's Clean Energy Message of June 4. Rather than total expenditures of \$42 million per year over a period of 8 years to (a) evaluate 7 known processes through the pilot plant stage and (b) select the best process or combination of various components thereof and proceed to establish and operate a commercial size demonstration plant, it was agreed to seek appropriation of funds by the Government and commitments by industry to apply \$30 million per year (\$20 million by Government and \$10 million by industry) for 4 years to conduct the pilot plant stage evaluation of six known processes and leave the details of the demonstration plant phase to later determination as more information became available.

In effect, this procedure recognized the immediate urgency and the prerequisite nature of performing the pilot plant evaluations are the next step in following up the extensive laboratory research to date on the processes which offered the most encouragement in confirming commercial feasibility. However, all concerned recognized the inherent risk and the research nature of scaling up from pilot plant operations in the magnitude of 1-2 million cubic feet per day to a commercial size in the range of 30-250 million cubic feet per day. As stated in the preamble to S. 1846, p. 2, lines 21-24—

The research and development effort is too large for any single company to risk undertaking and a consortium of companies would be difficult to assemble without Federal leadership.

Therefore, while AGA is most desirous of proceeding with the joint Interior Department-AGA program of pilot plant evaluations, we view the Coal Gasification Development Corp. as a suitable organization to perform the next logical step; namely, "to design, construct, operate, and maintain * * * a full scale, commercial-size facility to manufacture substitute natural gas from coal * * *." Thus, we view S. 1846 as a proposal entirely compatible with the presently contemplated Interior Department-AGA joint research effort. It is our hope that this committee and the Congress will also acknowledge the compatibility of these two specific steps in a logical and necessary se-

quence. The two steps complement each other. The goals of S. 1846 will be accomplished more efficiently upon utilizing the results of the pilot plant valuations after about 4 years. The Interior-AGA pilot research findings will be translated into commercial demonstration in a more timely and orderly manner by proceeding to establish the necessary corporate entity and organization.

Thus, Mr. Chairman, AGA is pleased to endorse S. 1846 to establish a Coal Gasification Development Corp. as a vehicle to perform the essential, final step in the long and rigorous research efforts which will result in a vital new coal gasification industry. We are confident that AGA member companies will be among "the private entity or entities * * * to participate in the carrying out of such purposes and functions, including the furnishing of financial assistance * * *" as noted in Sec. 2(d), p. 4, of this bill. But this should follow the pilot plant work covered by the Interior Department-AGA programs described earlier.

Finally, we offer these general recommendations for changes in S. 1846 which are consistent with the foregoing principal thoughts.

In Sec. 2(d), p. 4, in view of the long-standing experience and expertise of the Office of Coal Research, Interior Department, we question whether this office of the Federal Government, rather than the Administrator of General Services, should not be "authorized to enter into contractual arrangements." The General Services Administration would presumably still be available for appropriate assistance and auditing and other administrative services and serve as the repository for patent rights. Yet the more substantive, decisionmaking authority would be vested in the Federal office with the most knowledge of the area. Further, with this Federal office serving the key role in both Interior Department-AGA pilot research and the demonstration plant phase, there is more assurance of continuity without duplication of effort or expenditure. This is essential both for obtaining Government appropriations and industry financial commitments.

In Sec. 3(a), pp. 4, 5, the Corporation is in effect directed by statute to select the "two most technically and economically feasible methods" and "design, construct, operate, and maintain a demonstration type facility for each such method." The pilot plant evaluation under the joint Interior-AGA accelerated research program could permit the selection of a single process, probably including components from several of the present known processes, thus hopefully obviating the need to proceed initially with more than one such demonstration-type facility. In AGA's presentation to Interior of January 22, 1971, a single demonstration plant was estimated to cost \$186 million. In any event, there should be no statutory requirement to proceed with two demonstration type facilities.

A suggested substitute for this Sec. 3(a) would be an acknowledgment of the contemplated Interior Department-AGA accelerated research effort to evaluate through the pilot plant stage the most suitable known coal gasification methods, an expression of intent that periodic results of this research will be made available to the corporation and that when sufficiently conclusive results are possible to ascertain the most feasible method or combination of methods, that said results will

provide the bases for proceeding with the establishment and operation of a commercial-size demonstration plant.

Final changes in the language of S. 1846, which would be consistent with the foregoing recommendations are those which would permit the new Corporation to be active a full 6 years, if necessary, from the date of initial construction of the demonstration plant rather than from enactment of this act. This would permit the Corporation to be created and preliminary steps taken such as the appointment of the Board of Directors during the on-going Interior-AGA pilot research phase, but would still allow the Corporation up to 6 years to conduct its principal business of initiating commercial demonstration plant operations.

We would therefore suggest rewording the first two lines of Sec. 6, p. 8, to read as follows:

Sec. 6. On or before the expiration of six years following the date of initial construction of the demonstration plant, the Board * * *

Sec. 8, lines 11 and 12, p. 9, delete:

And for each of the next five fiscal years * * *

And add—

And for future fiscal years * * *.

In concluding, Mr. Chairman, let me again say that we appreciate the special interest in these matters shown by you, your cosponsor in S. 1846, and this committee. I recall a portion of your statement which accompanied the introduction of S. 1846:

If there are other recommendations of means to achieve coal gasification capability, I want to consider them * * *. But I am convinced that we have to take definite steps to achieve it as soon as possible.

Mr. Chairman, definite steps have been taken already by the many years of research both in industry and Interior's Office of Coal Research. This has resulted in a \$10 million pilot plant in Chicago for the two HYGAS processes, a similar size pilot plant in Rapid City, S. Dak., substantially completed for the CO₂ acceptor process. A pilot plant for the Bi-Gas process, to be constructed in Homer City, Pa., is presently in the design phase and the steam-iron hydrogen process, is ready for pilot plant design. Bringing these several processes under the accelerated program and centralized management that is accomplished by the current Department of the Interior-AGA program represents certain very definite steps to achieve a coal gasification capability. I might add that AGA now has informal—but we believe dependable—commitments for some \$7.5 million of the \$10 million industry portion to proceed with the accelerated program. I cite this as a further indication of our seriousness to proceed with these definite steps. Your proposal can provide the next logical step to accomplish the demonstration plant phase but it must, in our opinion, follow the pilot plant stage now under way.

We believe the "other recommendations" we have offered today do merit consideration and that they are responsive to the question contained in your letter of July 15, 1971, to AGA Chairman Tankersley. They are consistent with the basic thrust of S. 1846. We believe they offer a logical sequence of definite steps to achieve coal gasification

capability as soon as possible. We believe they will enable utilization of a highly efficient energy transmission system—the 900,000-mile underground network of pipeline and distribution mains—to bring this vast energy source to consumers in the manner most compatible with our growing environmental concerns. These are public interest needs of the highest priority.

Thank you.

Senator Moss. Thank you very much, Mr. Clay. That is an excellent statement. We have your more detailed version in the record and it will be most helpful to us. I appreciate your coming here today with your associates, Mr. Lawrence and Mr. King.

You heard the bell. That means there is a vote on. I would like to ask you gentlemen if you would return at 2 and let us ask a few questions. We cannot get started on them now because within 5 minutes we will have to leave. I know my colleagues here have a number of questions and we do have other witnesses.

The committee will stand in recess until 2 and we will have the gentlemen at the table for questions when we reconvene.

(The prepared statement of Mr. Clay and appendix A and B referred to follow:)

STATEMENT OF HERBERT D. CLAY, PRESIDENT, NATIONAL FUEL GAS COMPANY, CHAIRMAN, GOVERNMENT RELATIONS COMMITTEE, A.G.A.

Mr. Chairman, my name is Herbert D. Clay. I am President of the National Fuel Gas Company and Chairman of the Government Relations Committee of the American Gas Association (A.G.A.). I am appearing today on behalf of A.G.A. and the National Fuel Gas Company. Both organizations are greatly concerned about the domestic natural gas supply situation and not only our ability to satisfy rapidly increasing consumer demands but even to take care of present commitments.

We appreciate very much this opportunity to testify on S. 1846 and we are most encouraged by the understanding of the natural gas supply problem and the willingness to suggest specific steps to alleviate it demonstrated by you, Mr. Chairman, and the co-sponsor of S. 1846, Senator Frank E. Moss. In our testimony today, we would like to accomplish the following:

- (1) State briefly for the record in these proceedings the seriousness of the gas supply problem as viewed by A.G.A. and efforts directed toward its solution;
- (2) Review the A.G.A. experience in the area of coal gasification research, including the recent sharply accelerated pace;
- (3) Describe the joint Interior Department-A.G.A. research program to evaluate various known processes through the pilot plant stage as part of the establishment of a commercial coal gasification industry;
- (4) Express our view on the Coal Gasification Development Corporation as the vehicle to own and coordinate operation of the first demonstration plant to confirm ultimate feasibility of coal gasification.

First, a word about those for whom I speak today.

National Fuel Gas Company is a public utility holding company, whose subsidiary companies operate in northwestern Pennsylvania, western New York, and a small section of eastern Ohio. This system provides retail gas service to over 635,000 customers in 468 communities with an estimated population of 2,300,000. The business and industrial centers of Buffalo and Niagara Falls in New York State, and of Erie and Sharon in Pennsylvania, are key markets in the service area. Since this system is somewhat near the "end of the pipeline" from the principal producing areas in the Southwestern U. S., and

in view of the relative proximity to the substantial coal reserves of the Appalachian area, my own companies and consumers they serve in New York and Northern Pennsylvania have a special interest in a timely and successful coal gasification research effort.

The American Gas Association is a non-profit trade association, representing some 300 distribution and transmission member companies. The distribution companies serve the gas requirements of about 92% of the ultimate gas consumers in this country. Gas is used for industrial and commercial purposes as well as residential. It is an essential fuel for thousands of industrial processes, highly important and consistently preferred for many commercial uses and is a premium, economical, clean, safe fuel for major household uses. Gas powers 43% of industry in the United States, including some 28% of the nation's electric power. Gas presently serves more than 42,000,000 meters through 900,000 miles of pipelines in all 50 states. This national network of pipes and mains, with a total investment of \$46 billion serves some 150,000,000 of our population. The use of gas for space heating, water heating, and cooking, to mention only the more important residential uses, is vital to the comfort and health of most of these people.

We submit, therefore, that the gas industry -- the nation's sixth largest in terms of investment in facilities -- is important to this nation, its consumers, its economy, and its environment. For these reasons the gas industry is most concerned with adequacy of supply and service to customers. This is a concern emphatically expressed by the American Gas Association in its letter of December 16, 1968, to the Federal Power Commission, citing the need for incentives to increase domestic exploration and drilling for natural gas. Over the past two and one-half years, A.G.A. has reaffirmed this plea in presentations to Congress, the Interior Department, the Federal Power Commission, and in various public forums. Numerous spokesmen from the public and private sectors have joined in.

The gas supply problem and the public interest in alleviating it have now been widely acknowledged by public officials, industry spokesmen, the financial, industrial, and academic communities, environmentalists and consumers. Indeed, the introduction of S. 1846 on May 12 was accompanied by an excellent summary of the problem.

How to supply existing and future demands for gas is a question that deserves high national priority. However, in our opinion, it is a problem which can be solved by the combined effect of several steps, all of them significant and necessary. These are as follows:

The quickest and most economic step toward solution is to sharply reverse, and accelerate upward, a 15-year downward trend in exploration and drilling for conventional domestic natural gas supplies. Estimates of potential supplies in the contiguous 48 states range upward from 850 trillion cubic feet. This compares with the 260 trillion cubic feet of proved reserves on which the present tremendous industry investment is based. There are, in turn, three specific steps which can hasten the development of this potential:

- (1) More realistic field price levels to restore badly needed incentives for exploration and drilling. Present FPC efforts in this direction are encouraging. They are based on extensive evidentiary records and findings and merit the support of other public officials. These are not easy times for regulators or for the distribution segment of the gas industry which directly

serves, and hence is the closest link to, the consumer, because the price to the consumer must rise after some 10 years of relative stability. The alternative is scarcity of a highly premium fuel and even higher prices which would accompany a permanent shortage if the huge investment in facilities could not be used at its current near optimum efficiency;

(2) More frequent and regular public land lease sales including off-shore areas. The orderly and timely development of public land offers great benefit to the public. Interior Department efforts to this end are increasing. We hope they will be further intensified and encouraged by other public officials; and

(3) More stability in sales contracts of producers committing new supplies to interstate markets, which can only be accomplished by amendments to the Natural Gas Act. These should receive timely and favorable consideration by Congress.

I take this occasion to detail briefly the foregoing specific steps because they are believed to be matters of interest to this Committee. We would propose to describe them in more detail when this Committee conducts hearings pursuant to Senate Resolution 45.

Again, while these steps to stimulate domestic exploration provide the most timely and economic contribution toward solving the gas supply problem, it is accepted fact that they cannot add the huge new supplies necessary to meet demands which have increased at an average rate of 7% per year during the past years, and could have been much higher but for the restraint of the impending shortage. National air pollution concerns alone provide a continuous upward pressure on the demand for this cleanest burning of fuels. However, there are outstanding additional potential sources to meet these demands.

One such supply source is the North Slope of Alaska where the estimated potential is over 300 trillion cubic feet. It is in the overall public interest that these supplies be made available to the consuming centers of the lower 48 states as soon as possible. As A.G.A. pointed out in a recent statement to the Interior Department, it is essential that the proposed Alaska oil pipeline be placed in operation promptly to enable oil production which is the necessary forerunner of production and delivery of gas reserves. Other major sources of new gas supplies are pipeline imports from Canada, including those from the potentially prolific Canadian Arctic area, imported LNG by tanker from various parts of the world, and certain hydrocarbon reforming processes. Numerous gas companies now have concrete projects under way to effect new deliveries from all of these sources. These are being encouraged in the marketplace and should be encouraged by public officials. In addition, nuclear stimulation of tight formations to unlock otherwise non-commercial domestic gas reserves in the Rocky Mountain area has been conducted by the Federal Government and supported financially by gas companies with encouraging results to date. This research should be continued.

This brings us to the additional potential source for new gas supplies which in all probability offers the greatest long-term contribution; namely, establishment of a new coal gasification industry which would utilize the nation's virtually unlimited domestic coal reserves. The gas industry and government working together have confirmed the technical feasibility of this source of gas and are working on the initial stages of confirming commercial

feasibility. Coal gasification would become a new industry contributing greatly to our economy and one which would not depend so heavily on the producing segments of the gas industry, i.e., the petroleum industry, for the vast capital requirements as does conventional exploration and drilling. The transmission and distribution segments of the gas industry should provide the bulk of this new capital. The government's role in supporting this accelerated research program is vital and should be encouraged. The subject legislation establishing a Coal Gasification Development Corporation could become a most significant step in this accelerated research program. Before offering further recommendations in this regard, I believe it would be appropriate to describe the status of research efforts to date.

A.G.A. experience in the field of coal gasification research dates back to 1946 and encompasses a broad gamut of activities including the annual funding of related research programs of the Institute of Gas Technology in Chicago, Illinois. During the early 1960's A.G.A. funded specific engineering feasibility studies which investigated the generation of pipeline gas from bituminous coal utilizing Lurgi Gasification, Catalytic Synthesis of Methane and Hydrogasification as well as reports on Suspension Gasification and Catalytic Synthesis.

As a result of these and other investigations, in July, 1964, the Office of Coal Research, Department of Interior, and the Institute of Gas Technology under the sponsorship of the A.G.A., entered into a contract for the operation of a small laboratory size pilot plant which would utilize the HYGAS process for coal gasification. A.G.A. participated with Interior in funding this program on a 50-50 basis.

Such preliminary investigations combined with the operation of the small scale HYGAS plant led Interior's OCR and A.G.A. to amend the 1964 HYGAS contract in 1967 for the purpose of funding a larger scale pilot plant operation.

In conjunction with its continuing efforts to monitor the state-of-the-art and serve as a coordinator of research activities, A.G.A. sponsored the First Synthetic Pipeline Gas Symposium in 1966. Two subsequent symposiums were held in 1968 and 1970.

In July 1969, the Research, Engineering, and Development Executive Committee of the A.G.A. Board of Directors (REDEX), authorized studies to evaluate reserves of coal and water to support this new industry and to enable possible site selections for the first demonstration plant.

A formal presentation of a program to accelerate coal gasification research was made to the A.G.A. Executive Conference in June 1970, and to the A.G.A. Board of Directors on September 11, 1970. The Board appointed an ad hoc committee to work with REDEX to establish a firm plan of action and on December 11, 1970, the A.G.A. Board of Directors approved the plan. The Board also established a Coal Gasification Finance Committee as a formal Committee of the Board.

This served as the authorization for the memorandum entitled "Proposal for Coal Gasification Research and Development Program" to the Department of the Interior seeking a joint government-industry effort to establish a coal gasification industry by an accelerated pilot plant and demonstration plant research program. This was transmitted by A.G.A. President G. J. Tankersley's letter of January 22, 1971 to Hollis M. Dole, Assistant Secretary for Mineral Resources, Department of the Interior.

The following excerpts from the formal A.G.A. proposal of January 22 to the Interior Department, a complete copy of which is attached hereto as Appendix A, present the essence of that proposal which I believe is relevant in analyzing the goals of S. 1846:

"This proposal seeks to initiate a joint government-industry effort to establish a coal gasification industry which can serve a vital role in helping to solve the energy and pollution problems facing the nation today. This can best be accomplished by taking advantage of our greatest natural energy resource, coal, by converting it to clean burning gas for distribution in our existing networks of transmission and distribution lines.

"This proposal recommends a research and development program to accelerate the development through the pilot plant stage of coal gasification methods presently under active study and to construct and operate a technically feasible demonstration plant in the shortest possible time. The best process may prove to be one presently under development, but it is more likely that it will consist of an optimum selection from various process elements developed at the pilot plants proposed here.

"To achieve large-scale commercial success in the United States, the gas industry believes that high-capacity systems capable of handling a broad spectrum of coals are needed. Extensive laboratory and small scale pilot plant work has yielded a good understanding of the chemistry of coal gasification and studies have established processing routes which promise the potential high capacity operation. Accelerated large-scale pilot plant development work is warranted based on the results of these studies. Joint government and industry funding sufficient to support such a program is urgently needed if the coal gasification approaches which merit immediate large-scale pilot plant testing are to be brought to a commercial level as soon as possible to help meet the gas supply problem. The difficulty of converting coal to pipeline quality gas at economically competitive prices has required new and sophisticated engineering techniques. Proper development of them requires large-scale pilot plant investigation to establish the optimum design of a commercial demonstration plant.

"All of the known coal gasification methods have been evaluated for their suitability for inclusion in this accelerated program. The methods which have been chosen are:

- *HYGAS-electrothermal
- *Lurgi gasifier
- *HYGAS-Oxygen
- *CO₂ Acceptor
- *Synthane
- *Steam-Iron Hydrogen
- *BCR Super Pressure Process

"The program of work proposed herein is structured from the fact that there is a great similarity among the various gasification methods now under development, especially with respect to the chemistry of the coal-to-gas conversion route.

"It is possible that the best process route will be created from a combination of individual process elements which are now under development by the various investigators. For this reason, the gas industry should establish a vigorous research and development program which will bring the best of these process elements to a proven stage as quickly as possible and then to integrate these elements into the best possible configuration for the first commercial-sized demonstration plant.

"The program proposed involves the construction of two new pilot plants, one new partial plant, modification of three plants and operation of all seven processes through 1973 and the construction and operation of a feasible demonstration plant through 1978. Certain of these pilot plants will be complete gasification processes, while others will contain only some elements of a process. This will minimize duplication without losing valuable development time. The goal is, at the end of 1973, to establish the best process elements for a feasible commercial demonstration plant. In the period from 1974 through 1978 the resulting process would be utilized in a plant designed to produce 80 million cubic feet per day of pipeline quality gas.

"The pilot plant work should be carried out by the four research centers which are already staffed and active in coal gasification work. These are the Institute of Gas Technology, the Bureau of Mines, Bituminous Coal Research, and Consolidation Coal Company.

"The goal is to complete the program in eight years, three.... (subsequently changed to four)....years for the pilot plant phase and five years to design, construct, and operate the demonstration plant."

A principal benefit to be derived from this proposal is not only to accelerate research on each of the most feasible known methods, but to conduct it in a coordinated manner which would permit maximum time and money being devoted to those components of all the processes which test results confirm as offering the greatest contribution. Likewise the less desirable or technically condemned components can be laid aside at the earliest time. This would simply enable more efficient concentration of the research effort.

Following the A.G.A. proposal of January 22 to the Interior Department, there were numerous discussions between industry representatives and officials of the Interior Department and other offices of the Executive Branch. This led to the general agreement on a modified version of the A.G.A. proposal as described in the President's Clean Energy Message of June 4. Rather than total expenditures of 42 million per year over a period of 8 years to (a) evaluate 7 known processes through the pilot plant stage and (b) select the best process or combination of various components thereof and proceed to establish and operate a commercial size demonstration plant, it was agreed to seek appropriation of funds by the Government and commitments by industry to apply \$30 million per year (\$20 million by Government and \$10 million by industry) for 4 years to conduct the pilot plant stage evaluations of 6 known processes and leave the details of the demonstration plant phase to later determination as more information became available.

In effect, this procedure recognized the immediate urgency and the pre-requisite nature of performing the pilot plant evaluations as the next step in following up the extensive laboratory research to date on the processes

which offered the most encouragement in confirming commercial feasibility. However, all concerned recognized the inherent risk and the research nature of scaling up from pilot plant operations in the magnitude of 1-2 million cubic feet per day to a commercial size in the range of 80-250 million cubic feet per day. As stated in the preamble to S. 1846, p. 2, lines 21-24, "the research and development effort is too large for any single company to risk undertaking and a consortium of companies would be difficult to assemble without Federal leadership."

Therefore, while A.G.A. is most desirous of proceeding with the joint Interior Department-A.G.A. program of pilot plant evaluations, we view the Coal Gasification Development Corporation as a suitable organization to perform the next logical step; namely, "to design, construct, operate, and maintain... a full scale, commercial-size facility to manufacture substitute natural gas from coal....". Thus, we view S. 1846 as a proposal entirely compatible with the presently contemplated Interior Department-A.G.A. joint research effort. It is our hope that this Committee and the Congress will also acknowledge the compatibility of these two specific steps in a logical and necessary sequence. The two steps complement each other. The goals of S. 1846 will be accomplished more efficiently upon utilizing the results of the pilot plant valuations after about four years. The Interior-A.G.A. pilot research findings will be translated into commercial demonstration in a more timely and orderly manner by proceeding to establish the necessary corporate entity and organization.

Thus, Mr. Chairman, A.G.A. is pleased to endorse S. 1846 to establish a Coal Gasification Development Corporation as a vehicle to perform the essential, final step in the long and rigorous research efforts which will result in a vital new coal gasification industry. We are confident that A.G.A. member companies will be among "the private entity or entities.... to participate in the carrying out of such purposes and functions, including the furnishing of financial assistance...." as noted in Sec. 2 (d), p. 4 of this bill. But this should follow the pilot plant work covered by the Interior Department-A.G.A. program described earlier.

Finally, we offer these general recommendations for changes in S. 1846 which are consistent with the foregoing principal thoughts.

In Sec. 2, (d), p. 4. In view of the long-standing experience and expertise of the Office of Coal Research, Interior Department, we question whether this office of the Federal Government, rather than the Administrator of General Services, should not be "authorized to enter into contractual arrangements." The General Services Administration would presumably still be available for appropriate assistance and auditing and other administrative services and serve as the repository for patent rights. Yet the more substantive, decision-making authority would be vested in the Federal office with the most knowledge in the area. Further, with this Federal office serving the key role in both Interior Department-A.G.A. pilot research and the demonstration plant phase, there is more assurance of continuity without duplication of effort or expenditure. This is essential both for obtaining Government appropriations and industry financial commitments.

In Sec. 3 (a), pp. 4,5, the Corporation is in effect directed by statute to select the "two most technically and economically feasible methods" and "design, construct, operate, and maintain a demonstration type facility for each such method." The pilot plant evaluation under the joint Interior-A.G.A. accelerated research program could permit the selection of

a single process, probably including components from several of the present known processes, thus hopefully obviating the need to proceed initially with more than one such demonstration-type facility. In A.G.A.'s presentation to Interior of January 22, 1971, a single demonstration plant was estimated to cost \$186 million. In any event, there should be ^{no} statutory requirement to proceed with two demonstration type facilities.

A suggested substitute for this Sec. 3 (a) would be an acknowledgment of the contemplated Interior Department-A.G.A. accelerated research effort to evaluate through the pilot plant stage the most suitable known coal gasification methods, an expression of intent that periodic results of this research will be made available to the corporation and that when sufficiently conclusive results are possible to ascertain the most feasible method or combination of methods, that said results will provide the bases for proceeding with the establishment and operation of a commercial-size demonstration plant.

Final changes in the language of S. 1846, which would be consistent with the foregoing recommendations, are those which would permit the new Corporation to be active a full six years, if necessary, from the date of initial construction of the demonstration plant rather than from enactment of this Act. This would permit the Corporation to be created and preliminary steps taken such as the appointment of the Board of Directors during the on-going Interior-A.G.A. pilot research phase, but would still allow the Corporation up to six years to conduct its principal business of initiating commercial demonstration plant operations.

We would therefore suggest rewording the first two lines of Sec. 6, p. 8, to read as follows:

"Sec. 6. On or before the expiration of six years following the date of initial construction of the demonstration plant, the Board....."

Sec. 8, lines 11 and 12, p. 9, delete: "and for each of the next five succeeding fiscal years...." and add, "...and for future fiscal years...."

In concluding, Mr. Chairman, let me again say that we appreciate the special interest in these matters shown by you, your co-sponsor in S. 1846, and this Committee. I recall a portion of your statement which accompanied the introduction of S. 1846:

"If there are other recommendations of means to achieve coal gasification capability, I want to consider them.... But I am convinced that we have to take definite steps to achieve it as soon as possible."

Mr. Chairman, definite steps have been taken already by the many years of research both in industry and Interior's Office of Coal Research. This has resulted in a \$10 million pilot plant in Chicago for the two HYGAS processes, a similar size pilot plant in Rapid City, South Dakota, substantially completed for the CO₂ acceptor process. A pilot plant for the BI-Gas process, to be constructed in Homer City, Pennsylvania, is presently in the design phase and the steam iron hydrogen process, is ready for pilot plant design. Bringing these several processes under the accelerated program and centralized management that is accomplished by the current Department of the Interior-A.G.A.

program represents certain very definite steps to achieve a coal gasification capability. Your proposal can provide the next logical step to accomplish the demonstration plant phase but it must, in our opinion, follow the pilot plant stage now under way.

We believe the "other recommendations" we have offered today do merit consideration and that they are responsive to the questions contained in your letter of July 15, 1971, to A.G.A. Chairman, G. J. Tankersley. They are consistent with the basic thrust of S. 1846. We believe they offer a logical sequence of definite steps to achieve coal gasification capability as soon as possible. We believe they will enable utilization of a highly efficient energy transmission system -- the 900,000 mile underground network of pipeline and distribution mains -- to bring this vast energy source to consumers in the manner most compatible with our growing environmental concerns. These are public interest needs of the highest priority.

APPENDIX A

AMERICAN GAS ASSOCIATION, INC.,
Arlington, Va., January 22, 1971.

HON. HOLLIS M. DOLE,
Assistant Secretary for Mineral Resources, Department of the Interior, Washington, D.C.

DEAR SECRETARY DOLE: The American Gas Association and the Office of Coal Research have jointly sponsored research carried on by the Institute of Gas Technology for the gasification of coal. These efforts have brought into being a pilot plant which is now being placed in operation in Chicago, Illinois. Other processes are under various stages of research and development by OCR and other concerned groups.

We believe the need to develop a coal gasification industry in the United States is generally recognized and this should be accomplished in the shortest possible time. Ecological and environmental requirements emphasize the need to substantially add to the availability of clean burning gas for our existing networks of underground transmission and distribution systems. A massive and comprehensive research effort is essential to meet the nation's needs for gas energy.

We submit this proposal covering a broad and accelerated joint government-industry research program. Efforts at this level are believed necessary to attain the goal of a successful coal gasification process as evidenced by the operation of a demonstration plant by the year 1978.

This proposal as developed will require expenditures of approximately \$32 million a year by the government and of \$10 million a year by industry. The American Gas Association pledges its best efforts to obtain commitments for this money from industry and we feel this is an attainable goal.

We look forward to working with you on this most important program and sincerely believe these efforts can lead to a positive conclusion.

Sincerely,

G. J. TANKERSLEY.

PROPOSAL FOR COAL GASIFICATION RESEARCH AND DEVELOPMENT PROGRAM

PURPOSE

This proposal seeks to initiate a joint government-industry effort to establish a coal gasification industry which can serve a vital role in helping to solve the energy and pollution problems facing the nation today. This can best be accomplished by taking advantage of our greatest natural energy resource, coal, by converting it to clean burning gas for distribution in our existing networks of transmission and distribution lines.

Gas now provides about 32% of our nation's energy needs and could grow to 40% if an abundant supply is maintained. There is an urgent need to develop a coal gasification industry to ensure this supply for the long term future.

This proposal recommends a research and development program to accelerate the development through the pilot plant stage of coal gasification methods presently under active study and to construct and operate a technically feasible demonstration plant in the shortest possible time. The best process may prove to be one presently under development, but it is more likely that it will consist of an optimum selection from various process elements developed at the pilot plants proposed here.

BACKGROUND

The gas industry's excellent potential rate of growth may be limited by gas supplies unless supplemental sources can be developed. Potential supplemental sources have been evaluated and while it is likely all of them will find a market place, it appears certain that in the long term public interest a gasification industry based on our nation's extensive coal reserves is most desirable and must be established. It is emphasized that coal gasification is the only presently considered supplemental source that has no dependence on a foreign nation.

To achieve large-scale commercial success in the United States, the gas industry believes that high-capacity systems capable of handling a broad spectrum of coals are needed. Extensive laboratory and small scale pilot plant work has yielded a good understanding of the chemistry of coal gasification and studies have established processing routes which promise the potential of capacity operation. Accelerated large-scale pilot plant development work is warranted

based on the results of these studies. Joint government industry funding sufficient to support such a program is urgently needed if the coal gasification approaches which merit immediate large-scale pilot plant testing are to be brought to a commercial level as soon as possible to help meet the gas supply problem. The difficulty of converting coal to pipeline quality gas at economically competitive prices has required new and sophisticated engineering techniques. Proper development of them requires large-scale pilot plant investigation to establish the optimum design of a commercial demonstration plant.

All of the known coal gasification methods have been evaluated for their suitability for inclusion in this accelerated program. The methods which have been chosen are:

HYGAS-electrothermal, Lurgi gasifier, HYGAS-Oxygen, CO₂ Acceptor, Synthane, Steam-Iron Hydrogen, BCR Super Pressure Process.

These processes are briefly described in Appendix A.

The program of work proposed herein is structured from the fact that there is a great similarity among the various gasification methods now under development, especially with respect to the chemistry of the coal-to-gas conversion route. The significant differences lie mainly in the means of supplying the necessary heat to the step in which the hydrogen-rich gas is produced, the method employed for gas-solids contacting, and the mechanical and physical aspects of the reactor configuration proposed by the various investigators. The amount of methane produced in the coal gasification step versus the amount produced subsequently by catalytic methanation also significantly differs among the various processes. It is possible that the best process route will be created from a combination of individual process elements which are now under development by the various investigators. For this reason, the gas industry should establish a vigorous research and development program which will bring the best of these process elements to a proven stage as quickly as possible and then to integrate these elements into the best possible configuration for the first commercial-sized demonstration plant.

THE PROGRAM

The program proposed involves the construction of two new pilot plants, one new partial plant, modification of three plants and operation of all seven processes through 1973, and the construction and operation of a feasible demonstration plant through 1978. Certain of these pilot plants will be complete gasification processes, while others will contain only some elements of a process. This will minimize duplication without losing valuable development time. The goal is, at the end of 1973, to establish the best process elements for a feasible commercial demonstration plant. In the period from 1974 through 1978 the resulting process would be utilized in a plant designed to produce 80 million cubic feet per day of pipeline quality gas.

The pilot plant work should be carried out by the four research centers which are already staffed and active in coal gasification work. These are the Institute of Gas Technology, the Bureau of Mines, Bituminous Coal Research, and Consolidation Coal Company. An overall perspective of the program is shown in Table 1. The work to be performed by each research center is identified according to the basic process elements. These elements are generally interchangeable and can be assembled into the best ultimate process configuration for scale-up to the commercial-sized demonstration plant. These elements are:

Pretreatment, Hydrogen-rich gas production, Gasification, Gas clean-up, Methanation, Coal feed and discharge systems.

Other elements necessary to build a complete plant, such as coal preparation, coal handling, compressors, etc., do not require development work and can be engineered and purchased from existing proven technology. Combustion of coal chars produced by certain process methods will be studied to develop data necessary for commercial boiler design.

In proposing a broad-based program by the different research centers, there will appear to be some duplication of work, especially in the use of oxygen to supply heat to the gasifiers. Although the chemistry is similar, the mechanical and physical configurations and the various approaches differ considerably. There will be sufficient direction given to the program to avoid duplication of elements in the gas clean-up area and in methanation techniques so that all promising methods of gas clean-up and methanation will be adequately investigated at the pilot plant level. The pilot plants in this program should be sized to handle 3-5 tons/hour of coal.

The details of the pilot plant program are presented in Appendix B.

TABLE 1.—COAL GASIFICATION RESEARCH AND DEVELOPMENT PROGRAM

Process element	Institute of Gas Technology			Consolidation coal— CO ₂ acceptor	B.C.R.—B.C.R. super- pressure	Bureau of Mines	
	HYGAS-electrothermal	HYGAS-oxygen	3, steam-iron			Synthane	Lurgi
Approximate operating pressure. Pretreatment	1,000–1,500 p.s.i.g. Atmospheric pressure air pretreatment (external) ¹ and H ₂ pretreatment, upper stage of hydrogasifier. ¹			200–400 p.s.i. None	1,000 p.s.i. None	400–600 p.s.i. O ₂ -steam in upper portion of reactor. O ₂ -steam low-temper- ature fluid bed.	350–500 p.s.i. None
Hydrogen-rich gas generation	Electrothermal ²	Oxygen-steam, low- temperature fluid bed	Steam-iron: air blown, fluid bed producer with associated steam-iron system. Will not be integrated with H ₂ -steam plant.	CO ₂ acceptor system ²	High-temperature slagging gasifier.		C ₂ -steam fixed bed
Gasification	Integrate with hydro- gasification reactor.	Integrate with hydro- gasification reactor.	Will use H ₂ -steam from hydrogen plant.	Included in above re- actor.	Included in above re- actor.	Included in above re- actor.	Included in above re- actor.
Gas clean-up	M.E.A. or D.E.A. plus caustic ¹ plus Claus sulfur-recovery system ¹ plus engineering and experimental study on alternate systems.			Partial: hot potassium carbonate ² Addi- tional system to be chosen.	System to be chosen	System to be chosen	None.
Methanation							
Coal feed system and char dis- charge system.	Oil slurry, ¹ water slurry via orifice, ¹ dry via orifice.	Cold gas recycle system ¹		System to be chosen	do	Tube wall reactor.	Do
Char combustion				Lock hoppers, ² lock hopper. ²	Solids pump, water lock hopper.	Lock hoppers.	Lock hoppers.
Support studies.	General unified economic evaluations by I.G.T.-A.G.A.B.M. with sup- port by appropriate contractors or subcontractors. Data evaluation by I.G.T. with support by appropriate contractors.	Subcontract.		None	None	Inhouse	None
Commercial-sized demonstra- tion plant.				General.	General.	General.	Economic evaluation.

With assistance of subcontractor upon joint evaluation of all research centers.

¹ Included in existing pilot plant.² Under construction.

CLASSIFICATION OF COAL GASIFICATION PROCESSES

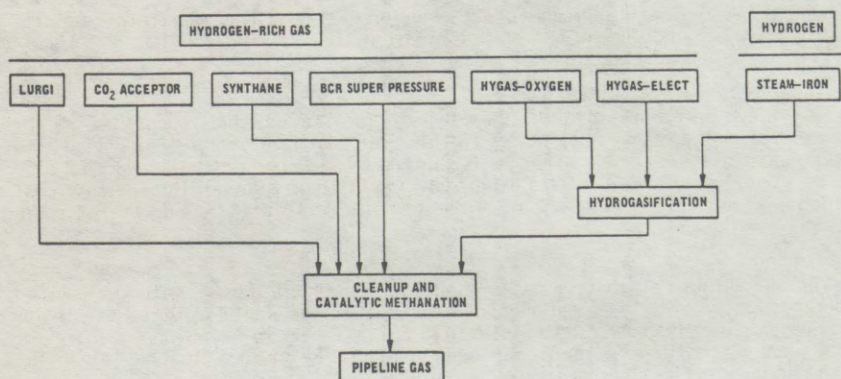


Figure 1

A-1143

Figure 1 shows a simplified classification of the above processes.

In the initial reaction, all of the processes, with the exception of Steam-iron, produce a hydrogen-rich gas. This gas contains carbon monoxide, carbon dioxide, steam and some methane in addition to hydrogen, while Steam-iron produces an essentially pure mixture of hydrogen and steam. Lurgi, CO₂ Acceptor, Synthane and BCR Super Pressure all then proceed to catalytically methanate the hydrogen-rich gas into essentially pure methane which is acceptable for pipeline gas. HYGAS-oxygen and HYGAS-electrothermal both pass the hydrogen-rich gas through a hydrogasification reactor to produce a substantial amount of methane to increase the thermal efficiency of the overall process. The effluent from the hydrogasification reactor requires catalytic methanation to convert residual amounts of carbon monoxide and hydrogen. The Steam-iron hydrogen-steam mixture is only useful for a feed to the hydrogasification reactor but it is ideal for that purpose.

Lurgi, Synthane, BCR Super-Pressure and HYGAS-oxygen all produce the hydrogen-rich gas by reaction of char with oxygen and steam. Lurgi is a fixed bed gasifier and is in commercial use in foreign countries. These economics do not appear attractive but new approaches to it should be studied using United States coals. BCR Super-Pressure is a fluid bed slagging gasifier and as such is unique from the other programs. Synthane and HYGAS-oxygen, in comparison, operate at relatively low temperature. These two are similar in that they are fluid bed reactors, but the mechanical approach to the problem is sufficiently different to make both efforts useful.

HYGAS-electrothermal and CO₂ Acceptor both produce the hydrogen-rich gas by reaction of steam and char. Oxygen is not used. The former supplies the required heat for the reaction by burning char with air to raise steam for electric power and using the power for resistance heating of a fluidized bed reactor. The latter burns char with air to heat the acceptor material which in turn, in a separate reactor, provides the heat to the steam-carbon reaction. CO₂ Acceptor is novel in this approach but it is presently limited to lignite.

The Steam-iron hydrogen process also avoids the use of oxygen. Heat and reducing gas are provided by burning char in a deficiency of air to form a hot producer gas. This gas is used to reduce particles of iron oxide to iron. The iron is reoxidized by steam in a separate reactor to produce a hot, high pressure mixture of hydrogen and steam for the hydrogasification reactor.

All of the processes require gas clean-up and methanation (the reaction of carbon monoxide and hydrogen to form methane and steam).

APPENDIX B

The details of the pilot plant program are shown in Table 1 and are described below.

HYGAS-Electrothermal

The HYGAS pilot plant has been completed except the Electrothermal reactor which is scheduled for completion in late 1971.

The program would include the following elements.

Pretreatment

An atmospheric pressure fluidized-bed pretreater has been provided as an element of the HYGAS pilot plant. In this unit coal is pretreated to destroy its agglomerating tendencies prior to its introduction into the gasifier. The first stage of the gasifier has been designed to avoid the agglomeration of raw coal which may eliminate the need for this separate pretreater. If successful, costs could be reduced.

Hydrogen-rich Gas Generation

An electrothermal reactor is now under construction and will be used to supply that type of hydrogen-rich gas directly to the gasifier. Plans are to integrate this unit into the pilot plant late in 1971.

A packaged hydrogen plant has been provided to supply this gas for plant operation until the electrothermal reactor is ready for operation.

Gasification

The gasifier contains a first-state dilute phase transport system. This is followed with a second stage fluidized-bed and a heat exchange bed.

Gas Clean-up

The gas will be cleaned by scrubbing with an MEA or DEA liquid absorbant followed by a caustic wash. A Claus sulfur recovery system of conventional design is used to recover elemental sulfur from this system.

Methanation

A cold gas recycle methanation system will be used. Various catalysts will be tested in this unit.

Coal Feed and Discharge Systems

A coal-oil slurry feed system using conventional mud pumps has been designed and constructed. The oil will be evaporated using sensible heat in the gasifier off-gases. Char is discharged from the gasifier by slurring the char with water at high pressure and reducing the pressure of the slurry through an orifice. Discharge of char is a steam-char mixture will also be investigated.

Char Combustion

A char combustion study is proposed to obtain necessary data for design of large-scale boilers for power of steam generation.

Lurgi Gasifier

The Lurgi gasifier produces a hydrogen-rich gas requiring clean-up and methanation process elements which Lurgi does not provide. The proposed program would include the following.

Pretreatment

None

Hydrogen-rich Gas Generation and Gasifier

Lurgi has facilities overseas which could be used to evaluate the technical and economic feasibility of the process. Funds have been included to modify a Lurgi gasifier by the addition of rabble arms. It is proposed to conduct tests under the direction of the Bureau of Mines on caking and non-caking U.S. coals. Cost of producing synthetic pipeline gas using this gasifier would be evaluated on a basis consistent with other processes in the program.

Clean-Up

None

Methanation

None

Char Combustion

None

HYGAS Oxygen

The HYGAS pilot plant would be modified by addition of a fluid-bed oxygen-steam-char hydrogen-rich gas generator in late 1972.

The program would include the following elements.

Pretreatment

Same as HYGAS-Electrothermal.

Hydrogen-rich Gas Generation

The laboratory development of an oxygen-based hydrogen-rich gas generator is in progress under A.G.A. support. It is proposed that such a hydrogen-rich gas generator would be scaled-up and integrated into the HYGAS pilot plant upon completion of the electrothermal reactor work.

Gasification

Same as HYGAS-Electrothermal except for rate of coal throughput.

Clean-Up

Same as HYGAS-Electrothermal.

Methanation

Same as HYGAS-Electrothermal with the possible exception that a different catalyst would be used.

Char Combustion

Differences in the char produced by this process may require combustion tests.

CO₂ Acceptor

Consolidation Coal has a pilot plant under construction. Gas clean-up and catalytic methanation are not included in the initial construction phase of the program. This plant is located in Rapid City, South Dakota and is scheduled for initial start-up in 1971. The process is basically adapted to lignite feed.

The program to be conducted at this facility would include the following elements.

Pretreatment

No pretreatment is required for lignite and none is provided.

Hydrogen-rich Gas Generation and Gasification

The CO₂ Acceptor method is basically a hydrogen-rich gas generator in which hot acceptor, which is a calcined dolomite material, is used to supply heat. Gasification is accomplished in a "Hydrodevolatilizer" reactor where a limited amount of methane is produced.

Gas Clean-Up

The pilot plant provides for partial clean-up of the product gas using a hot potassium carbonate system. A novel clean-up system should be constructed at this pilot plant.

Methanation

A novel methanation system should be constructed at this pilot plant.

Coal Feed and Discharge System

Lock hoppers would be used for feeding both coal and dolomite to the system and also to remove coal ash.

Char Combustion

Lignite is completely consumed in the CO₂ Acceptor method and therefore no char combustion studies will be required.

Synthane

It is proposed that the Bureau of Mines pilot the Synthane process currently under development on a laboratory scale.

The program to be conducted would include the following elements.

Pretreatment

Pretreatment is accomplished in the Synthane process by the injection of oxygen-steam mixtures into the upper zone of the reactor and is therefore considered an integral part of the gasifier.

Hydrogen-Rich Gas Generation and Gasification

The Synthane method is based on an oxygen-steam fluidized-bed reactor. Reactor units similar to that conceived by the Bureau are in existence at Hydrocarbon Research, Inc. in New Jersey and at the Midlands Research Station in Solihull, England. It is expected that preliminary work on this process would be conducted at HRI in order to expedite the program while the pilot plant is being constructed.

In this process some gasification occurs during devolatilization of the coal and in an intermediate bed in the hydrogen-rich gas generator.

Gas Clean-up

It is probable that the Bureau of Mines would investigate the use of hot potassium carbonate.

Char Feed and Discharge Systems

Lock hoppers will be used for both feeding coal and discharging Char.

Methanation

The Bureau will probably pilot a tube wall methanation reactor.

Char Combustion

Char combustion tests will be conducted by the Bureau and by boiler manufacturers.

Steam-Iron Hydrogen

The Steam-iron hydrogen process has been developed on a laboratory and small scale by Fuel Gas Associates. It is proposed to negotiate a suitable agreement with Fuel Gas Associates in order to pilot this process on a large scale.

Pretreatment

None

Hydrogen Gas Generation

An air-blown fluidized-bed producer and a steam-iron hydrogen reactor would be built. The fluidized-bed producer would supply hot reducing gas to the steam-iron hydrogen reactor. The attrition rate of iron oxide would be studied. The spent producer gas would be used to test the usability of that gas in an expansion turbine which would be required in a commercial system.

Gasification

None. It is proposed to eliminate the gasification and succeeding steps in the process in this program because the initial operation of the HYGAS-Electrothermal process would use hydrogen from a packaged system which is identical to steam-iron hydrogen. Therefore, integration of the Steam-iron hydrogen reactor in the HYGAS process would not be required.

Clean-Up

None

Methanation

None

Char Combustion

The resulting char may require combustion tests.

BCR Super Pressure

The Bituminous Coal Research, Inc. Super-Pressure process has been developed through the small pilot plant stage. It is a slagging-type hydrogen-rich gas generator and is novel in that respect.

The program to be conducted by BCR would include the following elements.

Pretreatment

No pretreatment is required.

Hydrogen-rich Gas Generation and Gasification

Hydrogen-rich gas is generated in a slagging reactor which is an integral part of the Super-Pressure gasifier. Gasification of coal is accomplished in dilute

phase transport of the coal by hydrogen-rich gases produced in the slagging reactor. Partially gasified char is recycled to the slagging reactor.

Gas Clean-Up

A novel gas clean-up system should be constructed at this pilot plant.

Methanation

A methanation system employing an internally-cooled reactor should be investigated in conjunction with this pilot plant.

Coal Feed and Ash Discharge System

BCR would use a solid pump for feeding coal to the Super-Pressure gasifier. A water quench and lock hoppers would be used to chill and remove the ash.

Char Combustion

None. All the coal is consumed in the gassifier.

(Subsequent to the hearing the following communication was received:)

AMERICAN GAS ASSOCIATION, INC.,
Arlington, Va. August 3, 1971.

HON. FRANK E. MOSS,
U.S. Senate, New Senate Office Building,
Washington, D.C.

DEAR SENATOR MOSS: On July 28, 1971, Mr. Herbert D. Clay presented testimony before the Senate Interior Committee on behalf of the gas industry on S. 1846, the proposal to "Establish a Coal Gasification Development Corporation." During the question and answer period, following the A.G.A. witness' testimony, you requested that the industry provide you with suggested language which would implement the program as outlined by A.G.A. and amend the bill as introduced.

Though some changes and additions were suggested in our testimony, we appreciate your desire to clarify several points. Therefore, I have attached a copy of S. 1846 which reflects language changes we feel would accomplish the goals as outlined in our presentation before the Committee.

We would, however, call your attention to several suggestions which we feel should be highlighted, as they form the basic fabric within which the provisions of S. 1846 and the A.G.A. program can be made most compatible.

As provided for in Sec. 2 (d), the bill authorizes the Administrator of General Services to enter into "contractual arrangements" to carry out the purposes of the Act. However, in view of the longstanding experience and expertise of the Office of Coal Research, Department of the Interior, we feel that such authority would be best delegated to this office of the Federal Government rather than the G.S.A. Further, with this Department of the Interior office serving the key role in both the Department of the Interior-A.G.A. pilot research and the demonstration plant phase, there would be more assurance of continuity and less possibility of duplication. The General Services Administration could continue to be available for appropriate assistance such as auditing and other administrative services, as well as serve as the repository for all patent rights.

We feel that the pilot plant evaluation under the joint Interior-A.G.A. accelerated research program could permit the selection of a single coal gasification process for use in the demonstration plant phase, and thus hopefully obviate the need to proceed with more than one such demonstration-type facility as is presently provided for under Sec. 3 (a) of the bill.

In the attached bill, I have noted additional language changes which are necessary to the above suggested amendments.

I would like to reiterate our complete accord with your desire to press ahead on this program, and obtain results which could be commercially applied at the earliest possible date. We at A.G.A. believe, however, that the pilot plant phase is vital to this program and should not be viewed as an unnecessary delay. Only through such research will the most technically and economically feasible method, or combination of known processes, be selected for use in the demonstration phase.

I would be pleased to discuss with you or a member of your staff any points which you feel need further clarification, and, of course, supply any additional information which you may require.

Very truly yours,

GEORGE H. LAWRENCE,
Director, Government Relations and Services.

Attachment.

The language changes suggested for S. 1846 by the American Gas Association, Inc., letter of August 3, 1971, are as follows:

Page 4, line 14, strike the phrase "Administrator of General Services" and insert the phrase: "Secretary of the Interior in conjunction with the Office of Coal Research of the Department of the Interior."

Page 4 line 21, strike the phrase "Administrator of General Services" and substitute therefor the phrase "Secretary of the Interior."

Page 4, lines 22-25 and page 5, lines 1-12, strike Sec. 3(a) in its entirety and substitute therefor the following:

"In recognition of the present on-going Interior Department, American Gas Association efforts in the pilot plant stage of developing a coal gasification process, the Corporation shall receive periodic reports on pilot plant evaluation. When sufficiently conclusive results are available from the pilot plant research to ascertain the most feasible and economic method or combination of methods, such results will form the bases for the corporation to proceed with the establishment and operation of a commercial-size demonstration-type facility at the earliest possible date."

(Whereupon, at 12:20 p.m. the committee was recessed.)

AFTERNOON SESSION (2 P.M.)

Senator Moss. We will now resume the hearing.

Mr. Clay and Mr. Lawrence and Mr. King are still before us. We had completed Mr. Clay's statement before we had to recess for lunch.

Mr. Clay, first of all, of course, I want to commend you and the American Gas Association for your present efforts in this field to find additional sources of gas, particularly in the area of coal gasification, which is the focus of our hearing here today.

Are you able at this point to give any estimate as to when we might obtain commercial production of gas from coal? There are a lot of imponderables in it. I wondered if you had a ball park statement.

Mr. CLAY. Somewhere within the bounds of these imponderables, it might be about 8 years.

Senator Moss. Roughly about 8 years would be your guess as to when we could be producing gas commercially, putting it into the pipeline and sending it to the consumer.

Mr. CLAY. That is correct. This will mean the completion of the pilot program, which would give us the basic research and information we need; the construction of a demonstration plant, which would, of course, produce sizable quantities of gas to be used in a pipeline system, I am sure; but a commercial plant of the size we are talking about, maybe 250 million a day, would be about 8 years.

Senator Moss. I suppose a great deal of the pipeline is in place, especially out in the west where we do have very large deposits of coal, but do you foresee the necessity for building additional pipelines extensive in length?

Mr. CLAY. The country seems to be quite well criss-crossed with major transmission lines. I am certain there would have to be some nominal extension of lines in coal areas. I would not anticipate any major construction of transmission lines.

Senator Moss. Getting a little bit away from gasification, if we bring gas down from the North Slope, would this have to come by pipeline or is there some other way to transport that?

Mr. CLAY. The most practical and economical way appears to be by pipeline. There is some discussion of liquifying it and bringing it in by tanker. The industry feels it is better to move products by pipelines rather than by tankers. It has not been completely eliminated but that is the thinking today.

Senator Moss. The very controversial question of bringing the pipeline down for oil from the North Slope has not been finally settled, but if that were built, would there be an attempt to lay a gas pipeline along that same right of way? Do you know?

Mr. CLAY. Certainly this would be considered. I think the investigation of gas pipelines is being carried on separately from the oil pipelines.

Senator Moss. To get back to gasification, I understand from your statement, that industry has now already committed itself to participate in the accelerated research being done by the department. In this new acceleration program of \$10 million from industry and \$20 million from the Federal Government, how much of that had already been committed.

Mr. CLAY. About \$7.5 million, Mr. Chairman.

Senator Moss. About \$7.5 million is already committed by members of your association.

Mr. CLAY. Yes.

Senator Moss. Would you say, then, the remainder would be available within a reasonable period of time; is that correct?

Mr. CLAY. I might explain how we arrived at the \$7.5 million. Of course, we have been considering this project for a number of months.

There was a finance committee organized to determine how money could be raised. The industry has been aware of the possibility of contributing up to \$10 million for this gasification program in the pilot stage and so the finance committee has contacted a number of the major industries and got an indication that they would contribute to this. I know in most cases this would have to go back to their boards of directors to get final approval but we think the figure is dependable. We contacted the major industries in the gas business. The remaining \$2.5 million we think would be forthcoming. It would be somewhat slower than the first commitments. We are optimistic about the full \$10 million.

Senator Moss. On page 7 of your full statement you express concern about using the Office of Coal Research expertise. You think section 7 of the bill as written does not adequately use and recognize this expertise in the Office of Coal Research?

Mr. CLAY. Well we certainly hope that this office would be used to the fullest extent of their technical ability and expertise. We think they have considerable ability and expertise.

Senator Moss. Do you have any suggestion as to how the bill might be amended to fully assure utilization of that? We would appreciate any suggestion you have. Do you have any comments to make on the patent provisions of 5C of the bill?

Mr. CLAY. The patent—

Senator Moss. Yes; if the corporation builds the plant and if any patents are acquired, they would be, of course, open public property. I wondered if you had any comment on that.

Mr. CLAY. No; I see no objections to that. I have no further comment on it.

Senator Moss. We are trying to get the greatest production of gas. Of course, we should not inhibit it, I suppose, by any restriction of patent rights on any processes developed. Do you suppose it would be

practical to set up any international venture to organize a workable gasification process?

Mr. CLAY. I think we would expect to profit by the experience of research in other countries.

I might ask Mr. King if he has any comments on that. I think he had some contacts here.

Mr. KING. We are contemplating working with the Lurgi Corp. in Germany. This is one of the concepts that was alluded to this morning. This is a gasification process that produces low British thermal unit gas, but as a part of the joint program we have in mind with OCR, we are planning to perform some tests actually in an existing Lurgi plant, either in England or Scotland, and we will ship American coals to that site, move the plant somewhat to breakup this caking characteristic, so we do plan to take full advantage of the Lurgi process and work closely with the British Council. They have perhaps done more than anyone else in the world in the development of coal gasification because they were behind us in the discoveries of natural gas. We worked very closely with them. We are quite aware of their processes for gasifying NAPHTHA and gasifying heavy oils, and we and many of the members of our industry are staying very close to their development. We developed a plan to include international as well as national.

Senator Moss. Does Britain still have great demand for natural gas supplies since the North Sea field came in?

Mr. KING. At the moment, Britain has converted substantially 80 percent of their pipelines to natural gas. They are still producing about 20 percent what they call "town gas," with gas fires such as the Lurgi gas fire we referred to here. They are still in use. They are gradually being phased out. It appears to be a logical use of equipment and saving taxpayers money is we can take advantage of their equipment, shipping American coals over there and testing there.

Senator Moss. So your response is that you would hope to have international exchanges of processes and whatever knowledge could be gained in any part of the world.

Mr. KING. Yes. As a matter of fact, there is a process in Japan at the moment licensed by the British Gas Council which we are following closely. It is a heavy oil gasification process which is something similar.

Senator Moss. Are any of these foreign processes far enough along to be moved to the demonstration stage?

Mr. KING. None of the foreign processes develop a synthetic pipeline gas of high enough B.t.u. content per cubic feet to be used interchangeably in the pipelines. They were developed much as our coal gasification processes in the early part of this century, to produce low B.t.u. gas, which was considered adequate at that time.

Now, of course, that we have the pipelines and natural gas, we cannot mix the two. As you recognize, all our burners have been converted to be compatible to the higher B.t.u. gases. None of the developments in the foreign countries we are aware of have come up with a process that would be suitable for demonstration at this time.

Senator Moss. Well, I do not have further questions now. I surely do appreciate the most excellent statement that you have prepared,

and we are most appreciative of having you appear before us. If questions occur to me later that I should have asked, I will write you a letter and ask you to respond and put the answer in the record.

Mr. CLAY. We appreciate that.

You did raise one question about the Office of Coal Research. We will review that again and offer any further suggestions. I think possibly we have covered it on page 15 of my testimony but if that is not adequate, we will certainly give it further thought and contact you.

Senator Moss. Very good. Thank you very much.

Mr. KING. Could I add a comment?

I attended part of yesterday's session and one of the testifiers concerned me somewhat. Speaking on behalf of the National Wildlife, they referred to the coal gasification processes being contemplated as being—well, specifically they referred to the carbon dioxide excerpter process as the dirtiest of those on which they obtained information. I would like to state for the record that every one of the processes that we in OCR/AGA are considering will be a completely clean process as far as the environment is concerned. They referred yesterday to the production of sulfur, sulfur dioxide and sulfur oxides. In every process we are considering, we are contemplating converting all the sulfur oxides to elemental sulfur, which will be noninjurious to the atmosphere.

There was also mention of thermal pollution from these large plants. We are considering all of these plants as being air cooled, not water cooled. The water that is used to produce hydrogen for converting the coal into carbon and hydrogen combinations of methane will be minimal in quantity and there will be no heated water returned to the rivers and streams. We are giving very careful consideration to the pollution problems that might have been associated with coal gasification. We recognize the important thing is to take the sulfur out of the coal and not contaminate the atmosphere, but to produce contamination-free natural gas. I wanted to make that clear for the record.

Senator Moss. I am glad to have that in the record. Certainly that is one of the principal considerations that we had in mind; how to preserve the environment, and not pollute it. One of the reasons we are seeking so diligently for gasification of coal is because we hope, by so doing, we will reduce or eliminate pollution which now often comes from the combustion coal.

Well, thank you again, gentlemen. I appreciate it very much.

Mr. Louis H. Roddis, Jr., president of Consolidated Edison. We are very glad to have you and look forward to hearing your testimony.

STATEMENT OF LOUIS H. RODDIS, JR., PRESIDENT OF CONSOLIDATED EDISON

Mr. RODDIS. Thank you, Mr. Chairman.

I have an engineering background. My recent experience has been in the managerial and administrative field in both the Federal Government and private administrations.

I have a prepared statement which is, I understand, now being passed around. With your permission I would like to brief it and enter the complete statement in the record.

Senator Moss. That will be granted. We will put the entire statement in in full and have you summarize or emphasize whatever parts you would like to have.

Mr. RODDIS. Consolidated Edison of New York, Inc., is in the regulatory jurisdiction of the New York Public Service Commission. It has the duty to supply energy to some nine million people in New York City and Westchester County. Specifically, we provide electricity to essentially the entire area, natural gas to Manhattan, Bronx, parts of Queens and Westchester County, and steam in lower and midtown Manhattan. I would like to dwell on the steam system somewhat later.

The amount of energy used in this highly populated area, some 600 square miles, is enormous. Our customers used approximately 32 billion kilowatt hours of electricity, 69 billion cubic feet of gas, 37 billion pounds of steam in 1970. This reflects an approximately 57-percent increase in the use of all three forms of energy in the last decade. This is substantially less than the average growth rate of the country.

Part of it is a result of the characteristics of the area and part of it I would like to emphasize is the fact that our company is not stimulating the demand for any of these energy forms. In fact, to the best of my knowledge, we are the only company actively promoting the conservation of electric power through our "save a watt" campaign seeking to induce customers to forego the wasteful use of electric energy consumption. So, too, with natural gas and steam.

Now a special circumstance confronts Consolidated Edison in our attempts to meet our public service responsibilities. It is not faced by every utility. It is the simple fact that we serve one of the world's most densely populated areas and, as we know, at the present time polluted air seems to be the inescapable result of urban crowding. Not all from us. Much from other sources. Stripped to the bone, Consolidated Edison's challenge is to meet the essential energy needs of the Nations largest city within an environment where the products of combustion from furnaces, incinerators, and automobiles mingle with the pollutants from adjacent areas.

It is this combination that brings me here today, because we feel the need for more clean fuel to produce more clean energy. A very substantial amount of our power generation is produced in stations which basically ring the Island of Manhattan. We also have substantial facilities up the Hudson River and at the far end of Staten Island, but we have, in being substantial, generating facilities, quite modern, in the immediate New York City area.

The simple question is: Why don't we build our plants outside the city and bring the power in by transmission lines? It is a bit complicated to answer.

First, the plants are there. They were built at a time when the hypothesis of power engineering said powerplants should be built as close to load centers as possible. Even if we could pick these plants up and move them out of town, we would not for a variety of reasons.

In the first place, we simply could not forego the availability of that generating capacity. More importantly, we can find no place to put them down that does not produce major controversy both as to the plant site and the route of the transmission into the city.

I might say that difficult as the plant siting problem is, the transmission problem is probably more acute. Certainly we are aware of underground transmission. We have more underground transmission than the rest of the United States put together. There are parts of our system that have never had overhead transmission. Beyond this, this is another reason why we will be operating fossil fuel plants in New York City well into the future and will have a great need for clean fuel. The great towers of central and lower Manhattan, the office buildings, hotels and apartments are heated and cooled by steam supplied by Consolidated Edison through an underground piping system. The magnitude of this commitment can be illustrated by saying that it is electrically equivalent to the total power requirements of the District of Columbia.

In addition to that, in that same area, we provide electric requirements of a city the size of Philadelphia. Manhattan is a fantastically concentrated user of energy.

Now the steam that I mentioned in our steam system is produced in some cases from plants used solely for that purpose and in some cases as a byproduct of the steam generation of electricity in certain in-city plants. The central point is that you cannot move steam effectively more than a few tens of thousands of feet. Therefore, fossil-fired plants will have to be operated in or near the heart of New York City until something better comes along.

Nuclear power plants, we believe, are the most desirable environmentally. It is also true that we feel nuclear power plants can properly be sited in an urban environment. Regrettably, this opinion is not universally shared. It is with reluctance we are forced to conclude that responsible planning demands the assumptions of nuclear powered electric generating plants or steam generating plants will not be permitted in central city areas. The delays associated with siting and licensing nuclear plants at any site anywhere more than support this conclusion. Even more remote solutions that have been suggested are the so-called exotic sources of power such as solar energy trapper by platforms or space and fusion, to name but two. These currently are being advanced most energetically by those who rigorously oppose the application of today's proven technology. Presumably technology is acceptable in inverse proportions to our knowledge of its feasibility and hazards.

We are mindful of the fact in the development of new technologies that 29 years have passed since Enrico Fermi did the first work and even today a very small fraction of the electric energy in this country is produced from nuclear sources.

Present problems cannot be solved by future expectations, no matter how promising or attractive. We have to serve today's load with technology available today.

Now in New York City, to indicate the magnitude of our use of fuels, in 1970 we burned approximately 44 million barrels of residual oil, over 2 million barrels of light oil and kerosene, and 83 billion cubic feet of natural gas under or boilers or in our gas turbines. This consumption will remain approximately static because the growth is taking place in nuclear plants and in out of city fossil-fired plants.

The cleanest fuel available to us for the generation of electricity—and it is now available to us on all but the coldest days of the year—is natural gas. We feel that the combined needs of our electric and steam system, as well as the needs of our gas customers, are going to make this a desirable fuel for us to continue to use. We are fully aware of the serious shortage of pipelines natural gas. We are aware of the various reasons for it and the various efforts to rectify it, and we fully support all of them.

We have also examined all of the alternatives to natural gas that are available to us. I mentioned the large amounts of fuel which we burn. This has to now be three-tenths sulfur or less and it has an extremely high cost. It also does have some sulfur and some ash. It is not as clean a fuel as natural gas or as manufactured gas. Moreover, the vast bulk of the oil which we have to use in New York—and, indeed, in the whole Northeastern United States—begins as foreign crude. It generally moves as residual from the refineries of Europe to the Caribbean, where it is blended with other residuals for final shipments to our tanks.

This leaves us dependent on foreign supply. We get roughly a million barrel tanker once a week. We also have extensively developed other alternatives of gas supply through the liquifaction route, LNG. We expect to buy a substantial quantity of Algerian liquid natural gas with deliveries beginning in 1973. The final contractual arrangements for this are in progress. I might add that although this is quite expensive gas by comparison with our natural gas prices, by comparison with what we are paying for clean fuel oil, it is not too bad.

This, therefore, leads us to the possible use of a massive natural resource which lies within our national boundaries. I am naturally speaking about the enormous quantities of coal with which this Nation is blessed. I spent nearly a decade as president of an electric utility in western Pennsylvania and helped develop the Keystone, Homer City, and Conomo complex which is in the east essentially what the Four Corners complex is on the Pacific coast. I have some feel for the size and importance of the U.S. coal reserves. Accomplishment of the goal of making use of this fuel, which has fallen into disfavor as a fuel in metropolitan settings because of its sulfur, ash, and transportation problems, is to turn it into methane, the most available and cleanest of all of the possible fossil fuels. We do not believe that the accomplishment of this goal requires any impressive technological breakthroughs. This is not to underestimate the difficulties which we are going to have but we have made an awful lot of gas in New York City. It certainly is not an impossible thing to do.

We have not made methane, naturally. Much of the coal in the eastern part of the country is in disfavor because of the high sulfur content. Coal gasification certainly can promote recovery of this massive reservoir of energy because, as Mr. King just mentioned, in all of the gasification processes that are being looked at, the inherent cleanup is a part of the design of the process.

We are not attempting to promote any specific form of coal gasification because we think that the program is one where the several processes should be considered and moved forward into pilot plant and

large-scale application. It seems apparent that with the large sums of money that are going to be required, together with a close coordination of effort, if we are going to properly develop our coal reserves for the maximum environmental benefit at an acceptable cost in the shortest periods of time, some form of participation of the Federal Government is required as the only agency with the capacity to provide the leadership and funding in cooperation with industry to reach this end.

This is not a plea to excuse industry from its responsibilities. We are participating fully in all of the programs that are in this area and also, I might add, in the electric area. But the task of harmonizing the sometimes diffuse interests of the coal owners, many of whom are large oil companies, the gas industry, with its division among producers, transmission companies and distributors, can prove too slow for adequate private initiative. We believe that a major governmental effort geared to the size of the task ahead will save it. We need the clean energy that is available to us from the gasification of coal.

Mr. Ruckleshaus has pointed out that New York City could burn three times the methane now used if it hopes to meet the new Federal air quality standards in the area. We agree roughly with those figures. All we need to do is to make up our minds to get it. It would seem beyond dispute that tapping this reservoir of clean energy would be clearly in the public interest. Thank you.

Senator Moss. Thank you very much, Mr. Roddis.

On page 16 you pointed out that the action by the Federal Government was necessary in order to harmonize and bring together the various interests that are all concerned with the problem, but they may be diffuse and it is hard to get them organized. Does this apply also on funding? Why is it necessary for the Federal Government also to put up a large part of the funding?

Mr. Roddis. I do not believe I said to put up a large part of the funding, sir.

Senator Moss. The bill says 60 percent. Is there justification for that?

Mr. Roddis. I think there is a justification in the prototype plant installations, which have some rather large risk uncertainties, for the government to participate. I have, for the last 20 years, both on the Government side and the private side, been deeply involved in our nuclear energy development in this country and I truly believe we could not have gotten it off dead center with the original water cooled reactor systems if there had not been some government participation in that. The so-called demonstration programs.

I think the same thing is true in the context of the fast breeder today.

I think there is an element of uncertainty and I think there is a real element here of trying to get a number of quite diffuse interests to pull together, and I think the Federal Government can play an important role.

Senator Moss. Does your company now contribute to the research that is going on in coal gasification?

Mr. Roddis. Yes, sir.

Senator Moss. You participate in that?

Mr. RODDIS. Yes, sir.

Senator MOSS. I think, of our witnesses, you are probably the most optimistic as to how far along we are with the technology. As I understood you to say, the technology is pretty far along. We are ready really to start the demonstration plant. Is that your feeling?

Mr. RODDIS. Basically, it is, sir. I think I have a view that at least for some of our specialized uses of gas, the competing price is substantially higher and most of the users who want to use it solely for normal gas distribution purposes are willing to do so. The competing fuel in this case is clean imported oil. Believe me, that is not cheap.

Senator MOSS. How expensive is this LNG that you are intending to bring?

Mr. RODDIS. I think I can answer that by saying from two to five times what our present price of gas is, or approximately one and a half times what our expected price for oil is when we reach the point 3 limit that we have to get to.

Senator MOSS. In that sense, the price for manufactured gas from coal would command a rather sizable amount of money.

Mr. RODDIS. Yes, sir; I do not think that the 80 cent figure bothers us. We are paying that right now for lots of fuel.

Senator MOSS. And you support, then, this bill that is before us because you think we are right on the threshold where we ought to push through.

Mr. RODDIS. Yes, sir.

I should say that, after a lot of experience in this development business, the engineer and scientist who is working on the process wants you to wait just a little while until he gets it a little bit more perfect. Likewise, the financial people want to know for sure what the answer is. But the only way that any of the major developments have come forth, either privately or publicly in this country, is because somebody with a little bit of entrepreneurial application here brought these things together and moved them forward. There is at least as long a period of time to get the mechanism in gear and the people working as it will take to get a pilot plant a year's operating experience. You have at least a year's lost motion after a bill becomes law before you really have an effective entity working. I think it is time to move on and get the framework established.

Senator MOSS. Well, I agree with you so I am glad to have you say that for the record. We do appreciate your testimony.

Senator FANNIN did not get to hear all of it, but you may have some questions.

Senator FANNIN. Thank you, Mr. Chairman.

I am sorry I did not have a chance to get back earlier. Naturally I know about your company and the great progress it has made in many areas of advancement and in the nuclear field. I know you are probably one of the leaders in that endeavor. But I am just wondering, you mentioned an 80-cent figure when talking about the production from the coal. You do not consider it to be realistic, is that what you said?

Mr. RODDIS. No, sir; what I said was that I do not consider that to be an unreasonably high figure. We would be quite happy to get that kind of clean fuel at that price.

Senator FANNIN. If you could get it right at the point of usage.

Mr. RODDIS. Yes, sir.

Senator FANNIN. Do you feel that the figures that they have which I heard from El Paso Natural Gas probably are in the range of bringing in LNG, is that right?

Mr. RODDIS. What I said before you came in was that we are in the process of contracting for some of that gas at a price which, depending on how you figure it because we get it at different periods of the year, runs from 80 cents to \$1.20. 1 million British thermal unit—

Senator FANNIN. There is not a possibility that that cost can be lowered appreciably, is there? Even if they gave it away at the source, they still have costs involved of tremendous equipment—

Mr. RODDIS. Not as long as money costs 9 percent. Most of it is investment.

Senator FANNIN. If they could, I realize it is a tremendous investment. I think they are talking in billions as far as equipment is concerned. As they go through the years, do you think it would be possible to lower those costs to any great extent?

Mr. RODDIS. I think they will lower relatively to other costs as other costs escalate forward. I unfortunately think that inflation is something that is with us, and if you can get something relatively fixed in cost by an initial investment, in 20 years it will look like a bargain.

Senator FANNIN. I take it we would have to discount the inflation if we are going to make comparisons, but do you feel they will have economies as they go along? They get their capital investment out of the way and—

Mr. RODDIS. Develop.

Senator FANNIN. Do you have any idea or have there been studies made to indicate what that might be projected to be, say, in 10 years?

Mr. RODDIS. Sir, there have been studies made. The degree of accuracy which I will assess to any economic study that has the kind of "ifs, ands, and buts" in it is substantially in excess of the numbers. In other words, the errors in it.

You can say this quite conclusively: Given a process and given an investment in a system, there is every likelihood that the price can be pulled down over a time period by between 10 and 25 percent.

Senator FANNIN. To some extent this would be true of coal gasification?

Mr. RODDIS. It should be at least as true of that, but here again the inflation factor is an important one. I might add that I think one of the biggest unknown cost elements in all of the cost estimates I have seen on coal gasification is the cost of the coal. I do not think we fully know all of the impact of the Coal Mine Safety Act and costs.

Senator FANNIN. Do you feel the Coal Mine Safety Act would add materially to the cost?

Mr. RODDIS. The Coal Mine Safety Act and the environmental problems. All these things taken together, I am not sure we fully understand the total impact of them on the price of coal.

Senator FANNIN. I agree with you because I happen to come from a State in the Four Corners area where we had this recent problem. It stopped the construction on most plants because of the unknown quantity and getting pollution-free power generated, though I do

think they are making great progress in that respect and I feel they will go forward after it is proven that they can have success in cleaning the stacks. I hope that will come about in the foreseeable future for the next 5 or 10 years, the statements that several of you made about the percentage of power that could be developed by nuclear energy. Why, we will certainly have a great need to care for the tremendous demand that is growing. Thank you very much.

Mr. RODDIS. Thank you.

Senator MOSS. Senator HANSEN?

Senator HANSEN. I have one question, Mr. Roddis.

I have a letter here addressed to the chairman of the full committee written by the Assistant Secretary of Interior, Hollis Dole.

On the second page of that communication he has this paragraph:

A new organization such as that created under S. 1846 would bring confusion and delay to this carefully developed program. We believe that the most effective way of accomplishing our common goal of making coal gasification a commercial reality is to move ahead as rapidly as possible along the lines already established.

Would you care to comment on that?

Mr. RODDIS. I guess I should say I do not agree with him.

Senator HANSEN. I beg your pardon?

Mr. RODDIS. I guess I should say I do not agree with him, sir.

Senator HANSEN. Thank you.

Senator MOSS. Thank you, Mr. Roddis. We appreciate your testimony. You are required to serve the gas and energy to the people of this concentrated population area so I suppose that adds to your feeling of urgency in moving on with this problem.

Mr. RODDIS. Yes.

Senator MOSS. Your future planning will depend a lot on whether we are able to produce synthetic gas.

Mr. RODDIS. Yes sir. We are right squarely up against the fact that we are fresh out of sites. We are looking at sites in the Atlantic Ocean, either with floating power plants, which, incidently, we already have several of, or possibly artificial islands. This, however, is a decade or more away both in terms of technology and in terms of the necessary legal and administrative framework to try and do this out in the ocean.

We have some power plants that are going to be needed to serve the city in the latter half of this decade, in the early part of the 80's, that, quite honestly, are not sited and we have been trying very desperately—for the period of time I personally knew about the company, which is a little over 2 years, and I know for a long time before that—to get some of these sited.

We have one of the most inoffensive plants pollutionwise you can imagine, which has been hung up in the Federal courts on environmental issues for—it is now in its ninth year, since the application was made. We have a transmission line in its sixth year of hearings. It appears now that one of the terminuses will be moved by the new fourth jet airport for New York City, which will require us starting all over again on that. These are very deep concerns of ours in trying to furnish this tremendously concentrated energy load which a major city is.

Senator Moss. I sometimes think Senators have frustrations. I can see you have a few, too.

Mr. RODDIS. We have some, too; yes, sir.

Senator Moss. Thank you very much, Mr. Roddis.

(The prepared statement of Mr. Roddis follows:)

STATEMENT OF LOUIS H. RODDIS, JR., PRESIDENT OF CONSOLIDATED EDISON

Mr. Chairman, may it please the Committee, my name is Louis H. Roddis, Jr. I am the President of Consolidated Edison Company of New York, Inc. I wish to thank the Committee for this opportunity to appear in support of an enlarged Federal role in the development of coal gasification.

Con Edison, under the regulatory jurisdiction of the New York Public Service Commission, has the privilege and duty to supply energy to the nine million people of New York City and Westchester County. Specifically, we provide electric service to almost the entire area; natural gas to Manhattan, the Bronx, part of Queens and Westchester County. And in lower and mid-town Manhattan, we provide central station steam service for heating, cooling and processing. Our net investment in facilities dedicated to the public's use is over \$4 billion.

The amount of energy used annually in our franchised area is enormous, and grows larger every year. In 1970, our customers used approximately 32 billion Kwh of electricity, 69 billion cubic feet of gas, and 37 billion pounds of steam. This reflects a 57% increase in the use of all three forms of energy in the last decade. And our best estimates show future demand will be even greater.

Con Edison must—and will—meet this demand. A demand, I should point out, we are not stimulating. On the contrary, we are actively promoting the *conservation* of electric power through our SAVE-A-WATT campaign, seeking to induce customers to forego wasteful electric energy consumption. So, too, with natural gas and central steam service. We are urging our customers not to waste any form of energy.

A special circumstance confronts Con Edison in meeting our public service responsibilities—one not faced by every utility. We serve one of the world's most densely populated areas, and, as we know, polluted air seems the inescapable concomitant of urban crowding. Stripped to the bone, Con Edison's challenge is to meet the essential energy needs of the nation's largest city within an environment where the products of combustion from countless furnaces, incinerators and automobiles mingle with airborne pollutants from adjacent industrial areas. All these combine to produce an atmosphere that Mr. Ruckleshaus publicly de-spairs can be sufficiently improved in time to meet minimum Federal air quality standards.

But mention of this special circumstance does not suggest immunity from the other problems that have brought us as a nation to the verge of an energy crisis. On the contrary. The shortages of natural gas and of low sulfur oil; the extraordinary problems of siting and licensing fossil, hydro and nuclear power generating plants; the growing opposition to new transmission lines and pipelines—these, and more, remain on Con Edison's agenda of unfinished tasks.

It is this combination that brings me here today: the need for *more clean fuel* to produce *more clean energy*.

To visualize this need, I would like to describe Con Edison's operations in slightly more detail. Generally speaking, the electricity used in New York City today comes from twelve generating stations. Of these twelve, ten can be thought as ringing Manhattan Island. Of the other two, one is on Staten Island, and the other, a nuclear plant, is located 25 miles north of the City on the Hudson River. In short, we operate ten power generating plants in what could be described as the heart of the City.

"Why don't you build your plants out of the City and bring the power in by transmission lines?" has, unfortunately, a complicated answer. First, these plants are *there*, built in a time when the apotheosis of power engineering wisdom held that power plants should be built as close to load centers as possible. But even if today we could pick these plants up in our hands and move them out of town, we couldn't for a variety of reasons. The most immediate is that we simply could not forego the availability of that generating capacity—for no matter how short a time. But, more importantly, we would have no place to put them down which would not produce controversy both as to the plant site and the route of the transmission into the City.

But beyond this there is another reason why we will be operating fossil fired plants in New York City for well into the future and therefore will continue to have a need for clean fuel.

Today, the great towers of central and lower Manhattan, the office buildings, the hotels and apartments, are heated and cooled by steam supplied by Con Edison through an underground piping system, with the electrical equivalent of the total power requirements of the District of Columbia. This steam is produced in some cases from plants used solely for that purpose and in some cases as a "by-product" of the steam generation at our in-city electric generating plants. The central point is that since steam simply cannot be effectively moved more than a few tens of thousands of feet, fossil fired plants will have to be operated in or near the heart of New York City until something better comes long—and there is nothing better on the horizon that we can see.

Nuclear energy may hold the answer to the problems associated with the operation of fossil plants, the shortages of clean fuel and the associated environmental consequences.

Nuclear power plants emit zero air pollution. It is also true that we feel nuclear power plants could properly be sited in an urban environment. Regrettably, this opinion is not universally shared. And it is with reluctance that we are forced to conclude that responsible planning demands the assumption that nuclear powered electric generating plants will not be permitted in central City areas. The delays associated with siting and licensing nuclear plants at *any* site, *anywhere*, more than support this conclusion.

Even more remot solutions are the so-called exotic sources of power, such as solar energy trapped by platforms in space, or fusion, to name but two. These currently are being advanced more energetically by those who vigorously oppose the application of today's proven technology. Presumably, technology is acceptable to inverse proportion to our knowledge of its feasibility and hazards.

This isn't to say we think new ways of generating electricity should not be explored. Our record here, we think, is intact. Con Edison sought and obtained the very first construction permit in the nation to build a nuclear power plant. Indeed, we have one nuclear plant operating, another virtually complete and in the final licensing procedures, and a third unit under construction. And we have made a substantial commitment to development of the fast breeder reactor. But, we are also mindful that 29 years have passed since Enrico Fermi did his seminal work under the grandstands at the University of Chicago.

Since that time, the Manhattan Project, the Nautilus and exhaustive research and application by industry has come and gone—yet fission accounts for only a tiny fraction of our country's energy supply. To wait for fusion or solar power or "something else" to be developed would be to sentence the country to stagnation. For it is indisputable that standard of living and energy consumption are inextricably interwoven. Fusion, undoubtedly, will one day come. And we will do our share to see that it does. But present problems can not be solved by future expectations, no matter how promising or attractive. We still have to serve today's load with technology available today.

Fossil fuel must remain the muscle of our national life. Just how important it is to New York can be seen in the size of Con Edison's fuel barn for electrical production. In 1970, we put 44,500,000 barrels of residual oil, 2,200,000 barrels of light oil and kerosene, and 83.2 billion cubic feet of natural gas under our boilers, or into our gas turbines. This enormous quantity of fuel, as mentioned before, was burned entirely within the City of New York, with all that that implies environmentally.

The cleanest fuel available to us for the generation of electricity on all but the coldest days of the year is natural gas, which is 98% methane.

Con Edison's sale of natural gas has steadily risen at about 5% per year. With the impact of the requirements of the Federal air quality standards, it is probable that this rate of growth will accelerate as more and more furnaces and incinerators switch to this clean burning fuel.

The combined need of our electric and gas system for this most desirable fossil fuel is certain to continue and will probably increase dramatically.

Regrettably, the country is facing a serious shortage of pipeline natural gas, a shortage that from all available evidence promises to be of long duration. The American Gas Association Reserves Committee estimates continental United States gas reserves at 264.7 trillion cubic feet, while production in 1970 was 22 trillion cubic feet. This means a reserve to production ratio of 12.0. Federal Power Commission Engineers estimate that a RP ratio of 10 is the critical

figure below which we could not recover quickly enough to meet the demand at current levels.

There is not universal agreement as to why we have a natural gas shortage. The principle cause advanced is that inadequate field pricing discouraged exploration and development of new reserves. This reason will be tested by the recently announced higher prices to producers in Southern Louisiana and the Rocky Mountain area. Higher well head prices undoubtedly will stimulate deeper drilling and more off-shore exploration. But it seems reasonable that, given the attractiveness of natural gas environmentally, supply will lag behind demand.

Alternatives to natural gas are several, but each has its limitations. First, very low sulfur residual oil (0.3%) can be obtained, and in fact we use a great deal of it. But it still has some sulfur and some ash, and its costs are beyond regulation. Moreover, the vast bulk of the oil used by Con Edison begin as foreign crude, moves as resid from the refineries of Europe to the Caribbean, and is there blended with Venezuelan petroleum for final shipment to our tanks. Dependency upon foreign supply and shipment is shared by another much discussed alternative, or more accurately supplement, to the natural gas supply—LNG. While we expect to buy a sizeable quantity (10 Bcf) of Algerian LNG with deliveries beginning in 1973, we do not view it as an acceptable long-range fuel alternative for electric power production. Rather, LNG will serve to augment winter gas supplies to meet our gas customers' peak day demands.

Synthetic gas from naphtha, methanol, and other feedstocks, are each feasible, but depend in nearly all instances upon a substantial hostage investment in a foreign country, and are sensitive to international economic and political forces that shadow their reliability. This is not to say they should not be used; but rather that we should press for an energy source that is in greater supply and lies within our national borders. Such an energy source exists in the enormous quantities of coal with which this nation is blessed. I spent nearly a decade as President of an electric utility in Western Pennsylvania and believe that it gave me some feeling for the size of the U.S. coal reserves.

The secret is to turn the coal, which has fallen into disfavor as a fuel in metropolitan settings because of its sulfur, ash and transportation problems, into methane—the most valued of all the fossil fuels.

Accomplishment of this goal should not require impressive technological breakthroughs. This is not to underestimate the difficulties that will be encountered, but before the advent of welded steel pipelines, gas was made from coal and oil. What is necessary is to make a gas with a content of 1000 Btu per cubic foot rather than half that—which was the Btu level of gas in the old manufactured gas days.

Much of the coal in the Eastern part of the country is disfavored from an environmental standpoint because of its relatively high sulfur content. Coal gasification can promote recovery of this massive reservoir of energy because in the gasification process SO_2 is converted to gaseous hydrogen sulfide. As such, through the application of known technology, the sulfur in its elemental form can be recovered producing a "sweet" gas.

Nor is the gasification process itself a new source of industrial pollution. The only gas discharged to the atmosphere from such a plant would be carbon dioxide, the same as would be emitted from a natural gas-fired plant.

There are today a number of coal gasification methods being explored. Probably the most advanced is hydro-gasification, or the HYGAS process developed by the Institute of Gas Technology. This process, now at the pilot plant stage, at full scale would convert 18,000 tons of bituminous coal a day into 250 million cubic feet of pipeline quality gas a day. This is a little better than half Con Edison's normal daily consumption of natural gas. Such a plant, it has been estimated, would require an investment of about \$150 million. Operating and Maintenance costs, less interest, taxes, and return on investment, would total about \$40 million a year. Such costs, of course, do not reflect the cost of pilot and demonstration plants. Nor should they be considered definitive—but merely illustrative. But considering this is only one of many competing processes, it seems apparent that large sums of money, together with close coordination of effort, is needed if proper development of our coal resources for the maximum environmental benefit is to be achieved at an acceptable cost in the shortest period of time. The Federal Government, in my judgment, is the only one with the capacity to provide the leadership and funding to reach this end. This is not a plea to excuse industry from its responsibilities. But the task of harmonizing the interests of the coal owners, many of whom are large oil companies, and

the gas industry, split among producers, transmission companies and distributors, could prove too slow for private initiative. Only a major government effort, one geared to the size of the task ahead—taking into full account the gravity and dimensions of the energy problems of the country—will satisfy.

Besides the primary objective of providing a clean fuel for clean energy, the gasification of coal could also have important economic benefits to the coal producing states. While this is difficult to quantify, given some license it can be estimated that on the order of 2,300 new jobs in plant operation, maintenance and coal mining would be associated with a full scale HYGAS operation. These new jobs in turn would support 1,600 additional jobs in the trades, service industries and professions.

Methane from far below the waters of the Gulf of Mexico was used this morning by a housewife in Connecticut to cook breakfast for her family. We go that far to find clean energy and think nothing of it. Today, in the hills of Pennsylvania and West Virginia, close to some of our major cities, that same clean energy is waiting. We need it. Mr. Ruckleshaus says New York City alone must burn three times the methane now used if it hopes to meet the new Federal Air Quality Standards. All we need to do is make up our minds to get it. It would seem beyond dispute that tapping this enormous reservoir of clean energy would be clearly in the public interest.

Senator HANSEN. Mr. Chairman, before you call another witness, I wonder if I might ask Mr. Clay one question.

Senator Moss. Yes.

Mr. Clay, would you return for a question? Senator Hansen would like to ask you a question.

Senator HANSEN. There are some who question the gas reserve figures used by the Federal Power Commission as a basis for recent well-head price increases for natural gas. A subcommittee of the other body has recently held hearings in which some witnesses implied that some gas producers may have understated reserve figures and may have actually created an artificial shortage with the objective of obtaining just such increases as recently were approved by the FPC in several gas producing areas.

In this morning's Washington Post, an article referred to a witness, Dr. Dale Helmerich, president of the American Public Gas Association, who testified before the Senate Intergovernmental Relations Subcommittee on Government Advisory Groups. Mr. Helmerich also referred to gas reserve figures in a recent National Petroleum Council report and I quote: "The level of gas prices is intimately related to the true extent of gas reserves but the Petroleum Council has simply accepted the totals reached by the Reserve Committee of the American Gas Association rather than the larger figures disadvantageous to the industry reported to the FPC," he said.

I would like to ask unanimous consent, Mr. Chairman, that the full article be included in the record at this point and that I would like to invite you, if you would care to, Mr. Clay, to comment on that story. I do not know if you have seen the story or not.

Senator Moss. The article may go in.

(The article referred to follows:)

[From the Washington Post, July 28, 1971]

U.S. OIL-GAS ADVISORY PANELS HIT AS INDUSTRY DOMINATED

(By Morton Mintz)

Government advisory committees on oil and gas matters are virtually dominated by the oil and gas industry, which exploits its "privilege status" in its own behalf, a spokesman for an organization of 950 publicly owned local gas distribution systems charged yesterday.

"I know of no advisory committee on which the oil and gas consumer's interest is adequately represented," said Dale Helmerich, president of the American Public Gas Association. He testified at a hearing of the Senate Intergovernmental Relations Subcommittee, which is probing the role of government advisory groups.

The National Petroleum Council, "supposedly an innocent medium for the communication of technical data, is in reality an official embassy for the major oil companies in the Interior Department," Helmerich said.

The council, created 25 years ago, has the Interior secretary as its co-chairman but is composed entirely of oil and gas industry officials. The chairman, E. D. Brockett, who is also chairman of Gulf Oil, will testify today.

Helmerich, who is mayor of Huntingbur, Ind., was similarly critical of the Federal Power Commission, which has set up a national survey to study the supply and demand situation for gas.

Of the 45 members of the gas survey's executive advisory committee, all but nine are "top executives of the major natural gas producing companies," Helmerich testified. On the supply committee, which has the sensitive job of estimating the gas reserves which significantly determine rates, "the consumer is not represented at all," he said.

As an example of "pro-industry bias," Helmerich cited the interim report on the nation's energy outlook, 1971-1985, that the petroleum council issued on July 15.

In charging that the FPC, for years, has held the prices of gas destined for interstate movement to "artificially low levels," the report simply echoed the long-standing complaint of producers seeking "to avoid the mandate of Congress set out in the Natural Gas Act of 1938 as interpreted by the Supreme Court," the witness said.

The level of gas prices is intimately related to the true extent of gas reserves, Helmerich continued. But the petroleum council "has simply accepted the totals reached by the Reserves Committee of the American Gas Association," rather than the larger figures—disadvantageous to the industry—reported to the FPC, he said.

Helmerich appealed for legislation to assure that government advisory committees reflect views "other than those of the industries potentially most affected by their efforts. Without such safeguards," he said, "it would be better wisdom to abolish" such committees.

Sen. Lee Metcalf (D-Mont.), who presided, has introduced a bill to lay down guidelines for advisory committees, including one for members to represent the public, and for exposure of their proceedings to public scrutiny. Sens. William V. Roth Jr. (R-Del.) and Charles H. Percy (R-Ill.) have introduced companion measures.

But Arnold R. Weber, associate director of the White House Office of Management and Budget, suggested that there is a "balance" in, say, committees composed exclusively of bankers advising the Treasury Department on management of the national debt, and committees composed exclusively of the poor advising the Office of Economic Opportunity. He questioned whether it would be desirable to have a cross-section in each committee. Metcalf didn't.

Weber said the administration opposes the reform bills, arguing that the problems of advisory committees—1,180 of them, by OMB's count—"are, in the long run, better dealt with by administrative action."

He said that a proposed Executive Order is the favored mechanism and that a draft of one is well along. While opposed in principle to secrecy, he said, the order would seek to control "irresponsible release of information."

Metcalf and Roth expressed fear that without legislation the committees could lapse back into their usual way. As for secrecy, Metcalf said, "The public interest lies in the most open, forthright and frank discussion."

Senator HANSEN. If you can respond to the question, we will appreciate it.

Mr. CLAY. Comments of this type have been rather common at times by certain people. I do not think there is any basis for this type of comment. I think the reserve studies prepared by the association are done as objectively as possible. There can be, in my estimation, no major error. From a personal company standpoint, I think we have

reserves—our figures might be presently overstated. We are in the process of drilling some deep wells in our territory and so far they are producing nothing but water, but we are supposed to have some gas reserves. This is the risk involved in attempting to find production.

Getting back to the question, I think the reserve figures are accurate.

Senator HANSEN. Thank you very much.

Senator FANNIN. I was just wondering if I could ask one question.

Senator MOSS. Surely.

Senator FANNIN. Over the years, I know you had success in storing petroleum gases in caverns like the salt caverns. Now I notice we have a new test coming up—I think it is the next month or two—where they will be having another blast, similar to what they did in New Mexico—was it Gasbuggy or something that they called it? I was wondering: Will they have any success in storing that product as liquid in storage? Would they be able to pressurize to that extent? An underground storage. I know you have refrigerated storage in large tanks. I know you had some good luck and some problems with it.

Senator MOSS. You mean in a natural structure?

Senator FANNIN. Liquid natural gas in a storage tank. Under that tremendous pressure. I was wondering if they could do anything in underground caverns? Would the pressure be too great if they tried it in underground caverns?

Mr. CLAY. I would think there would be technical and engineering problems that would be impossible to solve in trying to store liquified natural gas in great depth underground. There have been underground storage—

Senator FANNIN. They do it with propane and butane but with LNG you get up to tremendously high pressures. Butane would pull it down tremendously.

Mr. CLAY. The big problem with LNG is that I believe it liquifies at minus 260° and this would create technical problems in trying to—

Senator FANNIN. At 70° or 80° in the ground. It would still have a pressure of, what, 2,000 pounds or something?

Mr. CLAY. I do not believe it would be that high. I might call on—what would be the pressure?

Senator FANNIN. At 100°, around 3,000 pounds? 2,500 to 3,000 pounds?

Mr. KING. Over a thousand pounds at reasonable temperature.

Senator FANNIN. At 70 or 80 underground. Whereas propane would be, what, 150 and butane 75 or something like that?

Mr. KING. Yes.

Senator FANNIN. I was just wondering what the potential might be. I knew they were having this test and it happens to be in my home State so I was wondering what could be contemplated.

Mr. KING. Senator Fannin, I was under the impression that the test was to release natural gas—

Senator FANNIN. I know that particular test is for that purpose. I was wondering if there was any possibility of ever storing, as they do propane or butane, in this underground storage. I knew about the problem you had in Columbus not too many years ago when the refrigeration system failed and I do not know whether the relief valve went off the tank or what happened.

Mr. KING. That was a metallurgy problem, the tank itself.

Mr. CLAY. We developed the first underground storage in 1915 and certainly we would consider storing natural gas underground. There are adequate reservoirs for that purpose.

Senator FANNIN. I was thinking of the tremendous volume that could be stored if they ever could store it in liquid form.

Mr. KING. In response to your question, some years ago one of our members attempted to have a nuclear cavern formed in the Pennsylvania area and they had so much argument from the local population that they abandoned the concept. We have given serious thought in the research department of the American Gas Association to a nuclear created storage area off the coast of the Atlantic Ocean. We are still considering this. We recognize that the local population will be concerned. Technologically, it is sound. It can be done. You actually create a chimney well below the surface of the ground which will be sealed adequately to hold the pressures and temperatures of LNG. Oh, it can be done. It is possible, technologically.

Senator FANNIN. Thank you.

Senator Moss. Thank you, gentlemen. We appreciate your responding to the question.

We will move on now and call Russell J. MacMullan, Assistant to the President of Pullman Inc., Mr. MacMullan? Mr. MacMullan does not appear to be here. We have his statement and I will order that the statement be printed in the record at this point.

(The statement referred to follows:)

STATEMENT OF RUSSELL J. MACMULLAN, ASSISTANT TO THE PRESIDENT, PULLMAN, INC., CHICAGO, ILL.

GENTLEMEN: Senator Moss' letter to me of July 21st indicated three questions on which the Committee on Interior and Insular affairs would appreciate an answer regarding written testimony on S. 1846 (the Coal Gasification Development Corporation bill).

In our opinion there is a strong need to intensify the coal gasification effort. This intensification will provide the potential of being able to meet gas demands from our very extensive domestic coal reserves and eliminate or, at least, control the nation's dependence on overseas gas (LNG) or offshore gas, supply of which may become uncertain in times of emergency.

The Coal Gasification Development Corporation appears to have certain key characteristics that make it ideally suited for intensifying the necessary program. It will focus responsibility for advancing this important project on a Corporation which would have this sole objective. Because the project involves technology at the limits of today's frontiers, it is important that the responsibility for advancing this project not be diluted by competing demands in organizations having other tasks in addition to coal gasification development. Furthermore, because the risks involved in the new technology are substantial with respect to technology and size, organization of a government-industry corporation to assume the risks and responsibility is most likely to make the shared risk more acceptable to the financial backers of the corporation. This should serve to expedite effective undertaking of the development.

In addition, we believe that if the Corporation is formed, we are hopeful that the selection of the most technically and economically feasible methods for manufacturing substitute natural gas from coal will include the evaluation of the work done by firms such as our division—The M. W. Kellogg Company—involving a number of years and approximately \$1 million. The work performed was looked on with great favor by the Office of Coal Research and was only dis-

continued because of lack of funds. We are not including any technical data regarding what has been done since this will be the prerogative of the proposed Corporation.

One other point we wish to emphasize—if we read the bill correctly—is that on the dissolution of the demonstration units, **private industry will be refunded 100% of their prorated share rather than the 60% as we read in the Act.**

We greatly appreciate the opportunity of presenting our thoughts so they may be included in the record.

Senator Moss. Mr. Kenneth A. Roe, President of Burns and Roe left his statement to be included in the record and the statement of Mr. Roe will be printed in the record at this point.

(The statement referred to follows:)

STATEMENT OF KENNETH A. ROE, PRESIDENT, BURNS AND ROE, INC.
ORADELL, N.J.

Current projections anticipate that the United States will need economic, non-polluting fuels during the next 20 years substantially in excess of the known and anticipated domestic resources of oil and gas.

S. 1846 deals constructively and positively with this problem. Fortunately, the country's huge resources of coal and lignite are available to meet these deficiencies if the technology is available to convert these solid fuels into clean fuels in either a gas or liquid form on an economic basis.

No doubt the Committee Members and the Committee Staff are familiar with the substantial body of technical and nontechnical literature dealing both with the need for additional supplies of clean fuels and the technology for converting coal to clean fuels with significant and valuable by-product chemical production.

The Federal program, supplemented by the significant effort of private industry, has produced a firm scientific basis for the design and construction of large commercial plants for the conversion of coal and lignite to clean fuels.

Why is it then, at this point in time, when clean fuel production from coal promises to solve two of the most pressing problems of the decade, non-polluting fuels and abundant domestic energy, that the private sector is not committing substantial sums to conversion facilities. The answer, of course, is that the processes have not been demonstrated on a commercial scale in this country.

Several large installations abroad, using high pressure gasification, have been built and operated over the years but these plants produce low to moderate heating value gases and cannot serve to demonstrate economics and availability in the United States for pipeline gas production.

The problem, then, is one of engineering for a profit developing and proving the technology to the point where the private investor can feel reasonably secure in his venture. Hopefully the first commercial plants will cause a wave of optimism in the industries concerned, so that companies will move to continue to improve and develop the processes with private resources.

The technology gap is one of site adaptation, of process and equipment evaluations and optimizations, of heat and energy balances, of ash removal and coal feeding systems, and similar problems. These are engineering decisions and the more engineers that get involved in making them, the better will be the prospects for overall and early success in the program.

Characteristically, the economics of coal processing will be determined only after considerable growing pains. Gasification techniques and purification processes, like desalting, can be expected to show steady improvements in costs with operating experience. As the field becomes competitive, optimized process conditions, heat recovery and process power integration will continue to reduce costs while plant size and products can be selected for maximum overall usefulness and profitability.

It is apparent that no single process is likely to produce economical products for all coals or for all the varied local conditions which exist throughout the United States. Engineers must decide whether oxygen, hydrogen, or indirect heating systems will provide the best process, as well as whether fixed bed,

suspended or fluidized beds offer the best prospects. Specific end uses for the products call for different gasification and purification concepts so that a high temperature process using steam and air would be acceptable for use with a gas turbine power cycle, but a high pressure, moderate temperature, oxygen and steam process might lead to the most economical pipeline gas.

Now that the accumulation of basic data is underway from several pilot plants, the next logical step would be an engineering evaluation of this extensive body of knowledge to select two or three gasifiers and purification systems for full scale demonstration. To gain as much field experience as possible, the full scale gasification plant should be designed to incorporate several different systems to assure completeness in the project and to encourage competitiveness in the process.

As an example, it is Burns and Roe's judgment that the production of lean gas for mine-mouth power plants would show more promise than the production of pipeline gas. It would, indeed, be unfortunate if the program is not sufficiently flexible to confirm the relative economics. Further, when the gasification unit is fully integrated with the power plant, the cost of a lean fuel could even be reduced. These potentially fruitful prospects should not be overlooked by scoping the anticipated program to pipeline gas production alone.

Burns and Roe agrees that the time is right to initiate the programs envisioned under this Bill. The importance of producing clean fuels from coal cannot be overstated. Our assessment of the field to date indicates that sufficient basic data is in hand to design and construct a full scale demonstration plant that would have excellent prospects for success. Such a plant should be designed with a high degree of flexibility and should be able to broadly assess as many aspects of production and utilization as possible.

The question is not whether coal gasification is feasible. Installations around the world have been gasifying large quantities of coal for thirty years. *What must be established is the set of conditions and combination of processes that lead to the best commercial venture.* These objectives can only be achieved by prudent investments of effort and financial support. We believe the time for real action has arrived.

Senator Moss. This now completes our list of witnesses we had scheduled before the committee.

To all of those appeared as witnesses I want to express my thanks. We certainly have had a very informative 2 days of hearings. If, as a result of other statements that were made or any of the discussion that went on, any of you feel that there is some supplementary statement or contribution you would like to make to clarify any of the problems that were raised here, we would welcome that and would include it in the record if it is submitted to us in writing within the next 2 weeks. For 2 weeks the record will be open so that we may add additional materials to it. You are invited to contribute to that record. The hearing shows we definitely face a serious problem and something needs to be done. All we have to do now in this committee is figure out what.

[Laughter.]

Thank you very much.

Senator HANSEN. Mr. Chairman, I would like to add something:

Mr. Chairman, all of us on this committee are acutely aware of and concerned with the Nation's energy problems.

The legislation we are considering here today is for the purpose of assuring the country an adequate energy supply in the future. In that regard, this committee now has underway a study of national fuels and energy policy and there are also other studies that will undoubtedly contribute to the committee study.

One of these is the so-called McKetta report made at the request of the Secretary of Interior.

The report has just been released to the Secretary of Interior and although I haven't seen the full report the Oil Daily of July 27 carried a summary of the report. I will not read the entire article but would like to quote a few of the highlights: "A blue-ribbon advisory committee has told the Federal Government that the United States has the energy resources to meet most of its requirements over the coming years—but, unless it moves soon to encourage their development, shortages are in prospect of growing severity.

The tone of the report, made to Interior Secretary Morton, was much like that of a preliminary assessment made by a committee of the National Petroleum Council earlier this month.

"The Nation," the committee told Morton, "now faces the prospect of serious and costly shortages of energy in the near future. Only prompt measures taken to encourage expansion of secure supplies at a rate in keeping with the requirement of our economy can minimize energy shortages that will adversely affect consumers and the Nation."

"It made these points:

"1. The United States has sufficient potential energy resources from most sources' to rely on continuing expansion of production to meet growing needs and to remain self-sufficient in energy 'provided it chooses to do so and follows policies designed to achieve that objective.'

"2. What is needed are ample supplies of energy from conventional fuels and 'new sources' of energy when needed.

"3. Nuclear power is already 'well on the way to becoming an important source' of energy which can be used in a manner consistent with a 'good environment.'

"4. Synthetic fuels from coal, oil shale, and tar sands 'can be' a significant source of liquid and gas hydrocarbons in the 1980's.

"5. But these 'new' fuels will come into use only gradually to meet 'part' of the additional requirements and not as a major displacement of fossil fuels.

"6. Thus, 'we will need more fossil fuels, plus all the energy that can be expected economically from new sources in order to meet total needs for energy in the next 10-15 years.'

"7. 'Because of past mistakes in governmental energy policies—and the long leadtime needed for major capacity expansion—the United States 'cannot escape experiencing some shortages of energy . . .' as is now the case for natural gas."

In view of the relevancy of the McKetta report to the hearings on this bill, Mr. Chairman, I ask that the article be included in the record of these hearings.

Senator Moss. That will be included in the record.

(The article referred to is in the appendix.)

Senator Moss. The committee will be recessed at this time.

(Whereupon, at 2:55 p.m., the committee was recessed.)

The first part of the paper is devoted to a general discussion of the problem of the existence of a solution of the system of equations (1) for arbitrary values of the parameters α and β . It is shown that the system (1) has a solution for arbitrary values of the parameters α and β if and only if the condition $\alpha + \beta = 1$ is satisfied. The second part of the paper is devoted to a detailed study of the properties of the solution of the system (1) for arbitrary values of the parameters α and β . It is shown that the solution of the system (1) is unique and that it depends continuously on the parameters α and β . The third part of the paper is devoted to a study of the properties of the solution of the system (1) for arbitrary values of the parameters α and β . It is shown that the solution of the system (1) is unique and that it depends continuously on the parameters α and β . The fourth part of the paper is devoted to a study of the properties of the solution of the system (1) for arbitrary values of the parameters α and β . It is shown that the solution of the system (1) is unique and that it depends continuously on the parameters α and β . The fifth part of the paper is devoted to a study of the properties of the solution of the system (1) for arbitrary values of the parameters α and β . It is shown that the solution of the system (1) is unique and that it depends continuously on the parameters α and β . The sixth part of the paper is devoted to a study of the properties of the solution of the system (1) for arbitrary values of the parameters α and β . It is shown that the solution of the system (1) is unique and that it depends continuously on the parameters α and β . The seventh part of the paper is devoted to a study of the properties of the solution of the system (1) for arbitrary values of the parameters α and β . It is shown that the solution of the system (1) is unique and that it depends continuously on the parameters α and β . The eighth part of the paper is devoted to a study of the properties of the solution of the system (1) for arbitrary values of the parameters α and β . It is shown that the solution of the system (1) is unique and that it depends continuously on the parameters α and β . The ninth part of the paper is devoted to a study of the properties of the solution of the system (1) for arbitrary values of the parameters α and β . It is shown that the solution of the system (1) is unique and that it depends continuously on the parameters α and β . The tenth part of the paper is devoted to a study of the properties of the solution of the system (1) for arbitrary values of the parameters α and β . It is shown that the solution of the system (1) is unique and that it depends continuously on the parameters α and β .

APPENDIX

(Under authority previously granted, the following communications were ordered printed:)

STATEMENT OF W. A. BOYLE, PRESIDENT, UNITED MINE WORKERS OF AMERICA

Mr. Chairman and Members of the Committee, we appreciate the opportunity to present testimony on S. 1846 a bill to create a coal gasification corporation.

Attached, as an appendix to this statement is a release which I made at the time of the introduction of this legislation supporting it and pledging the cooperation of the United Mine Workers of America in efforts to secure the passage and implementation of the corporation envisioned by the legislation.

Since the time of the introduction of S. 1846, the problem of natural gas supplies has become more acute. Testimony before this committee has underlined the urgency of the matter. It would therefore be redundant for me to elaborate on this point other than to suggest that the pressing need for additional and large supplies of pipeline quality gas must be considered as nothing less than a number one national priority, a priority which urgently demands a crash program.

We commend Senator Jackson and the other sponsors of S. 1846. We feel that in introducing this legislation they have not only provided a needed focus upon the crisis which is existent in our gas supply but they have also provided a vehicle for the ultimate solution to the problem posed by such shortage.

In viewing the legislation we would make one suggestion with regard to the make up of the corporation. We feel that there should be a place made on the corporation board of directors for a labor representative, as well as a consumer representative. Such representatives would bring to the corporation the voice of the American worker and the American consumer and would provide a valuable input to the corporate officers in the discharge of their duties. For, it should be obvious that this corporation, if it is to be effective, must have the broadest possible representation from among the American people.

Within the last several days the Department of Interior has entered into a major agreement with the American Gas Association to promote gasification research. While, on the surface, this proposal may seem to be in conflict with S. 1846, close examination reveals this not to be the case. The urgency of the gas supply situation is immediate. It requires the concerted effort of both public and private sectors if it is to be solved. The Department of Interior and the American Gas Association, in pushing forward on a research and development program in the gasification area have recognized this need and have taken steps to solve it. Their work, if pushed to successful fruition, would be a valuable contribution to the gasification corporation when it is once set up. It would provide the needed pilot plant technology which could be used with any of the demonstration plants to be established under S. 1846. It would also permit a continuation of the research and development effort on gasification while the corporation envisioned in S. 1846 is going through the Congress and in the early stages of its formation.

We would, therefore, urge the Congress to continue to support the Interior Department's research and development program until the time that the gasification corporation becomes a reality. We would also suggest that when the corporation actually begins that the Gas Association and other people with an interest in coal gasification could easily transfer their funding and their expertise from the current work to the new corporation. We would also suggest that when the corporation begins to function that the proper governmental agency for it would be the Office of Coal Research within the Department of Interior rather

than the General Services Administration. The Office of Coal Research has a great deal of experience in gasification technology. This experience is probably the most extensive in the development of some technology in any government agency. It can be effectively utilized by the new corporation and would provide a method for a continuity of technical development with minimum loss of knowledge in the transfer from the present gasification program to those of the new corporation.

In conclusion we strongly support S. 1846. We congratulate its sponsors and offer to the Congress whatever assistance the United Mine Workers of America can bring to bear upon the problem of coal gasification. This program is of obvious and immediate interest to the United Mine Workers. It potentially can mean millions and millions of dollars in wages to our members, millions of additional dollars in welfare payments to the beneficiaries of the UMWA Welfare and Retirement Fund and an economic stimulus of unparalleled magnitude to coal mining areas throughout the United States. It would permit the maximum utilization of U.S. coal, a resource which for too long has been slighted in efforts aimed at meeting the energy needs of our country. We believe that the decade of the 1970's and the 1980's are decades of coal. We believe that coal and coal alone possesses the reserves and technical know-how to meet the expanding energy needs of our nation.

However, our interest in S. 1846 transcends our immediate parochial concern for the well being of America's coal miners and their families, for large and expanding quantities of pipeline gas are vital to the prosperity of the entire American nation. Such gas can be made available from domestic energy resources. Such availability would provide the necessary stimulus for our continued economic growth and will also permit us to meet our energy needs and the problems associated with environmental quality. We, therefore, concur most strongly with the efforts made by Senator Jackson and the other sponsors of S. 1846 and urge the Committee to do whatever is necessary to see the legislation through to a speedy passage and enactment into law. We pledge to the Committee our support in this endeavor.

UMWA News

(FOR IMMEDIATE RELEASE)

MAY 20, 1971.

The United Mine Workers of America today endorsed S. 1846, a bill introduced into the Senate last week by Senators Henry Jackson (D-Wash.) and Frank Moss (D-Utah). The bill would establish a Coal Gasification Development Corporation, jointly owned and funded by the federal government and private industry.

"We are fully in agreement with the objectives of this bill which seeks to utilize available resources to meet pressing fuel needs with minimal environmental hazards. We are also in agreement that a federal-industry corporation of limited life would be best suited to do the job because it will bring new expertise to the task and give industry a concrete stake in reaching the measure's objectives," W. A. (Tony) Boyle, UMWA president, said.

The UMWA president said that the union has but one significant reservation regarding the bill, but that this can readily be overcome without delaying action. He noted the measure, as introduced, would establish a governing board of nine—five appointed by the President subject to Senate confirmation and four named by the President from recommendations made by industries with a direct stake in the research.

"Labor and the consumer have a major economic and environmental stake in the conversion of coal to gas. We urge modification of the bill to require the President to name one member of the Board of Directors from recommendations of labor organizations with a direct interest in the research and one from recommendations made by bona fide consumer groups. The labor and consumer voice must be heard in establishing research priorities in this increasingly important area of national concern," he added.

Boyle stressed that the creation of a joint corporation limited to research on converting coal to gas is as vital to the national interest as the creation of Comsat and Amtrak. He added that the results of such research could have even more far-reaching results for the nation's future than the two joint industry-government corporations already established for international communications and passenger rail service.

"At issue is the development of an economical, environmentally safe and plentiful fuel to meet the basic energy needs of the nation. Natural gas supplies are now being depleted at an uncomfortably rapid rate. Domestic oil is also in short supply and foreign oil supply is subject to political pressures and pricing. Atomic energy presents serious unknown health and environmental hazards and, in any case, the supply of economic uranium is also reaching the point of exhaustion.

"America is blessed with an abundant supply of coal which can be extracted readily and, with proper regulations, with minimal ecological hazard. At least for the foreseeable future, this nation must increasingly turn to coal as its basic energy source. We already lag in essential research and the Jackson-Moss bill represents legislative recognition of what must be done now," Boyle said.

STATEMENT OF FRANK J. ALLEN, GENERAL COUNSEL FOR WESTERN OIL SHALE CORP., SALT LAKE CITY, UTAH

My name is Frank J. Allen. I am General Counsel for Western Oil Shale Corporation, a public corporation.

Western Oil Shale Corporation holds State of Utah oil shale leases of 76,000 acres on the known oil shale deposition in Utah's Uintah basin. The company has intensively investigated the oil shale and hydrology of an area considered to be the heart of the Utah oil shale deposition. The investigation included coring through the shale formation, conducting the full spectrum of logs in the holes, subjecting the cores to assay by the Bureau of Mines and others and establishing the rock characteristics of the formation with the assistance of the Atomic Energy Commission and others.

The company's objective in making this investigation, at a cost of approximately $\frac{1}{4}$ million dollars, was to demonstrate the peculiar amenability of the deep lying shale in the area to an oil recovery methodology involving the release of nuclear energy to produce permeability in the formation. The conclusions of the investigators were extensively reported at a symposium sponsored by the Bureau of Mines at Laramie on February 17, 1971.

Without dwelling on the conclusions of the investigators, it is fair to say that there is scientific support for the assertion that economic recovery of oil from shale by in situ retort treatment after nuclear fracturing is a distinct possibility, and that possibility could be intelligently evaluated in a safe, small scale nuclear experiment were conducted in the area we have investigated. There are, unfortunately, no funds now available for such an experiment.

We believe a public corporation such as the one proposed to be formed by S. 1846 should concern itself with the development of oil shale as well as coal technology. The nation's oil shale is much more extensively in public ownership than its coal reserves and it offers comparable promise as an oil source.

We would urge that this concept be incorporated in S. 1846.

FRANK J. ALLEN.

[From The Oil Daily, July 27, 1971]

DEVELOPMENT ALSO URGED, BUT MCKETTA REPORT FINDS U.S. ENERGY RESOURCES "SUFFICIENT"

(By Jim Collins)

WASHINGTON.—A blue-ribbon advisory committee has told the federal government that the United States has the energy resources to meet most of its requirements over the coming years—but, unless it moves soon to encourage their development, shortages are in prospect of growing severity.

The tone of the report, made to Interior Secretary Morton, was much like that of a preliminary assessment made by a committee of the National Petroleum Council earlier this month.

The latest report was made by an ad hoc "advisory committee on energy," set up about two years ago by Interior Secretary Walter Hickel, headed by Dr. John J. McKetta Jr., professor of chemical engineering at the University of Texas, Austin. Other members are Willis S. Strauss, Northern Natural Gas Co.; Thomas M. Lydon, Peabody Coal Co.; William F. Kieschnick Jr., Atlantic Richfield Co.;

James F. Sorensen, Consulting Engineer, Visalia, Calif. Dr. Richard Gonzalez, Houston; Dr. Michel T. Halbouty, Houston; and Francis P. Cotter, vice president, Westinghouse Electric Corp.

"The nation," the committee told Morton, "now faces the prospect of serious and costly shortages of energy in the near future. Only prompt measures taken to encourage expansion of secure supplies at a rate in keeping with the requirement of our economy can minimize energy shortages that will adversely affect consumers and the nation."

It made these points:

1. The U.S. has "sufficient potential energy resources from most sources" to rely on continuing expansion of production to meet growing needs and to remain self-sufficient in energy "provided it chooses to do so and follows policies designed to achieve that objective."

2. What is needed are ample supplies of energy from conventional fuels and "new sources" of energy when needed.

3. Nuclear power is already "well on the way to becoming an important source" of energy which can be used in a manner consistent with a "good environment."

4. Synthetic fuels from coal, oil shale and tar sands "can be" a significant source of liquid and gas hydrocarbons in the 1980's.

5. But, these "new" fuels will come into use only gradually to meet "part" of the additional requirements and not as a major displacement of fossil fuels.

6. Thus, "we will need more fossil fuels, plus all the energy that can be expected economically from new sources in order to meet total needs for energy in the next 10-15 years."

7. "Because of past mistakes" in governmental energy policies—and the long lead time needed for major capacity expansion—the U.S. "cannot escape experiencing some shortages of energy . . .", as is now the case for natural gas.

Here are its four specific recommendations:

—The interrelation of all forms of energy "means that effective U.S. energy policies must be formulated broadly and on a long-run basis in order that consumers and investors may make intelligent decisions about the use and production of various competing fuels."

—Because energy problems are complex, in terms of technology, economics and environment, they require a "co-ordinated, analytical examination on a continuing basis". Primary government responsibility for analysis of energy policies "should be placed in the hands of one entity knowledgeable on all energy problems, such as the proposed department of natural resources."

—Policy regarding reliance on domestic energy sources versus dependence on imports "should be defined clearly for the long run to promote increased development of supplies of domestic oil, gas, coal and uranium, as well as development of alternate fuels from coal, shale and tar sands so that consumers may have sufficient options among secure domestic supplies."

—And, government energy research work, and support of private research, should be expanded "for those crucial areas of energy development and use that involve greater benefits socially than to individual companies." Research promoting more "efficient use" of energy "deserves special attention by the government."

McKetta, in forwarding the report to Morton, said that the "advocates of specialists" in each energy-source area were "intensively tested and debated by the committee," and that the "special insights of numerous government and industry experts were integrated" into it.

"This effort," McKetta told Morton, "was convincing evidence to us of the value and necessity of a continuing, interdisciplinary, and total-energy-scope government analysis of energy options, problems, programs, and policies."

The committee said the task of developing and using energy supplies, in conformance with environmental goals, will be difficult—but it can be done.

It said the costs of a clean environment can be met; the nation has the economic strength to do it.

But, the McKetta group warned government has a "major responsibility for promoting intelligent solutions" to the problems, and the task "must be dealt with promptly."

Energy, the group said, is the sine qua non of vigorous prosperous economic growth in the U.S., and domestic adequacy has brought the nation far.

But, the rapid rise in energy demands has exerted sharp upward pressures on prices at home and abroad over the past year and the demands of foreign energy

producing countries "are bringing to and end the abundant and cheap energy supplies from foreign sources."

The committee pointed out that there was a sharp rise in domestic drilling, and development in the 1946-56 period because of "better real prices for oil and gas," but that was followed by a drop of about 50 percent in wells drilled between 1956 and 1970, bringing "the numbers" back to the levels of 1946.

Until "recently," the U.S. had shut-in producing capacity for emergencies when overseas imports were interrupted—but this capacity "has declined rapidly and is expected to essentially be eliminated by 1973."

Production every year since 1961 has exceeded new discoveries of oil in the U.S. and the nation has been living off past discoveries and liquidating its reserves, it warned.

Remaining onshore reserves—estimated at 100 billion barrels in the lower 48 states—will be more and more difficult to find, contained in difficult and expensive-to-locate geologic areas.

There are large additional reserves in the offshore and Alaska areas—and they hold great potential for production, "provided that environmental regulations and leasing policies do not preclude development or increase costs to uneconomic levels."

It flatly urged: "government should encourage the discovery and development of more domestic reserves of petroleum liquids and gas."

"In order to insure that the desired indigenous (domestic) production levels are achieved," it declared, "gradual improvement in domestic (real) prices appears necessary."

On natural gas, the committee warned wellhead prices haven't kept pace with prices of other commodities—actually declining since 1960—and industry's aggressiveness and investor confidence "have been shaken."

It urged new government policies to "trigger increases in exploration and development onshore while affording the industry opportunity of earning an acceptable rate of return . . ."

It urged stimulating exploration and development on the outer shelf "along all three coastlines," more rapid leasing of lands in the public domain and revision of current bonus-bidding practices for leases "to reduce short-run diversion of capital funds away from needed exploration and development."

It also urged government policies to increase the availability of imports of natural gas and liquefied gas, under conditions that protect the "interests of consumers and national security."

The McKetta group also urged, as quickly as possible, exploration, development and marketing of potential gas supplies in the Arctic regions.

It also urged intensified efforts to make gas from coal.

Discussing coal, the group said "a national energy policy" should be adopted to encourage prudent investments in this fuel resource, but "flexible enough to take into account technological developments," recognizing the "basic role" of coal in the economy.

A primary recommendation was that federal support of coal research be "increased greatly," and intensified on gas from coal.

On electricity, it urged prompt construction, under regulation, of new plants without delays, with a "one-stop" licensing procedure, aggressive development of the nuclear breeder reactor, and "careful evaluation" of the controlled thermo-nuclear (fusion) reactor.

On synthetic fuels, it urged "gradual development" as the most economic—but warned that total North American output is not likely to reach 1,000,000 b/d before 1985; later, production rates of 515,000,000 b/d could be "easily supported" by domestic resources.

NATIONAL ECONOMIC RESEARCH ASSOCIATES, INC.,
Philadelphia, Pa., August 27, 1971.

Hon. FRANK E. MOSS.

Chairman, Subcommittee on Minerals, Materials, and Fuels, Senate Committee on Interior and Insular Affairs, New Senate Office Building, Washington, D.C.

DEAR SENATOR MOSS: A review of the various submissions to your Committee concerning Senate Bill 1846, on the subject of Coal Gasification, prompt us to offer the following remarks, to put the subject in perspective. It is now some

fifteen years since the William B. Tippy, then head of Commonwealth Services, Inc., marshalled charts and data to convince the attendees at an American Gas Association convention that the nation would, in not too great a span of years, be running out of natural gas. Therefore, he pleaded, it behooved the gas industry to get on with the task of perfecting the manufacture of synthetic methane against the day it would need to be phased in as a replacement for natural gas. No one seriously argued with him then—though not too much was done about it—any more than they have more recently, when present-day speakers develop the same theme. The only difference is in the degree of the reaction, brought on by the events of the past two years—the superimposition of the new wave of demand for sulfur-free fuel on a slowdown in the rate of development of new gas reserves, culminating in the fuels “crisis” of 1970. Now, people are prepared to heed the lesson and proceed with greater vigor toward the technological development of synthetic gas. A number of pilot projects have been announced. More are scheduled in the years ahead, under the announced government-industry “cooperative program.” Is there need then for a government-sponsored program such as is called for by Senate Bill 1846, sponsored by Senators Jackson and Moss?

We think the answer is “yes”—but before addressing ourselves to this specific question a number of tangential questions require discussion. Four are here singled out.

(1) Can the recently ordered price stimulus revive exploration in the “lower 48” to the point where synthetic gas again recedes into the distance, as it did after Bill Tippy’s speech, leaving only the disembodied idea, the smile on the Cheshire cat?

(2) Will Arctic gas replace the “lower 48” as a source, again postponing the need for synthetic?

(3) Can LNG (liquefied natural gas) imports fill the gap?

(4) Do we really need all that gas anyway, down the road?

For ease of discussion, the last question will be approached first. Gas consumption has been growing steadily, at the rate of some 6 per cent a year, for the past two decades. This is a rate of growth somewhat below the rate of growth in consumption of electricity (7 per cent a year), but above that of fuels and energy in total. Leaving aside the use of gas for generating steam in electric plants, gas is still moving to replace oil and coal, first (and still, in many areas) on the basis of price, and second on its sulfur-free propensities. While it suffers competitive losses to electricity each year, there is no present reason to believe that the problems which beset the electric industry will permit the latter to become a more vigorous competitor in the years immediately ahead—and interest in air quality is here to stay. Consequently, one may with confidence forecast a steady rate of growth for gas in the years ahead, for this century at least, even if not at quite the same rate as that prevailing in the last decades. The basic and important consideration is that gas is still—and increasingly—the form by which fuel can be distributed most economically—Btu for Btu—throughout urban America.

One parenthetical note, however. There is not and will not be enough gas to supply all the gross boiler fuel demands which the nation’s interest in air quality would otherwise put on it. Either by governmental fiat, via end-use control, or by governmentally-approved pricing policies, this form of gas use will have to be curbed under any rational long-range energy policy. This will take time, if too great economic disruption is to be avoided; but it makes little sense to hasten the day when gas must be made from coal—an expensive process, all will agree—by burning it now under utility boilers. At that time, down the road, if fossil fuel is burned at all in new plants, it will be low-sulfur coal, probably supplemented by a sulfur-free material more directly derived from coal. Consequently, here and throughout this presentation, gas demands are defined to include only limited expansion in boiler fuel use.

If then demand for gas will continue to mount, though at a more moderate pace, what are the chances of a price-increase-inducted revival in domestic exploration and development meeting this demand? Not too good, it is suggested. Despite the oil industry’s partial ability to explore for gas directionally, the gas and oil rates of development proceed in general accord with each other—and domestic oil expansion is simply not picking up at the required pace. There are other, too-promising investment potentialities. We expect much gas to be found—but not at the rate and in the overall volumes required. Thus we show as our

Table I our estimate of the demand-supply balance for gas to 1985 (using the most likely set of assumptions with respect to the use of gas for boiler fuel). This table shows that in the years before the Arctic gas reaches the U.S. (the next five years or so), and even with the stimulus from higher prices, the reserve life index will continue to fall, to a practical minimum of ten year's life, and even then all demands, even as narrowly defined, may not be met. Consequently, without the supplement of gas from outside the "lower 48," gas shortage conditions will remain severe until the end of the '70s.

The principal hope for meeting the gap between demand, restricted as above specified, and supply, is the bringing in of very substantial quantities of new supplies from Alaska, the Mackenzie River delta, and probably also the Canadian Arctic Islands. It is probable that an Alaskan pipeline by itself could be filled to produce deliveries approaching three trillion cubic feet per year; and while the estimates of Canadian Arctic gas availability are more tentative—and the question of export equally unresolved—it is conservative to estimate it at an equal order of magnitude. Most projections for the beginning of this flow put it at 1976–1977. The final conclusion with respect to the technological feasibility of Arctic pipelining will not be reached for another year or more, and what with the delays attendant upon environmental considerations, and upon the evolution of the required institutional arrangements, it is difficult to see construction work beginning before 1974. Whatever the timing may be, however, it is entirely possible that the absorption of this large new supply, at a lower cost than is likely to be the case with gas made from coal, will further postpone the need for synthetic gas, for perhaps another decade.

We are now looking, then, at a reasonable balance of demand (as we define it) and supply in the late '70s and early '80s, assuming always that adequate pricing incentives will continue to produce annual supply increments from the "lower 48" in the thirty trillion a year order of magnitude. This assumption is reasonable, for that period, but unless the Gas Supply Committee's "speculative" gas resources materialize, this period will see a peaking-out of production from lower U.S. sources.

The final question then, assuming that additional gas will be required, is whether or not LNG imports can fill the gap. The answer would seem to be in the negative. In the first place, with the lead time required, supplies would not reach here in any volume before 1976. At *that* point in time, with Arctic gas available, or soon to be available, they are not likely to be needed. Later, as U.S. deliveries peak out, there is serious question as to the availability of accessible reserves in any substantial volume. Thus there are not now available within reasonable shipping distance of the U.S. foreign reserves which can be counted upon to do more than add relatively small annual amounts to available supply. If we are talking about shortages (before synthetic gas) which could amount to five trillion and then ten trillion cubic feet per year, we are talking about all of the available free reserves in Northern Africa and the Caribbean, with some supply for the West Coast thrown in. It is reasonable to expect some projects to get under way for delivery in the late '70s, but if they totalled as much as five billion cubic feet per day, deliveries would still only amount to two trillion cubic feet per year.

At this point the limitations to the transport of liquefied natural gas should be discussed. LNG enthusiasts let their imaginations roam over the globe in seeking out adequate sources of supply. In so doing they ignore the extremely high cost of transportation involved, in contrast to moving the same number of Btu's in the form of crude oil. At some distance, believed to be in the order of 4,000 to 5,000 miles, it becomes cheaper to ship in the crude, and make gas by one or another of various available methods, thus avoiding the material excess cost of shipping and liquefaction, and vastly improving reliability by siting the plants in the United States and opening up the source of supply. We can only conclude, therefore, that plans for demand-supply balance will be little affected by LNG imports.

To come back full circle to the original question—Is the government-sponsored program envisaged by Senate Bill 1846 needed now? Our conclusion remains positive. Let us consider the timing. *If all works out favorably*, as portrayed in Table I, coal gasification plants will be needed in substantial numbers by the mid-'80s. This means that *both* the *pilot plant* phase and the *first generation operating plant* phase should be completed and evaluated by, say, 1981, to permit

TABLE 1.—FORECAST BALANCE BETWEEN U.S.¹ ADJUSTED REQUIREMENTS THROUGH 1985 WITH ESTIMATED SUPPLIES OF GAS FROM DOMESTIC PRODUCTION AND SUPPLEMENTAL SOURCES

Year (1)	Domestic production and reserves (billion Mcf at 14.73 psia)					Supplemental gas supplies (billion Mcf at 14.73 psia)							
	Adjusted ² requirements (2)	Reserve additions (3)	Domestic production (4)	Field use (5)	Available to consumers (6)	Remaining proved reserves (7)	R/P ratio (8)	Requirements not met by domestic production (9)	Pipeline imports, western Canada (10)	LNG from other countries (11)	Synthetic gas west Canada (12)	Gas from Alaska and north-west Canada (13)	Unfulfilled requirements (14)
1970	3 21.3	21.0	24.2	3.1	21.1	4 259.6	10.6	1.0	1.0				
1971	22.1	22.0	24.8	3.1	21.7	265.4	10.2	1.2	1.1				
1972	22.9	22.1	25.1	3.1	22.0	263.6	10.0	1.6	1.1		1		
1973	23.7	23.1	25.2	3.1	22.1	261.5	10.0	2.6	1.3		2		
1974	24.1	24.2	25.1	3.1	22.0	250.7	10.0	3.5	1.3		3		
1975	24.5	24.5	25.1	3.1	22.0	251.1	10.0	4.3	1.3		4		
1976	25.4	25.8	25.3	3.2	22.1	252.6	10.0	5.1	1.4		5		
1977	26.1	26.1	25.3	3.2	22.3	255.2	10.0	5.7	1.5		5		
1978	26.4	26.5	25.9	3.2	22.7	258.8	10.0	6.4	1.5		5		
1979	26.5	30.0	26.3	3.2	23.1	265.5	10.0	7.2	1.6		5		
1980	28.4	30.0	26.9	3.2	23.4	269.9	10.0	7.5	1.7		6		
1981	31.3	30.0	26.9	3.1	23.8	271.8	10.0	7.9	1.8		7		
1982	32.1	30.0	27.2	3.0	24.2	274.4	10.0	8.5	1.9		8		
1983	32.9	30.0	27.4	3.0	24.4	272.2	10.0	9.4	2.0		1.0		
1984	33.7	25.0	27.2	2.9	24.3	270.2	10.0	10.3	2.1		1.2		
1985	34.5	25.0	27.0	2.8	24.2	270.2	10.0	10.3	2.1		1.4		

¹ Continuous 48 States.² Does not include FRC "field use" volumes.³ Future Requirements Committee, "Future Natural Gas Requirements of the United States," vol. 3 (Denver, Colo.: Future Requirements Agency, 1969), table 1, p. 6.⁴ 1970 remaining proved recoverable reserves as reported in the American Gas Association, "Reserves of Crude Oil, Natural Gas Liquids and Natural Gas in the United States and Canada, Productive Capacity as of Dec. 31, 1970," vol. 25, May 1971, with Alaskan volumes deleted.

Note: Approximate levels and growth rate for reserve additions, pipeline imports from western Canada for the period 1971-80, LNG imports for the period 1973-77 and the general format of this table are from a presentation (exhibit 21) by Radford L. Schantz (Foster Associates, Inc.) in FCC docket No. AR 69-1.

Source: Col. (2)—Volumes 1980 and 1985 are based on FRC data. (See footnote 3.) Intervening years volumes are estimated by use of average growth rates; col. (3)—assumes gross reserve additions will be 21 trillion cubic in 1971 and will increase at a compounded annual growth rate of 5 percent per year through 1979; col. (4)—from 1973 through 1985, calculated production necessary to maintain the R/P ratio at 10; col. (5)—calculated by taking the FRC estimated "field use" volumes for 1980 and 1985 as a percent of the "total" requirements and applying these percentages to 1980 and 1985 volumes in col. (2). Intervening years volumes are estimated by use of average growth rates; col. (7)—for each year, remaining reserves are calculated by taking the previous year's reserves less the current production plus the current reserve additions.

the large-scale production of gas in the latter half of the decade. Working backwards, and allowing a *year* for evaluation, *three* years for operation to secure results, and *four* years for engineering and construction, we ought to be getting started within the *next year* or so, not five years or more from now as the pilot plant program presently visualized would indicate. Moreover, this timetable assumes that U.S.-Canadian production will be as favorable as we have posited—certainly not a foregone conclusion. If those assumptions are wrong, the timetable is even tighter.

We submit that the exigencies of the needed supply call for a material start *now*, in the construction of first generation plants, even at the risk of making mistakes which the more leisurely pilot plant program now envisaged might enable us to avoid.

If this conclusion is correct, we view it as a corollary that national (government) leadership is called for, as typified by the ingenious administration arrangements provided for in S. 1846. Consider the low level of research expenditures on gas from coal, as compared with, to use only one example, the announced drilling support programs of \$75,000,000 which only four pipelines propose to invest in the Canadian Arctic. It is thus clear where the industry places its investment priorities.

Yet it is the very speculative, uncertain and tentative nature of the conclusions in respect to gas-from-coal which has made it impossible to plan rationally for gas industry supply in the years ahead. Whether this source is needed in 1980, 1985, or 1990, we can no longer safely ignore the lead time of nearly a decade of technical progress toward the discovery of the most economical processes for the manufacture of gas from coal, our most prolific fossil fuel resource. If we follow the counsel, "Well, let's wait and see what happens, to U.S. and Arctic supply and maybe even LNG, before spending much more effort on a program which will certainly be a more expensive alternative," we will likely be in the position which we are in today, still not knowing how to proceed to make gas from this source, economically, and still not knowing what it will cost. Then, if any of the assumed conditions of supply needed to produce a balance in the 1975-1985 decade do not work out as contemplated, we will again be in a gas shortage situation at that time. It is far better, with the known tremendous resources of coal still available in this country, to have contingency plans available for the production of synthetic gas, knowing that these plans will be needed in any event, down the road, than to repeat the experiences of the last two years where we drifted into a demand-supply imbalance with no contingency plans in any shape to be utilized.

There is another consideration which is worthy of mention, underscoring the need for this legislation. The nation is groping its way toward the formulation of a rational energy policy for the next century—if we dare look that far ahead—or at least to take us to the year 2000. The bases on which it will have to be built are three:¹ nuclear energy, oil shales, and coal. Hundreds of millions of tax dollars have been spent on the first source, but relatively insignificant amounts have been spent on the other two resources, despite the fact that they may well play important roles during the next century. This is not to begrudge the expenditures made and to be made; but simply to make the point that a balanced energy policy implies a balanced research policy—and research in coal (and in shale) still has a long way to go.

Very truly yours,

CHARLES H. FRAZIER.

¹ Though many other sources will have to be tied in, in the intermediate years.

