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THE PHASING OUT OF OIL AND GAS USED FOR BOILER FUEL: CONSTRAINTS AND INCENTIVES

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I. INTRODUCTION

Shifting the nation's dependence from oil and gas to coal and uranium is the key to solving the energy crisis. American industry recognizes that as part of this necessary transition, its own use of oil and gas in boilers must eventually be minimized. However, the phasing out of oil and gas is an objective which must be reached taking into account numerous economic, physical, and other elements involved in the maintenance of a healthy economy served by reliable energy supplies. This objective can best be attained by facilitating the construction of new coal and nuclear steam electric generating capacity and by allowing those oil and gas burning industrial and utility facilities which were originally designed to burn coal to convert or reconvert to this fuel. Emphasis should be placed on expediting the construction of new steam electric generation plant because the long-term substitution of coal and uranium in most end-use applications will require the conversion of these fuels to electricity.

Assuring the timely installation of new capacity will require the removal of regulatory obstacles to its construction and operation. It will also require federal and state actions in the realms of tax policy and rate regulation designed to enable the electric utility industry to mobilize the necessary capital resources. Switching existing industrial and utility convertible capacity back to coal will require a realistic implementation of air quality regulations including recognition that alternative methods of SO_2 control are preferable to the retrofitting of

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scrubbers. This recognition is especially critical for those convertible boilers whose age and size preclude such retrofitting.

II. INCENTIVES FOR PHASING OUT OIL AND GAS AND FOR CONSTRUCTION OF NEW NUCLEAR AND COAL FACILITIES

Measures required to accelerate use of coal and nuclear fuels for boilers relate primarily to the removal of existing regulatory obstacles. Government efforts to shorten lead times by eliminating regulatory delays in the construction and operation of both nuclear and coal-fired generating units would have a significant impact on oil and gas use and would serve to reduce the heavy cost burden on utilities and their customers by minimizing the effects of cost escalation during construction.

Besides reforming regulatory procedures for the approval of new plant construction and operation, a number of other incentives are needed to hasten the building of these facilities. These include:

(1) Prompt and adequate rate relief by state and federal regulatory agencies to permit building necessary nuclear and coal facilities while maintaining the financial integrity of the industry and minimizing the cost of capital needed to serve the electricity consumer.

(2) Modification of the Clean Air Act[1] to: recognize alternative strategies in meeting health-related, primary ambient sulphur oxide standards (i.e., tall stacks and intermittent controls) and require cost-benefit justification of stringent state implementation plans, no significant deterioration and non-attainment interpretations.

(3) Governmental commitment to the immediate additional leasing, development, transportation and utilization of western coal in those areas now primarily dependent on natural gas, including the possible conversion of coal to low btu gas for boiler fuel use.

(4) Resolving the major issues relating to the nuclear fuel cycle to keep this energy option viable.

(5) Resolving the continuing uncertainty over nuclear plant design and safety standards which risks driving both utilities and equipment fabricators away from nuclear power.

(6) Requiring the users of natural gas to pay for the scarcity value of this fuel and permitting electric utilities obliged to surrender rights to gas supplies to sell these rights at prices which cover the full cost to electric consumers of any forced conversions.

1. Clean Air Act of 1977, Pub. L. No. 95-95, §§ 107, 108, 91 Stat. 691, 693 (to be codified in 42 U.S.C. § 7410).

(7) Enacting legislation to permit the construction and use of coal slurry pipelines where feasible.

(8) Establishing a permanent investment tax credit at 12% and permitting the credit to be offset against the full tax liability, as in 1976, rather than reducing it at the rate of 10% per year until only 50% of the liability is usable.

(9) Eliminating the double taxation of dividends. If this cannot be achieved, at a minimum, dividends reinvested should be exempt from taxation until the stock is sold.

(10) Encouraging the inclusion of construction work in progress (CWIP) in the rate base with a commensurate rate of return.

(11) Allowing higher book depreciation rates.

(12) Normalizing the tax benefits resulting from accelerated depreciation.

Conversion of Existing Convertible Capacity

Measures which could hasten the reconversion to coal of industrial and utility boilers originally designed for its use must deal essentially with existing air quality control regulations which effectively preclude many reconversions.[2]

III. The Impracticality of Attempting an Oil and Gas Phase Out Through the Reconstruction of Boilers Not Originally Designed to Burn Coal

Discussions of phase-out strategies frequently include reference to the possibility of converting to coal those oil and gas fired boilers which were not originally designed and constructed for use of this fuel. In order to achieve any such accelerated conversion of industrial and utility boilers, a number of significant problem areas would have to be dealt with and various incentives considered which are at the heart of national energy policy decisions and which potentially conflict with policy options in the environmental, economic and federal-state political areas. In addition, several threshold factors require recognition: (1) almost no new base-load oil or gas electric generating capacity has been planned since 1973; (2) existing oil and gas generating capacity represents substantial investment being paid for by electric consumers,

2. Necessary modifications include allowing the use of: (1) tall stacks for SO_2 emission dispersal; (2) intermittent control as a means of maintaining ambient air standards; and (3) natural gas when available as part of an intermittent control technique.

based on government energy policy existing at the time of construction; (3) much of the industrial and utility boiler capacity is impractical to convert to coal and has substantial economic life remaining; (4) electricity is supplied to consumers on a "cost of service" basis and the full economic costs of forced conversion from oil and gas will have to be borne by those served by systems now using these fuels, including the cost of: forced conversion and associated pollution control, replacement power during conconversion, and the loss of efficiency or reliability resulting from conversion; (5) conservation of energy to be effective and accepted must be accomplished on an economy-wide basis and not solely through an individual fuel, energy source or industry, with its economic costs and benefits carefully studied beforehand; and (6) the role of state governments and federal pre-emption will have to be resolved.

All of these factors must be considered against the background of the massive physical and financial undertaking which a forced draft conversion to coal would represent for the American economy. The dimensions of such an undertaking for the electric utility industry are outlined in the following discussion.

A. *Steam Electric Generating Capacity Using Oil and Gas*

Existing Installations

In 1976 some 93,000 MW of steam electric generating capacity in the United States was oil-fired. This total included approximately 20,000 MW in units capable of burning coal without complete reconstruction of boilers and fuel handling facilities. Gas-fired steam capacity amounted to nearly 59,000 MW of which only 2,000 MW was convertible to coal without major rebuilding.[3]

Planned Additions

Between 1977 and 1985, utilities have scheduled for commercial operation a further 16,500 MW of oil burning steam electric facilities and 1,000 MW of gas-fired steam plant. Virtually all of this capacity will be in service by 1980, reflecting the fact that since 1973, the uncertainty of future oil and gas supplies plus government restrictions have

3. See the total capacity figures from NERC, A STAFF REPORT ON FOSSIL AND NUCLEAR FUEL FOR ELECTRIC UTILITY GENERATION—REQUIREMENTS AND CONSTRAINTS, 1976-85 (1976). Also note the convertible capacity data from FPC, A STAFF REPORT, BUREAU OF POWER, THE POTENTIAL FOR CONVERSION OF OIL-FIRE AND GAS-FIRED ELECTRIC GENERATING UNITS TO USE OF COAL (1973).

effectively excluded these fuels as planning options for steam electric generation.

B. *Coal Requirements for Total Conversion*

If it were possible to convert the existing oil and gas burning steam capacity which will still be in service in 1985 to coal utilization, the incremental coal requirement would be on the order of 275 million tons by 1985. Were the planned 17,500 MW of gas and oil using capacity also converted to coal, an additional increment of coal supply of approximately 40 million tons would be required. These estimates, however, are based upon several assumptions.[4]

Of the existing 152,000 MW operating on oil and gas, only 22,000 MW are convertible to coal without major reconstruction. The coal requirement of these "easily" converted facilities could total about 30 million tons in 1985 if some assumptions can be made.[5] The total coal requirement implied by complete conversion is thus some 315 million tons of which only 30 million tons would be for use in plants subject to conversion without major reconstruction.

C. *Coal Requirements for Planned New Coal Burning Capacity*

Any incremental coal requirements resulting from conversion of existing or planned gas and oil burning facilities would have to be supplied by a mining industry already straining to expand production necessary to fuel some 111,000 MW of new coal-fired capacity planned for operation by 1985.[6] This new capacity will have an annual need of nearly 358 million tons of fuel by year-end 1985. Thus, presently projected coal output from new and expanded mines supplying utility fuel

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4. Such assumptions include:

(a) *Capacity Existing in 1976 and Still in Service in 1985*
   (1) 137,500 MW to be converted.
   (2) Utilization of 3,800 hours per year in 1985.
   (3) Average effective heat rates of 10,500 Btu/Kwhr.
   (4) Coal with an average heat content of 20 million Btu/ton.

(b) *Additional Capacity Planned as of 1976*
   (1) 17,500 MW to be converted.
   (2) Utilization of 5,000 hours per year in 1985.
   (3) Average effective heat rate of 9,500 Btu/Kwhr.
   (4) Coal with an average heat content of 20 million Btu/ton.

5. These assumptions are: (a) utilization of 3,000 hours per year in 1985, (b) average effective heat rate of 11,000 BTU/KWHR, and (c) Eastern coal with an average heat content of 24 million BTU/ton.

6. *See* FPC, STAFF REPORT, BUREAU OF POWER, STATUS OF COAL SUPPLY CONTRACTS FOR NEW ELECTRIC GENERATION UNITS, 1976-1985 (1977).

would have to be augmented by 88% if the 315 million tons of "conversion" coal requirements were to be satisfied.

D. *Mining Industry Requirements to Handle Total Conversion*

The additional 315 million tons of coal required by total conversion of existing and planned gas and oil capacity would necessitate the development of some 40 new surface mines of 5 million tons annual output, and some 75 underground mines of 1.5 million tons of yearly production. These estimates are premised on an incremental expansion pattern similar to the coal industry's present expansion profile which calls for 65% of all new capacity in the form of surface operations.[7]

Capital costs for such an incremental expansion would approximate $12 per ton of annual surface production and $35 per ton of underground annual capacity.[8] The total capital burden on the coal industry would approximate some $6.3 billion.[9] Labor requirements in 1985 to man the "conversion" coal production could approximate 73,000 men—50,000 underground and 23,000 surface.[10]

E. *Transportation*

Moving the incremental coal supplies necessary for a total conversion program would present economic and physical problems as great or greater than those associated with increasing coal output. The bulk of these problems would rest on the railroads. Since most of the additional fuel would come from Western sources, the capacity of rail lines linking the coal regions of the West to the Northeast, Southwest and Pacific Coast would have to be increased considerably. Quantifying the cost of the incremental expansion needed is difficult because these rail arteries are already in need of considerable rebuilding simply to handle presently projected coal, grain, and other goods movement. To these costs, however large, would also have to be added a sizeable investment in rolling stock and power units.

7. *See Coal Mine Development and Expansion Survey*, in COAL MARKET COMMENTARY AND RESEARCH SERVICE (1977).

8. J.A. Self, Project Financing, Southern Coals Conference, Cinncinnati, Ohio (Oct. 21, 1976).

9. This $6.3 billion includes: (a) $2.45 billion for surface mines ($12/ton × 205 million tons of annual capacity) and (b) $3.85 billion for underground mines ($35/ton × 110 million tons of annual capacity).

10. These figures are based on the factors: (a) underground; 220 work days a year, 10 tons per man a day and 110 million tons of annual production, and (b) surface; 220 work days a year, 40 tons per man a day and 205 million tons annual production.

F. *Electric Utility Financial Requirements to Handle Total Conversion*

The additional financial burden placed on the coal industry to meet a total conversion of utility gas and oil use would be dwarfed by the capital requirements which the electric industry would have to face. To convert the 155,000 MW of existing and planned oil and gas burning capacity expected to be still in service in 1985 would necessitate an expenditure of $50 billion in 1976 dollars. Of this total, approximately $28 billion would represent conversion of oil facilities to coal and $22 billion would be accounted for by gas to coal conversion.[11]

If an annual inflation rate of 7% were assumed and conversion expenditures were staged uniformly over the nine years, 1977-1985, the $50 billion constant dollar capital requirement would equate to a current dollar outlay of $71 billion. Present estimates of electric utility current dollar expenditures on electric plant and equipment over the same period total some $345 billion. Thus a total conversion program would increase presently projected capital requirements by more than 20%. Virtually all of the additional funds would have to be raised externally if present rate and regulatory practices were maintained. In

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11. The breakdown is as shown:

Oil to Coal	
Reconstruction	
89,500 MW × $300/KW =	$26.9 billion
Easily Converted	
20,000 MW × $ 80/KW =	$ 1.6 billion
Subtotal Oil to Coal	$28.5 billion

EEI estimates based on cost figures appearing in the Preliminary Report of the FPC Technical Advisory Committee on Fuels on the "Fuel Oil Conservation Targets for the Electric Utility Industry Outlined in the President's October 8, 1974 Economic Message and the Accompanying Fact Sheet," October 18, 1974. Scrubbers are assumed needed on one third of reconstructed capacity and half of convertible capacity.

Gas to Coal	
Reconstruction—Units of 150 MW or Smaller	
10,000 MW × $600/KW =	$ 6.00 billion
Reconstruction—Units of More Than 150 MW	
33,500 MW × $475/KW =	$15.90 billion
Easily Converted	
2,000 MW × $ 80/KW =	$ 0.16 billion
Subtotal Gas to Coal	$22.06 billion
Total Cost of Conversion— Oil and Gas to Coal	$50.56 billion

EEI estimates based on unit cost figures for use of low sulfur coal appearing in the submission by "The Utilities of the State of Texas pursuant to Texas Railroad Commission Docket No. 600—Reducing or Eliminating Natural Gas as a Boiler Fuel in Texas," EBASCO Services Incorporated, May 1975. If scrubbers were required on reconstructed gas-fired boilers, unit costs could equal or exceed $700/KW.

the case of investor-owned electric utilities, an external financing rate of 60% is presently being envisioned based on existing expansion plans. This rate would probably increase to nearly 70% if a total conversion program were undertaken.

A dependence on money markets for up to 70% of total construction expenditures would produce extremely serious financing problems for an industry still burdened with financial difficulties engendered by the inflation of recent years and the effects of inadequate rate relief. Maintaining such an external financing rate for any length of time would likely prove to be impossible. At some point, companies with inferior credit would just not be able to obtain funds. At any rate, coverage ratios would drop precipitously and the cost of all new financing increased significantly with a concomitant impact on the prices ultimately paid by electricity users. Moreover, these burdens would be concentrated essentially on utilities and electricity users in the Northeast, Southwest, and Pacific Coast regions of the country.

G. *Constraints on Conversion Through Reconstruction*

A number of constraints, in addition to financial limitations, would tend to hinder any accelerated phasing out of oil and gas as boiler fuel through reconstruction. These include:

(1) Sites and plants are restricted from the standpoint of zoning requirements and the availability of land for fuel delivery, storage and handling facilities as well as the storage and handling of wastes.

(2) Present system designs and operational reliability will not tolerate the 2 to 3 years of outage time required for the conversion of an existing steam generator to burn coal. Capacity would be insufficient to meet peak obligations and many utilities would be obliged to install additional combustion turbines and/or reinforce transmission interties in order to maintain reliable service. The cost of these interim measures would only aggravate the financial problems posed by the first order costs of conversion itself.

(3) There are limitations on the ability of boiler manufacturers and the fabricators of the necessary auxiliary equipment to produce equipment, on coal suppliers to mine and transport coal, on engineers to plan and design, and on craft manpower to do construction work.

(4) Air quality controls by federal, state and local regulations for both primary and secondary standards could require use of SO_2 scrub-

bers which are characterized by reduced reliability, high operation and maintenance costs, and waste disposal problems.

(5) Regulatory lag exists due to proliferation and division of responsibility for approving utility construction projects.

(6) Environmental and regulatory factors will limit access to coal supplies for future power generation.

(7) Federal and state environmental restrictions exist on the construction of transmission interconnections needed to assure reliability during conversion or to implement any coal-substitution-by-transmission policy.

The age of many plants is such that they would have been reduced to only peaking service before their conversion could be completed.

IV. Electric Utility Plans for Phasing Out Oil and Gas by the Construction of New Nuclear and Coal Facilities

The magnitude of the physical and financial prerequisites for a total "forced draft" conversion to coal by reconstructing existing utility oil and gas-fired generating facilities clearly indicates that such a course of action is not to be recommended. Phasing out even half of the present oil and gas use through reconstruction would entail a reallocation of capital and other resources in the economy which cannot be justified. Instead, the optimum way to reduce oil and gas as rapidly as possible lies in expediting the electric utilities' planned expansion program which is focused on the construction of new coal and nuclear facilities.

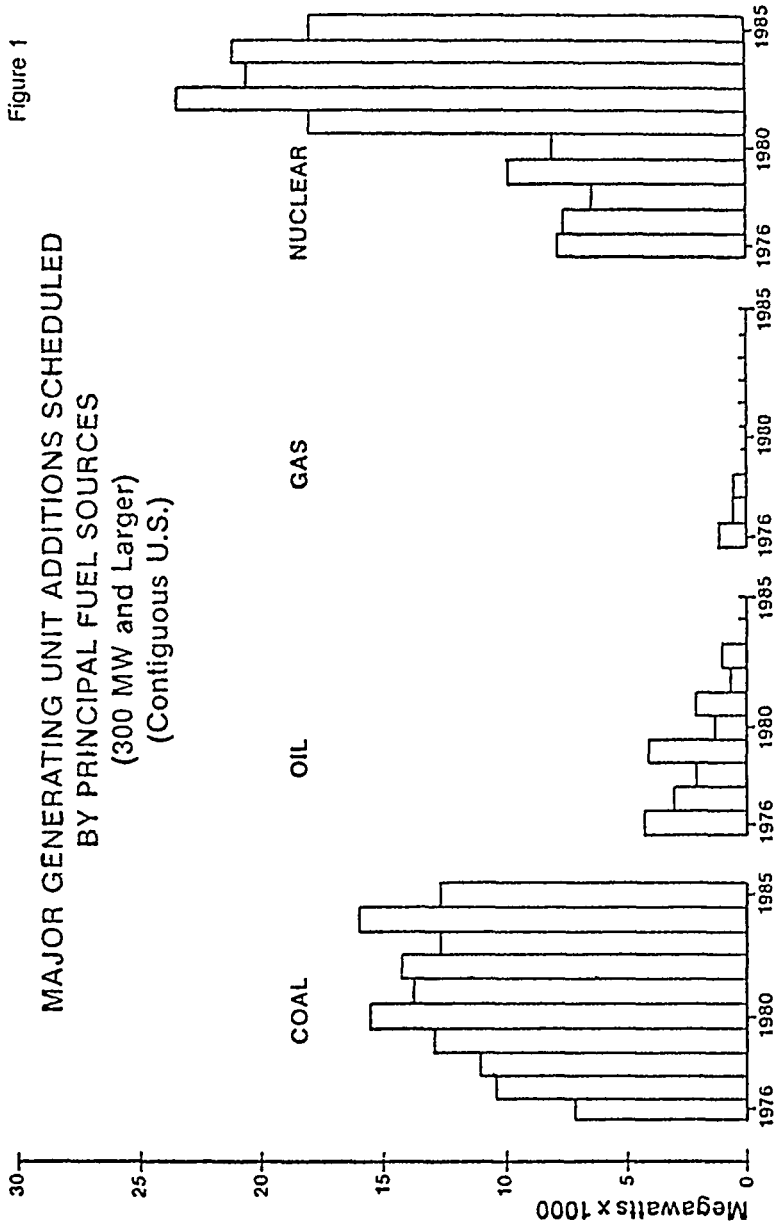
National Electric Reliability Council (NERC) studies, conducted in response to questions posed in the Joint Hearings on Greater Coal Utilization before the Committee on Interior and Insular Affairs and Public Works of the United States Senate, pursuant to Senate Resolution 45, 94th Congress, National Fuels and Energy Policy Study on S. 1777, indicate that the electric utility industry is already phasing out installation of new oil-fired and gas-fired generating units. No new major generating units are planned for natural gas-firing in the years ahead and installation of oil-fired units is essentially phased out by the early 1980's. The bulk of this capacity is already committed and under construction. The following charts, indicating the substitution of coal and nuclear fuels planned by utilities, are taken from the NERC "Review of Overall Adequacy and Reliability of the North American Bulk Power Systems (Sixth Annual Review—July 1976)."

Figure 1 (appended) reveals that 1978 will mark the installation of the last gas-fired unit of more than 300 megawatts. The last unit of this size using oil is due for completion in 1983. Figure 2 (appended) delineates the shifts in the relative importance of oil and gas in the electric utilities' generation mix. From 30% of generation in 1976, the share of these two fuels in total output is projected to fall by nearly half by 1985. More importantly, gas use is forecast to account for only 3% of electricity production in that year compared to almost 13% in 1976. This draconian reduction in gas' percentage share will be due in part to a 60% decline in absolute gas use from 2.9 TCF in 1976 to 1.1 TCF in 1985.

V. CONCLUSION

The minimizing of oil and gas use in industrial and utility boilers is a desirable objective for a national energy policy. This objective can best be attained by facilitating the construction of new coal and neclear capacity sufficient to cover load growth requirements while permitting a steady and rational withdrawal from base load service of existing oil and gas burning plants. Assuring the timely installation of this new capacity will require the removal of regulatory obstacles to its construction and operation. It will also require Federal and state actions in the realms of tax policy and rate regulation designed to enable the electric utility industry to mobilize the necessary capital resources.

Figure 1


MAJOR GENERATING UNIT ADDITIONS SCHEDULED
BY PRINCIPAL FUEL SOURCES
(300 MW and Larger)
(Contiguous U.S.)
COAL
OIL
GAS
NUCLEAR
Megawatts x 1000
0
5
10
15
20
25
30
1976
1980
1985
1900

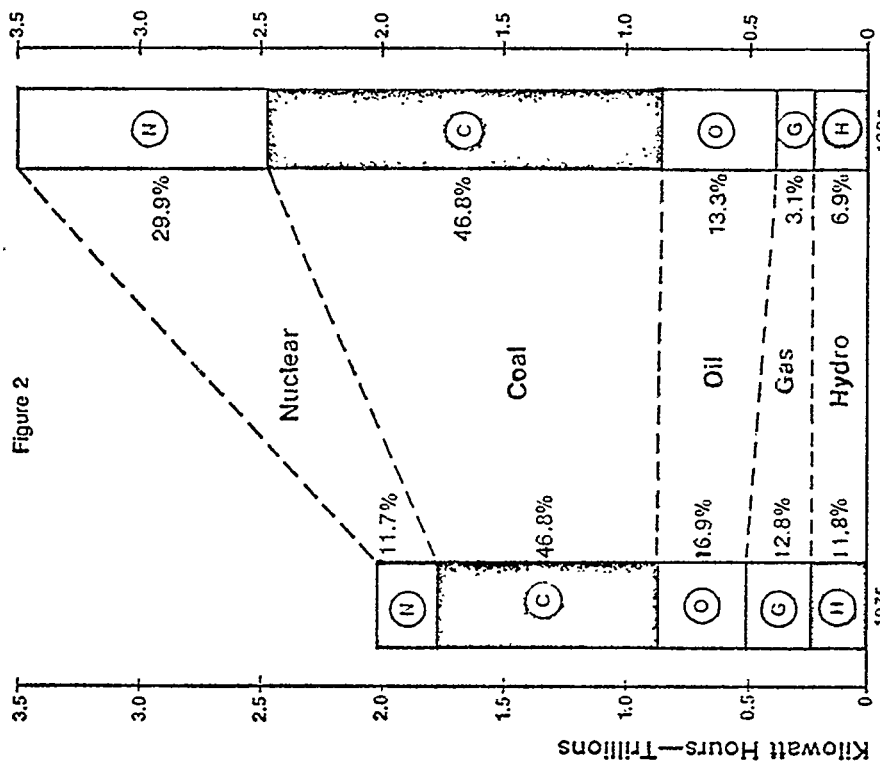


Figure 2

ELECTRIC GENERATION
by
PRINCIPAL ENERGY SOURCES
(Contiguous U.S.)