# FINAL REPORT OF THE
# COAL AND ENERGY COMMISSION

## TO
## THE GOVERNOR
## AND THE GENERAL ASSEMBLY OF VIRGINIA


**Senate Document No. 15**

**COMMONWEALTH OF VIRGINIA**
**Department of Purchases and Supply**
**Richmond**
**1977**

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TO: Honorable Mills E. Godwin, Jr., Governor of Virginia

and

The General Assembly of Virginia

## I. INTRODUCTION

A. Creation of the Commission.—During the winter of 1974 a group of persons interested in the potential for coal liquefaction and gasification formed an ad hoc group to address the issue. This group met several times during the year, its members serving on a voluntary basis, and submitted a report to the Governor and General Assembly during the 1975 Session including Senate Joint Resolution No. 109. As a result of this resolution, which requested formal status and funding for the group, the Virginia Coal and Energy Commission was created to study the development and utilization of Virginia's coal including exploration, mapping, and transportation.

### SENATE JOINT RESOLUTION NO. 109

Creating a commission to study the development and utilization of Virginia coal; allocating funds therefor.

WHEREAS, the ad hoc Virginia Coal and Energy Board was formed in February of nineteen hundred seventy-four to work specifically on coal gasification and related areas: and

WHEREAS, this Board has met on numerous occasions, has worked diligently and has submitted a report to the Governor and the nineteen hundred seventy-five Session of the General Assembly; and

WHEREAS, there is a need to continue the work of this Board

to further the study of the development and utilization of coal as Virginia's number one energy resource; now, therefore, be it

RESOLVED by the Senate, the House of Delegates concurring, That there is hereby created the Virginia Coal and Energy Commission. The Commission shall study all aspects of coal as an energy resource of the Commonwealth and make specific suggestions or legislative recommendations on exploration, mapping, development and transportation of coal. The Commission shall specifically continue the study on coal liquefaction and gasification and make appropriate recommendations.

The Commission shall be composed of nineteen members, five to be appointed by the Speaker of the House of Delegates from the membership thereof, two to be appointed by the Committee on Privileges and Elections of the Senate from the membership of the Senate and twelve to be appointed by the Governor from the State at large. The Commission shall be composed, insofar as it may be practicable, of the same persons who were members of the ad hoc Virginia Coal and Energy Board in nineteen hundred seventy-four. The members so appointed shall elect from their membership a chairman and a vice-chairman.

Legislative members of the Commission shall receive such compensation as set forth in § 14.1-18 and all members shall be reimbursed for their actual expenses incurred by them in the performance of their duties in the work of the Commission. For such other expenses as may be required, including secretarial and other professional assistance, there is hereby allocated from the general appropriations to the General Assembly the sum of three thousand dollars. All agencies of the State shall assist the Commission in its work.

The Commission shall submit to the Governor and the General Assembly an interim report no later than November one, nineteen hundred seventy-five, and a final report no later than November one, nineteen hundred seventy-six.

B. Members of the Commission.—The membership of the Commission is as follows: Senator J. Harry Michael, Jr., Charlottesville, Chairman; Delegate C. Don Dunford, Tazewell, Vice Chairman; Senator Peter K. Babalas, Norfolk; Edmond M. Boggs, Virginia Department of Labor and Industry, Richmond; Cecil W. Bolling, Pound; Charles A. Christophersen, Director, Intergovernmental Affairs, Richmond; B. V. Cooper, Virginia Surface Mining and Reclamation Association, Inc., Big Stone Gap; Delegate J. Paul Councill, Jr., Franklin; Delegate Garry G. DeBruhl, Critz; Ernst W. Farley, Jr., Richmond; Dr. Herbert O. Funsten, Williamsburg; Delegate Joseph A. Johnson, Abingdon; Mark R. Kilduff, Economist, Division of Industrial Development, Richmond; Harden Lacy, Williamsburg; Louis R. Lawson, Jr., Director, Virginia Energy Office, Richmond; Marvin M. Sutherland, Director, Department of Conservation and Economic Development, Richmond; Delegate W. Ward Teel, Christiansburg; W. Luke Witt, Virginia Coal Association, Richmond. Bragdon R. Bowling, Jr. and Ms. Susan T. Gill served as staff to the Commission from the

Division of Legislative Services.

C. Principle Areas of Study.—During the past year the Commission has been particularly concerned with the following: 1) liquefaction and gasification; 2) exploration and mapping of coal reserves in Virginia; 3) development and transportation; and 4) the possibility of the creation of a coal research bureau or authority.

## II. DEVELOPMENT AND TRANSPORTATION

The subcommittee dealing with development and transportation of coal relied upon two publications in particular: Coal Mine Expansion Study, May, 1976, by the Federal Energy Administration, and Rail Transportation Requirements for Coal Movement in 1980, April, 1976, by the United States Department of Transportation. Many persons were interviewed on the subject of coal development and transportation including representatives from the Chessie System, the Virginia Port Authority, the Virginia Air Pollution Control Board, Southern Railway and Pennisula Port.

The following statistics were compiled on coal by the subcommittee:

1975 coal production: 648 million tons

Planned capacity by 1980: 911.7 million tons

Planned capacity by 1985: 1,029.6 million tons

1975-1980 increase: 41%

Estimated 1980 consumption: 800 to 863 million tons

Estimated 1985 consumption: 1,040 million tons

The subcommittee noted that among the constraints upon industry was demand in a currently weak market which is the main constraint upon growth in capacity. Also uncertainty as to the environmental regulations concerning the burning of coal is a concern. Federal leasing policies, particularly in regard to Western coal, pending strip mine legislation and court suits has led to skepticism concerning increased coal production. However, the subcommittee believes that transportation and equipment availability are not major constraints. It was noted that both N & W and the Chessie System are studying major changes in coal handling methods at the port of Hampton Roads. Any changes made here could greatly increase the capacity to handle coal. There is at present a considerable excess capacity at coal piers.

## III. THE STATUS OF COAL CONVERSION

The status of coal conversion in the United States is at present

uncertain. Research and development funded mainly by the Energy Research and Development Administration (ERDA) is directed toward "second generation" technology with greater potential than the older methods developed in Germany such as the Lurgi, Koppers-Totzek and Fischer-Tropsch. Only one synthetic full-scale plant is presently under construction: the H-coal process or liquefaction at Catlettsburg, Kentucky, to be in operation by late 1978. However, ERDA is inheriting the Office of Coal Research (OCR) conversion programs and will be spending $5.1 billion annually on conversion research and development. ERDA hopes for approximately six large scale conversion or direct combustion plants by the 1980's.

The high cost of a full-scale commercial plant, approximately $1 billion, precludes profitable operation unless the price of natural oil doubles to approximately $23/bbl. Research and development usually progresses through several design and construction stages: a) the pilot plant, b) the demonstration plant and c) the full-scale commercial plant. Some observers, noting the long development time for full-scale plants (5-10 years) versus the 10-25 years remaining of plentiful world oil production, urge extensive synthetic fuel efforts. Conversion plants have more than 55% efficiency while electric utilities operate at 40% efficiency. Legislation has been introduced in Congress in 1975 and 1976 for federal 50/50 sharing of commercial plant costs. The legislation was defeated on both occasions.

## IV. GASIFICATION

A twelve year effort in the United States to develop new pipeline gasifiers has not been successful: pilot plants based on four processes including CO2 Acceptor, Hy gas, Bi gas and Synthane have not indicated development towards full-scale plants which are now planned for two British designs. These are a modification of the old Lurgi system and Cogas, a gas and liquid fuel process. ERDA is planning a low quality gas demonstration plant.

## V. LIQUEFACTION

Liquefaction is the most difficult method of coal conversion; present processes gasify the coal first, then liquefy. The only operating plant today is in South Africa; in the United States it would be uneconomical. "Second generation" processes, adapted from hydro-cracking technology developed for petroleum refining, use catalysts for directly liquefying the coal. Construction of a pilot 600 ton per day H-coal process at Catlettsburg, Kentucky, has been recently funded by ERDA on a 75/25 basis with a Mobil, AMOCO and Standard of Indiana consortium. Operation of a small Donor Solvent Process developed by Exxon is being considered by ERDA. A different process, the Solvent Refined Coal process, developed by Gulf, removes ash and sulfur by dissolving powdered coal with a solvent yielding a solid boiler fuel which melts upon heating. Two

small pilot plants are operating with apparent success.

Plans for a future Coalcon process for demonstration by Union Carbide are uncertain. This process distills coal under heat and gasifies residual char yielding both liquid fuel and methane. There may be difficulties with caking coals, a lack of adequate previous pilot plant testing and cost overruns.

## VI. DIRECT COMBUSTION

A third alternative, direct combustion (DC) of coal, would have a major use in electric power generation. Emission standards on pollutants limit DC to only 15% of the United States energy supply. Two processes for the removal of pollutants are being developed: stack scrubbing, supported by EPA, and fluidized bed combustion, supported by ERDA. Present commercial scrubbers cost a substantial percent of power station capital and consume approximately 5% of the station's power. A lime compound is used to scrub pollutants. This is then ejected as a wet sulfur bearing sludge eventually occupying an area of several square miles.

Presently under development are several regenerative processes which recycle the scrubber and eject sulfur in a commercially useful form: the Wellman-Lord process, operating in Japan on oil-fired boilers and planned by EPA for a single United States' demonstration plant; the magnesium oxide process with two demonstration plants which have suspended operation due to difficulties apparently unrelated to the process; the citrate process; and the aqueous carbonate process. The latter two yield elemental sulfur and, being newer processes, are planned by EPA for demonstrations plants. Fluidized bed combustion, in which a bed of coal and limestone is suspended or "fluidized" by air blowing upward through it, is a newer process. It is independent of coal characteristics and removes all except 10% of the sulfur while operating at a lower combustion temperature. A 30 megawatt plant at Riversville, West Virginia, which is supported by ERDA is just beginning test operation. The Tennessee Valley Authority intends to build a 200 megawatt unit.

## VII. EXPLORATION AND MAPPING

It is recommended that funds be provided to continue the Virginia Division of Mineral Resources coal sampling and analysis program. In 1976 a field program to collect samples and geologic information was begun in the southwest Virginia coal fields. Three types of data are sought: (1) a complete geologic description of each coal, (2) a proximate and ultimate analysis of each sample by the U. S. Bureau of Mines, and (3) a trace element analysis by the U. S. Geological Survey. Tests are made for 72 minor and trace elements or compounds such as iron, zinc, copper, nickel, and uranium. These data may be used to verify correlation of coal beds and to facilitate determination of optimum end uses of the coal. The information will

be entered into a computerized system known as the National Coal Resources Data System. This data system when in full operation, in two or three years, will be able to produce maps of coal beds, overburden, sulfur and ash content, Btu value, and minor and trace element characteristics. These data will be available to the public and should be of great value to coal producers, consumers, planners and other concerned with the State's most valuable mineral resources.

The Division of Mineral Resources will use the data in studies concerned with coal formation, occurrence, characteristics, and the interrelationship between these and other factors. It has long been known that Virginia has large resources of superior coal and it is anticipated that this sampling program will demonstrate this as fact. The data will be extremely valuable in the preparation of geologic maps of the quadrangles located in the coal area of southwest Virginia. In 1976 the U. S. Geological Survey reported detailed analyses on 45 samples collected in Virginia by their personnel. The ongoing program of the Virginia Division of Mineral Resources collected 100 samples during 1976 which are being analyzed.

Since the early nineteen hundreds mining surveys in the coal producing region of southwestern Virginia were made primarily to schedule subsequent blasting, cutting, and haulage activities. Frequently difficulties arose when a seam would "run out" or the physical characteristics would change abruptly. These crucial problems stemmed from misidentification of look-alike coal beds in which the depositional environments at their time or origin changed from place to place or fault structures developed where coal beds were offset and similarly appearing units were brought together. The solution to these problems lies partially in detailed geologic mapping. Through this approach proper correlation of geologic formations and structures can be made. In 1974 the Division published a study of coal beds in southwestern Virginia bringing together data compiled from examination of rock cuttings and core representing nearly a half million feet from oil and gas tests and coal boreholes. Among the many coal units present in this area the Pocahontas Formation, No. 3 coal bed is one of the richest and thickest. It was pointed out that the Pocahontas No. 3 and the War Creek coals have the greatest economic potential of those investigated. From the study some generalities were made about the relationship between the physical properties of the coals and their structures and environments of deposition. This work is a precursor to the detailed delineation and evaluation of the State's coal reserves.

Ahead lie the important problems of detailed geologic mapping that require information on depth, distribution, and physical and chemical quality of the many coal beds known to be present. In consideration of this need the Division is requesting that current studies be developed into a program staffed by the United States Geological Survey and operating in close cooperation with the State. The Division has only one man assigned full time to fuel studies, and facilities available through federal support far exceed this Division's physical plant. The geologic mapping and associated

projects will require an average of about two man years per quadrangle or about 48 man years. The optimum program from the standpoint of manpower requirements as presently foreseeable by the United States Geological Survey, Branch of Coal Resources, is eight years at a cost of $250,000 the first year and $300,000 each succeeding year.

In particular the products from this program would be published as rapidly as possible so that the public, industry and governmental agencies can have maximum access to modern scientific data to make responsible decisions. These products will contribute to the compilation of a new State geologic map. They will be of aid also to those involved in highway planning, water pollution abatement, health and safety of miners, control of mine refuse and preparation plant waste, and land management with reference to water development, recreation, restoration, and revegetation of mined areas. The accurate location of coal seams will aid the Division of Mined Land Reclamation in its responsibility for restoration activities of surface mined lands. The results of the analytical work will be of use in determining industrial usage of the coal resources, studies of the possibilities for recovering trace elements, water and air pollution control factors, and environmental restoration studies. Above all, the results will serve pressing current national needs for sound and comprehensive data on low-sulfur coal resources and mineable reserves.

## VIII. SUMMARY

Coal conversion and direct combustion processes (with the exception of fluidized beds) are extremely dependent upon input coal quality (caking characteristics, sulfur content, etc.). An ongoing appraisal of the suitability of Virginia's coal for several conversion and DC processes may be important.

The high capital costs of the processes, approximately $1 billion, has appreciably eroded their prospects as seen several years ago. Even at $13/bbl., Arab oil may still be a "bargain".

State furtherance of coal usage may be brought about in part by the state taxing and regulatory authority.

An increase in energy efficiency in conversion processes above approximately 55% may be obtained with a coal multiplex or "coalplex" concept whereby several tandem chemical processes at one site produce gas, crude oil, electricity, etc. from coal.

Centralized district heating can feasibly use coal, Enkoeping, Sweden, has 75% compeleted such a conversion in 7 years using central fluidized bed boilers. Capital costs are appreciably less than an equivalent synthetic plant.

## IX. RECENT TECHNOLOGICAL AND

From approximately $3 billion in 1970 the United States will increase its amount of imported petroleum valued at approximately $36 billion in 1976 while experiencing the accompanying devastating effects on the United States balance of payments, creation of jobs, reduction of unemployment, and the fight against inflation. Increasing from the importation of approximately one-third of United States' petroleum needs in 1973, the year of the embargo, the nation currently imports over 40% of its needs and the increase is continuing. According to statistics of the American Petroleum Institute, the United States imported nearly 49% of its petroleum needs for November, 1976. The import payments for petroleum will continue to increase because of international pricing increases as well as the increase in the total volume required by our expanding economy. Because of the critical and daily determination of the value of individual currencies throughout the world by "floating" exchange rates, adverse developments, affecting the United States balance of payments, will quickly impact negatively upon the world value of the American dollar and react adversely upon inflation in the economy.

In the production of electrical energy coal and nuclear energy appear to be the main source of power for the new generation capacity in the future. The current environmental problems of nuclear energy as perceived by the public have slowed the growth rate of this promising technology substantially from an acceptable to a very modest rate in 1976. As a result, coal must be able to make a greater contribution to electrical generation than was projected originally to compensate for the shortfall growth of nuclear power. Furthermore, coal development should be encouraged and accelerated in the state, regionally and nationally, to provide the growing electrical energy needs of the growing economy.

## X. RECOMMENDATIONS

1. In view of the energy situation in the United States which is becoming worse, the Commission memorializes Congress to create and implement a national coal policy fostering maximum coal usage and development.

2. The Commission recommends encouraging the usage of methane gas currently being vented into the air from coal mines by addressing in the form of state legislation the question of legal ownership of the methane.

3. As a furtherance of coal usage in Virginia, the Commission urges consideration of incentives for state electric utility generation conversion from gas or oil to coal.

4. The Commission recommends the consideration of the coal industries sharing state coal research and development costs.

5. Coal conversion and combustion (with the exception of fluidized beds) processes are strongly dependent upon input coal characteristics. The Commission recommends that continuing studies in cooperation of Dr. James Calver of the Division of Mineral Resources may determine the feasibility of Virignia coal for these purposes.

6. The Commission recommends the examination of new coal usages in the State such as "coalplex", a coal site complex processing coal to yield several out-puts including gas, crude oil, electricty and heat, and centralized community heating by a direct coal combustion process with low pollution.

7. The Commission also recommends the consideration of State institutions converting from oil or gas to coal.

8. In reference to the development of a coal research bureau, the Commission recommends that the legislation known as House Bill No. 902 of the 1976 Session of the General Assembly be reintroduced into the 1977 Session with the following changes:

A. That there be established a Virginia Coal Research and Development Advisory Committee.

B. That the above mentioned Committee be advisory to the Executive Director of the Center.

C. That the Committee be authorized to advise on those matters set forth in Section two of this act.

D. That representatives from the coal industry, railroad industry and utility industry be appointed by the Board of Visitors.

E. That the Board of Visitors be permitted to appoint other such individuals as they deem necessary.

F. Representatives from the Department of Conservation and Economic Development, the Division of Industrial Development, the State Energy Office, the Department of Labor and Industries, the Virginia Port Authority, institutions of higher education (excluding Virginia Polytechnic Institute and State University) and the Community College System shall serve on the Advisory Committee.

9. It is recommended that funds be provided to continue the Virginia Division of Mineral Resources coal sampling and analysis program during the next three years at an annual cost of $ 20,000.

10. In reference to geological mapping, it is further recommended that funds be provided to accelerate this mapping of Virginia's coal area.

Respectively submitted,

J. Harry Michael, Jr., Chairman

C. Don Dunford, Vice-Chairman

Peter K. Babalas

Edmond M. Boggs

Cecil W. Bolling

Charles A. Christophersen

B. V. Cooper

J. Paul Councill, Jr.

Garry G. DeBruhl

Ernst W. Farley, Jr.

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