Coal and Energy Commission, 1979(1): memoranda, reports, and other materials related to Batman's service on Virginia Coal and Energy Commission. File included notice of Batman's appointment to committee (3 May 1979), and memoranda concerning alternative energy sources during gas shortage of 1979.
COMMONWEALTH OF VIRGINIA

SENATE

May 3, 1979

The Honorable Herbert H. Bateman
P. O. Box 78
Newport News, Virginia 23607

Dear Senator Bateman:

Senator Hirst, Chairman of the Senate Committee on Privileges and Elections, has requested that I notify you of your appointment by the Committee to the Virginia Coal and Energy Commission pursuant to Chapter 330 of the 1979 Acts of Assembly.

The other members of this Commission are Senators Michael, Goode, Boucher and Colgan. House members have not been appointed to date to the Commission. A copy of Chapter 330 is enclosed for your information.

With kind regards, I remain

Sincerely yours,

J. T. Shropshire
Clerk of the Senate

JTS/s
Enclosure

cc: Honorable Omer L. Hirst
Honorable John Warren Cooke
Honorable Joseph H. Holleman, Jr.
Honorable John A. Banks, Jr.
An Act to amend the Code of Virginia by adding in Title 9 a chapter numbered 22.1, consisting of sections numbered 9-145.1 through 9-145.4, establishing the Virginia Coal and Energy Commission; allocation of funds.

[S 829]

Approved MAR 22 1979

Be it enacted by the General Assembly of Virginia:

1. That the Code of Virginia is amended by adding in Title 9 a chapter numbered 22.1, consisting of sections numbered 9-145.1 through 9-145.4, as follows:

CHAPTER 22.1

VIRGINIA COAL AND ENERGY COMMISSION.

§ 9-145.1. Commission established; agency assistance; powers and duties.—The Virginia Coal and Energy Commission is hereby established as a permanent agency of the Commonwealth and is hereafter referred to in this chapter as "Commission." The Commission shall generally study all aspects of coal as an energy resource and shall study ways in which the Commonwealth can take action on energy related problems. All agencies of the State shall assist the Commission in its work. In addition to the aforementioned general powers, the Commission shall also perform the following functions:

A. Act in an advisory capacity to the Governor and executive branch agencies upon energy related matters;

B. Investigate and consider such questions and problems relating to the field of coal and energy utilization and alternative energy sources as may be submitted;

C. Make recommendations to the Governor and General Assembly on its own initiative;

D. Consult with applicable State agencies on all matters regarding energy conservation, including the promotion and implementation of initiatives for the public-at-large to conserve energy;

E. Endeavor to encourage research designed to further new and more extensive use of the coal and energy resources of the Commonwealth;

F. Effectively disseminate any such proposals to groups and organizations, both State and local, so as to stimulate local governing bodies and private business initiative in the field of energy related matters; and

G. Coordinate its efforts with those of the Virginia Solar Energy Center established pursuant to § 10-214 and the Virginia Center for Coal and Energy Research established pursuant to Article 2.01 of Chapter 11 of Title 23 (§ 23-135.7:1 et seq) of the Code of Virginia.

§ 9-145.2. Membership; compensation.—A. The Commission shall consist of twenty members, of whom five shall be appointed by the Committee on Privileges and Elections of the Senate from the membership of the Senate, eight shall be appointed by the Speaker of the House of Delegates from the membership thereof and seven shall be appointed from the State at large by the Governor. The at-large appointees shall include representatives of industry, government and groups or organizations identified with coal and energy production and conservation.

B. The terms of office of the legislative members shall be coincident with their service in the house from which appointed; the appointees of the Governor shall serve for terms of four years and their successors shall be appointed for like terms, but vacancies occurring other than by expiration of term shall be filled for the unexpired term. Any member may be reappointed for successive terms.

C. The members of the Commission shall elect its own chairman annually.

D. Legislative members of the Commission shall receive such compensation as is 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.

§ 9-145.3. Clerical and secretarial facilities; supplies; printing.—The Division of Legislative Services shall serve the Commission as its secretariat and central administrative office and shall furnish the Commission with such services as the Commission shall deem necessary.

§ 9-145.4. Annual report.—The Commission shall report its findings and recommendations to the Governor and the General Assembly on an annual basis.

2. That all unexpended funds remaining in the accounts of the Virginia Energy Study Commission and the Coal and Energy Commission are hereby transferred and allocated to the Virginia Coal and Energy Commission established pursuant to this act in order to
effectuate the purposes contained herein.

President of the Senate

Speaker of the House of Delegates

Approved:

Governor
LEGAL OBSTACLES AND INCENTIVES TO
THE DEVELOPMENT OF SMALL SCALE
HYDROELECTRIC POWER IN VIRGINIA

Submitted to
UNITED STATES DEPARTMENT OF ENERGY
WASHINGTON, D. C.

By The
ENERGY LAW INSTITUTE
FRANKLIN PIERCE LAW CENTER
CONCORD, NEW HAMPSHIRE

Scheduled Report #: DOE Contract: ET-78-S-02-4934
Principal Investigator: Professor Peter W. Brown
Senior Research Fellow: Anthony W. Buxton, Esq.
Student Research Assistant: Donnie Pope

May 24, 1979
Table of Contents

Flow Diagram ......................................................... i

I. VIRGINIA WATER LAW ............................................. 1
   A. Riparian Rights Doctrine ............................... 1
   B. Virginia Milldam Act ................................. 4
   C. Eminent Domain ........................................... 6
      1. General Authority of the State ................. 6
      2. Eminent Domain Authority of Public Utilities .... 7

II. DIRECT REGULATION ............................................. 7
    A. State Corporation Commission ....................... 7
    B. Certificate of Convenience and Necessity ........ 12
    C. Ratemaking Authority of the State Corporation Commission . 13

III. INDIRECT REGULATION .......................................... 14
    A. State Water Control Board ............................. 14
       1. The Groundwater Act of 1973 ..................... 16
       2. Flood Damage Reduction Act - Virginia Erosion and Sediment Control Law ........ 16
    B. Wetlands Act ............................................ 17
    C. The Soil and Water Conservation Commission .......... 18
    D. Division of State Parks ............................... 19
    E. Commission of Outdoor Recreation ................... 19
    F. The Scenic Rivers Act .................................. 20
    G. Environmental Acts ...................................... 20
       1. Virginia Environmental Quality Act ............. 20
       2. Critical Environmental Areas ..................... 21
       3. Environmental Impact Reporting .................. 21
    H. Commission of Game and Inland Fisheries ............ 22
    I. State Historical Landmarks Commission - State Antiquities Act ......................... 22
J. Virginia Endangered Species Act ................. 23
K. Zoning ........................................ 23
L. Conclusions ................................. 24

IV. CONTINUING OBLIGATIONS ...................... 25
   A. Liability for Dam Breach .................. 25

V. TAXATION AND FINANCIAL INCENTIVES .......... 26
   A. Taxation ..................................... 26
      1. Taxing Authority ......................... 26
      2. Taxation of Water Power ................. 27
   B. Financial Incentives ...................... 29
      1. Division of Industrial Development .... 29
      2. Virginia Industrial Building Authority 30
      3. Industrial Development Corporations ... 32
      4. Certified Pollution Control Equipment and Facilities 32

VI. INTERSTATE COMPACTS AND COMMISSIONS ....... 33
   A. Potomac River Basin Compact .............. 33
   B. Ohio River Valley Water Sanitation Commission - Ohio
      River Basin Commission ................. 34
Flow Diagram of Regulation of Small Dams in Virginia

I. Ownership
   - Does developer qualify as a riparian owner?
   - Does developer own one or both banks of the waterway?
   - Is the waterway navigable or non-navigable?

II. If Navigable
    State Owns Bed

    Appeal To State Court

II. If Non-Navigable
    Developer Owns Bed If He Owns Both Banks

    Waterway Determined Non-Navigable

III. Apply to State Corporation Commission for Dam Construction Permit and Supply. Copy of F.E.R.C. Application to S.C.C.

Application Must Include All Relevant Information Required By S.C.C.

IV. State Corporation Commission Will Review Application as Well as Application and Findings of F.E.R.C.

Permit approved if F.E.R.C. has approved. S.C.C. has interpreted their action as pre-emption.

Permit Denied

Appeal to State Court
V. Does Developer Anticipate Flowage Upon Adjacent Property?

Yes

- Developer must institute action against owners for a flowage easement.

- If valid public use, easement granted and may specify dam height and dimensions and period of time which dam may be maintained.

- Court would compute damages which developer must pay adjacent landowner to flow land [title does not pass].

No

VI. Does Developer Anticipate Generating Power for Other Than Own Personal Consumption?

Yes

(If Public Service Company, developer may be able to acquire property through eminent domain with approval of State Corporation Commission.)

Must receive certificate of convenience and necessity from State Corporation Commission.

Must file rate schedule with State Corporation Commission for approval and have schedules available for public inspection.

No
I. Virginia Water Law

A. Riparian Rights Doctrine

The use of a natural surface watercourse in Virginia is governed generally by the doctrine of riparian rights. Riparian rights is a system of water rights based on ownership of land bordering on a natural stream or watercourse.\(^1\) For land to be considered riparian to a stream, that land must be located on the watershed of that portion of the stream.\(^2\)

The theory of riparian rights followed in Virginia is one of reasonable use.\(^3\) Under the reasonable use doctrine, each riparian owner has an equal right to the reasonable use of the water running naturally through or by his land for any useful purpose. The water must continue to run after such use without material diminution or alteration and without pollution. A riparian owner may not diminish its quality materially or exhaust the supply to the prejudice of lower riparian owners, unless he has acquired a right to do so by grant, prescription or license.\(^4\) "The reasonableness of a use depends upon the nature and size of the stream, the business or purpose to which it is made subservient and on the ever varying circumstances of each case."\(^5\) In a 1940 case,\(^6\) the Supreme Court

\(^1\) Henninger v. McGinnis, 131 Va. 70, 76, 108 S.E. 671, 673 (1921).


\(^4\) Hite v. Town of Luray, 175 Va. 218, 8 S.E.2d, 369, 372, 373 (1940).

\(^5\) Davis v. Town of Harrisonburg, 116 Va. 864, 869, 83 S.E. 401, 403 (1914).

\(^6\) Supra, Note 4.
of Virginia found that the use by a mill of all water except what would flow through a pipe two and one-half inches in diameter was a property right and also constituted a reasonable use.

In addition to the right to the reasonable use of the water, each riparian owner has the right to the water frontage belonging by nature to his land. This includes the right of access from his land to the navigable part of the watercourse. Riparian owners also have the right to the soil under the water between his land and the navigable line of the stream where he may erect wharves, piers or bulkheads for his own use or the use of the public, subject to any regulations by the legislature to protect the public interest.  

On navigable waters, a riparian owner owns to the waters edge only. The legislature of Virginia has qualified this ownership right by extending the line to the mean low-water mark.  

The Supreme Court of Virginia has defined the term "low-water mark" as ordinary low water, "not spring tide or neap tide, but the normal, natural, usual, customary or ordinary low water, uninfluenced by special seasons, winds or other circumstances." The title to the bed of all navigable waters in Virginia is held by the state for the benefit of all its citizens. This claim of ownership of title by the state is known as The Public Trust Doctrine Under The Common Law. The Supreme

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8Home v. Richard, 8 Va. (1 Call.) 441 (1798).
The Court of Virginia applied this doctrine in a 1902 case by stating that:

The title to the bed of a navigable river between the low-water mark and the line of navigability is not in the adjacent riparian proprietor, but in the state for the benefit of its citizens, and the riparian owner merely has certain rights beyond the low-water mark, such as building wharves, ... 12

The bed of non-navigable streams and waters are owned by the riparian owners. 13 Riparian owners of non-navigable streams are presumed to own to the thread of the stream.

A stream is a navigable or floatable one if by the increased precipitation at seasons, "recurring periodically with reasonable certainty", the flow of water will be sufficient to be useful to the public for transportation. 15 The test of navigability is whether the stream or water in its natural or ordinary condition is used or susceptible of use as a highway for commerce on which trade and travel may be conducted in the customary manner. 16

The Supreme Court of Virginia in a 1915 case included in the classification of navigable waters, the great navigable lakes of the state. 17 The court has not defined what great navigable lakes are in Virginia, but in many states they include ponds and lakes of more than either ten (10) or twenty (20) acres.

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14 Jennings v. Marston, 121 Va. 79, 92 S.E. 821 (1917).


B. Virginia Milldam Act

The Virginia Milldam Act allows a riparian owner the opportunity to apply for leave to build a dam across non-navigable waters in the state.\textsuperscript{18} The applicant may apply for such leave in the circuit court of the county where he intends to build the dam.\textsuperscript{19}

The applicant must give ten (10) days prior notice to each "tenant, or the guardian or committee of the tenant, of the freehold of any lands not owned by the applicant, upon which it is desired to abut a dam . . ."\textsuperscript{20} When proof of the notice has been given, the court will appoint five (5) disinterested freeholders of that county who will act as commissioners and meet on a certain day at the land where the dam is to be erected.\textsuperscript{21} The commissioners will then ascertain the impact of the proposed activity, and may set aside up to one acre for a dam and determine the just compensation to be paid for the land.\textsuperscript{22}

The applicant must start construction within one year after his application has been approved and finish within three years or have the lease lose its validity.\textsuperscript{23} The limitation on the power of the circuit courts to grant a leave to erect a dam is that "no leave shall be granted to any person to erect a dam which will obstruct ordinary navigation

\textsuperscript{19} Id.
or the passage of fish. Nor will the leave be granted to erect a dam which will obstruct or interfere with the navigation of a watercourse without the express authority of law or consent of the company incorporated to open, improve or extend such navigation. \(24\) If it is determined that the dam will obstruct the passage of fish, the dam owner may be required to construct fish ladders. \(25\)

Any applicant granted leave to erect a dam, upon paying just compensation for the land which the commissioners have determined is necessary to erect the dam, will own the land. The Supreme Court of Virginia has held that the applicant is not entitled to the ownership of the land overflowed by the erection of a dam even after paying the damages assessed by the jury. Title remains in the overflowed owner and the applicant gets only the right to flow their lands. \(26\) The applicant will also be held liable for any unforeseen damages not compensated for at the time leave to erect the dam was granted. \(27\)

The constitutionality of the Virginia Milldam Act has not yet been challenged in the courts. The constitutionality of Milldam Acts of other states have been challenged and generally upheld. A developer wishing to utilize the Virginia Milldam Act, however, should be aware of the issues raised in those states where such acts have been challenged.


\(26\) Whitworth v. Puckett, 43 Va. (2 Gratt.) 528, (1846); Hunter v. Matthews, 40 Va. (1 Rob.) 468 (1843).

C. Eminent Domain

1. General Authority of the State

"The right to appropriate private property to a public use is the right of eminent domain and lies dormant in the state until legislation points out the occasions, the modes, the conditions and the agencies for its appropriations." \textsuperscript{28} The constitutional limitations on the power of eminent domain require that the taking be for a public use, the use be needful for the public and the rights of the public to use the property taken be adequately protected. \textsuperscript{29} A use to be public must be fixed and definite and one in which the "terms and manner of its enjoyment must be within the control of the state, independant of the rights of the private owners of the property appropriated." \textsuperscript{30}

The measure of compensation for property taken is the fair market value of the property at the time of the taking. It is the actual value of the land condemned with all its adaptations to general and special uses. \textsuperscript{31} It should be awarded upon the basis of the most advantageous and valuable use of the land, having regard to the existing business demands of the community or such as may be reasonably expected in the near future. \textsuperscript{32} A private dam developer would not have authority to take private land by eminent domain.

\textsuperscript{28} Alexandria B.F. Ry Co. v. Alexandria B.W. Ry Co., 75 Va. 780 (1881).


\textsuperscript{32} Id.
2. Eminent Domain Authority of Public Utilities

Public utilities have been given substantial powers of eminent domain by legislative act.\(^{33}\) The applicable statute states that:

Every public service corporation engaged in the development of water power in this state for the production, sale and supply of hydroelectric power and energy to the public shall be vested with the right of eminent domain to the full extent requisite for the acquisition of all lands, property and rights necessary for the purpose of the construction, enlargement, maintenance or operation of any dam, reservoir, power station and/or other structures of any such waterpower development, . . . \(^{34}\)

This statutory authority given to public utilities in Virginia may offer a substantial incentive for the development of hydroelectric power projects by developers qualifying as a public utility.

II. Direct Regulation

A. State Corporation Commission

The regulation and control of the development of the waters of Virginia is exercised by the State Corporation Commission.\(^{35}\) Any person, firm, association or corporation, private or municipal, proposing to construct a dam across any waters in Virginia for the purpose of generating hydroelectric energy for use or sale must be licensed or permitted by the State Corporation Commission.\(^{36}\) No license or permit may be granted by


\(^{34}\) Id.


the State Corporation Commission until a hearing has been held and it is found that the public interest will be promoted or not detrimentally affected by the proposed dam.\textsuperscript{37}

A dam developer must submit an application to the State Corporation Commission and it must contain all the essential facts to enable the Commission to arrive at a decision on the merits of the proposal. Applications should include maps, plans and any other information which will give the State Corporation Commission a clear and full understanding of the proposed development. Information concerning the dam, generating stations and any other major structures shall be included in the application.\textsuperscript{38}

As soon as possible after the application is received by the State Corporation Commission, the Commission will set a day for a public hearing on the application. The applicant must give notice to the public, as approved by the State Corporation Commission, by publication once a week for four successive weeks prior to the public hearing in the newspaper(s) of general circulation in the city or county where the construction is proposed to take place.\textsuperscript{39} At the hearing the applicant and any interested persons may present any facts, evidence or arguments for or against the granting of the application.\textsuperscript{40}

Before the State Corporation Commission acts upon any application, it shall weigh all perceived advantages and disadvantages from the standpoint of the state and the people to be affected and make any investigation

\textsuperscript{37} Id.


\textsuperscript{40} Va. Code § 62.1-87 (1950).
which the Commission deems necessary. If the State Corporation Commission is of the opinion that the plans of the applicant provide the greatest utilization of the waters for which the application was made and that the applicant is financially able to construct and operate the proposed dam and works and that the public interest is promoted, they may grant the license to construct and operate the dam. If on the evidence before it, the State Corporation Commission believes that the scheme of the applicant does not meet the needs of the public interest, the Commission may require the applicant to modify the plans for the development in any manner the Commission deems necessary, or the Commission may reject the application.

The State Corporation Commission in granting any license may include in the license any terms and conditions dealing with the construction, operation and maintenance of the dam to be built as are necessary in the interest of public safety and navigability of the river or stream. If the dam is to be built on a navigable river of the United States, the applicant shall make any provisions for navigation as required by the Secretary of the Army.

License priority shall only be given to those applicants desiring a license to reconstruct or enlarge an existing dam development. If there is a conflict between two or more applicants, the State Corporation Commission may grant the license to the applicant they deem best in

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light of all the considerations. 45

Upon the granting of any license, the State Corporation Commis-
sion will prescribe a time limit of not more than two years after the
license is granted to begin construction of the dam. The dam must be com-
pleted within five years of the granting of the license, but either of
these time limits may be extended by the Commission upon a showing of good
cause. 46

Licenses granted by the State Corporation Commission are effec-
tive for fifty years and upon expiration the owners maintain ownership
under an indeterminate license until the dam is purchased by the state.
However, the state reserves the right to take any dam development for which
a license has been issued by condemnation and payment of just compensation. 47

No license may be voluntarily transferred or assigned unless the
transferee or assignee is deemed by the Commission to be financially able
to carry out the project. Any person acquiring a license by transfer or
assignment is subject to all the obligations, liabilities and conditions
of the original license. 48

A license may be altered or amended by the mutual consent of the
State Corporation Commission and the licensee, provided it conforms to
existing laws. 49

The requirements of the State Corporation Commission and licenses acquired through the Commission do not affect the jurisdiction of the federal government over the waters of the state.\textsuperscript{50} This means that under the Federal Water Power Act a person must obtain a license from the Federal Energy Regulatory Commission to build a dam across a navigable river even though the person holds a license from the state.\textsuperscript{51}

While technically the State Corporation Commission has absolute authority in deciding whether or not to license a dam project within the state, practically they have very little opportunity to have any direct effect on the final decision of whether a project will or will not be built. Any person proposing to build a dam for hydroelectric purposes in Virginia must receive a license by the State Corporation Commission, however, this process up until now has been no more than ministerial. Since the time that the State Corporation Commission was vested with the licensing authority for dams in Virginia the applicants for licenses for such dams have come under the jurisdiction of the federal licensing agencies. Because the requirements of applicants for meeting the federal license requirements are substantially the same and in many cases more stringent than the state requirements, the State Corporation Commission has in effect been relieved of the necessity of scrutinizing the contents of the applications.\textsuperscript{52}


\textsuperscript{52}Interview with Mr. Hall, Counsel for the Va. State Corporation Commission, (February 12, 1979).
B. Certificate of Convenience and Necessity

Any public utility wishing to construct, enlarge or acquire any facility for use in the public utility service must first obtain a certificate from the State Corporation Commission that the public convenience and necessity require the exercise of this right. A public utility as defined by statute includes:

any company which owns or operates facilities within the Commonwealth of Virginia for the generation, transmission or distribution of electric energy for sale, for the production, transmission, or distribution, . . . , or for the furnishing of telephone service, sewerage facilities or water.

However, the term public utility does not include:

(2) Any company generating and distributing electric energy exclusively for its own consumption.
(3) Any company (A) which furnishes electric service together with heating and cooling services, generated at a central plant installed on the premises to be served, to the tenants of a building or buildings located on a single tract of land undivided by any publically maintained highway, street or road at the time of installation of the central plant, and (B) which does not charge separately or by meter for electric energy used by any tenant except as part of a rental charge.

If a small-scale hydroelectric developer does not intend to consume all the energy which he produces or likewise does not intend to confine his operations to a single dwelling located at the site, as described above, he must apply for and receive a certificate of convenience and necessity from the State Corporation Commission. The developer must prove

to the Commission's satisfaction that he or she has the ability to render adequate service to the public under the prevailing circumstances.\(^\text{56}\) The factors to be considered by the State Corporation Commission are the retail rates, the area involved, the ability of the utility to serve the area normally and under emergencies, the different types of services rendered, and the character of the services required.\(^\text{57}\)

**C. Ratemaking Authority of the State Corporation Commission**

Virginia law places a duty on every public utility to furnish reasonably adequate service and facilities at reasonable and just rates to any person, firm or corporation who is along the utility's lines and wishes to receive that service. Public utilities must charge for their service uniformly for use under like circumstances.\(^\text{58}\) (For definition of public utility see section of report associated with footnote 20). The actual charge for public utility service must be at the lowest rate applicable for that type service and must be in accordance with the schedules required to be filed with the State Corporation Commission.\(^\text{59}\)

Every public utility in Virginia must file with the State Corporation Commission and keep open to public inspection schedules showing rates and charges, for itself, or jointly between itself and other public utilities.\(^\text{60}\)

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\(^\text{57}\) *Id.*


\(^\text{59}\) *Id.*

The State Corporation Commission may review the rates being charged by any public utility on an annual basis when the Commission feels that the annual review is in the public interest.\textsuperscript{61} The State Corporation Commission also has the authority to fix rates and schedules under certain circumstances. If after investigation the State Corporation Commission determines that rates, tolls, charges, schedules or joint rates charged by a public utility are unjust, unreasonable, insufficient or unjustly discriminatory, the Commission has the power to fix and order substituted rates, tolls, charges or schedules that they find to be just and reasonable.\textsuperscript{62}

III. Indirect Regulation

A. State Water Control Board (SWCB)

The State Water Control Law is directed at the maintenance of existing high water quality and restoration of any degraded state waters to a condition of quality that will permit all reasonable public uses and support the growth of all aquatic life. The law also requires the prevention and reduction of pollution and the establishment and promotion of water resource management and conservation.\textsuperscript{63} Any project which would reduce the water quality level of state waters is subject to approval by the SWCB.\textsuperscript{64} The SWCB is a branch of the executive department of the State of Virginia.\textsuperscript{65}


\textsuperscript{64}Va. Code § 62.1-44.4 (1950).

\textsuperscript{65}Va. Code § 62.1-44.7 (1950).
The SWCB is a seven member board charged with the authority to exercise general supervision and control over the quality of all state rates. The SWCB is also empowered to investigate and study all related problems of water quality and to establish standards of quality and policies and conduct scientific experiments to discover methods for maintaining water quality. In addition, the SWCB adopts rules governing all procedures with respect to hearings, reports, the issuance of certificates, and regulations necessary to the enforcement of the general water quality management program. The SWCB also has the power to issue special orders to persons to cease and desist in the violation of SWCB rules, regulations and policies and to comply with any rules, regulations and policies. The SWCB has the power to set fines and penalties. The SWCB must investigate any large scale killing of fish within the state. Finally, the SWCB is responsible for the development of programs and policies for effective area-wide and basin-wide water quality control and management.  

While the SWCB is the paramount agency on state water policy, there are some limitations on their power. It must exercise its authority in accordance with procedures such as public hearings, publication of notice, notice by certified mail, or by other means of notice. The SWCB is also required to seek the advice of local, regional and state


planning authorities. Any final decision by the SWCB is subject to judicial review on appeal.

1. The Groundwater Act of 1973

The SWCB administers the Groundwater Act of 1973 in cooperation with the State Health Department. The purpose of the Act is to recognize and declare that the right of reasonable control of all groundwater resources within the state belongs to the public, and the state will exercise that control. The SWCB is authorized to institute a groundwater study area proceeding which may limit the use of groundwater in that area.

2. Flood Damage Reduction Act—Virginia Erosion and Sediment Control Law

The SWCB is charged with coordinating the enforcement of the Flood Damage Reduction Act with the administration of the Virginia Erosion and Sediment Control Law. Under the Flood Damage Reduction Act the SWCB has the duty to collect and distribute information on flooding and flood plain management and to coordinate with federal, state and local agencies the implementation of flood plain management activities, including the establishment of minimum requirement guidelines for the Natural Flood Insurance Program.

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Under the Virginia Erosion and Sediment Control Law, the SWCB is required to advise the Virginia Soil and Water Conservation Commission in the development of an effective erosion and sediment control program. This program is carried out mostly on the local level.  

B. Wetlands Act

The Wetlands Act was enacted in Virginia to protect the people of Virginia against the destruction and pollution of the Commonwealth's rivers, bays and estuaries, and to prevent the diminution of Virginia's marine and inland animals and plants. Wetlands means "all that land lying between and continuous to mean low water and an elevation above mean low water equal to the factor 1.5 times the mean tide range at the site of the proposed project in the county, city or town in question; and upon which is growing on July one, nineteen hundred seventy-two or grows thereon subsequent thereto, any one or more of the following: saltmarsh cordgrass, saltmeadow hay, saltgrass, [etc.]." To determine whether or not the project falls within the area affected by the Wetlands Act, a developer should consult both the statute and any sources which would provide the geographical location of the plants and animals listed in the statute to determine if the proposed project is within a wetlands area.

Under the Wetlands Act, counties, cities and towns are authorized to adopt wetlands zoning ordinances for the purpose of regulating the use and development of the wetlands. Counties, cities and towns are authorized to adopt permit requirements and procedures and no person may conduct

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any activity which would require a permit under a wetlands zoning ordinance until a permit has been received. If a county, city or town has not adopted a wetlands zoning ordinance at the time a person proposes to begin development, that person must apply for a permit to the Marine Resources Commission.

C. The Soil and Water Conservation Commission

The Soil and Water Conservation Commission wields the technical expertise required to handle the problems of erosion and sedimentation. It monitors the activities of local Soil and Water Conservation Districts. The Commission also administers the Conservation, Small Watersheds, Flood Control and Area Development Fund. The purpose of the Fund is to make loans for the acquisition, maintenance, or operation of water storage facilities, for improvement of such facilities and for the acquisition, maintenance or operation of necessary machinery and other equipment incident to soil and water conservation purposes.

The directors of the local soil and water conservation districts have the power to regulate the use of lands within their respective districts. Such regulation may include provisions requiring the necessary

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83Id.


construction, observance of particular land use methods, specification of
cropping programs and tillage practices, retirement from cultivation of
highly erosive areas, and any other necessary measures. 88

D. Division of State Parks

The Division of State Parks may exert some influence over state
water policy. The Division has the ability to acquire lands of scenic
beauty, recreational utility or historical interest. 89 It is also respon-
sible for the establishment, protection and maintenance of the Appalachian
Trail. 90

E. Commission of Outdoor Recreation

The Commission of Outdoor Recreation was established to create
and effect long range plans for the acquisition, maintenance, improvement,
protection and conservation for the public use of areas of the state which
are best suited for outdoor recreation facilities, including scenic areas,
waters and highways, boat landings, beaches and other areas of public ac-
cess to navigable waters. 91 It is the duty of the Commission to develop
an up-to-date comprehensive plan for the development of outdoor recreational
facilities, to establish and promote standards for such facilities and to
coordinate its activities with other agents of the state. 92 The Commission


is also charged with the administration of the Scenic Rivers Act.93

F. The Scenic Rivers Act

The provisions of the Scenic Rivers Act are carried out by the Commission of Outdoor Recreation. The purpose of the Act is to provide for the identification, preservation and protection of scenic rivers by assuring that full consideration and evaluation of a river as a scenic resource shall be given before alternative plans for use and development are approved. This evaluation is to be included in all projects for the construction of impoundments, channelizations, locks, canals or other uses which might change the character of a stream or waterway, or which might destroy its scenic value.94

The Commission of Outdoor Recreation is to make studies of river sections and recommend to the Governor and General Assembly their designation as scenic rivers.95 Once a river has been designated as a scenic river by the General Assembly, no dam or other structure impeding the rivers natural flow may be constructed in such river.96

G. Environmental Acts

1. Virginia Environmental Quality Act

The purpose of this Act is to implement the policy of promoting the wise use of the state's air, water, land and other natural resources and to protect them from pollution, impairment or destruction so


as to improve the quality of the environment.\textsuperscript{97} The Act provides for a single unified application if a project requires a state permit or certificate from more than one state environmental agency.\textsuperscript{98} The State Corporation Commission is listed under this section as one such state environmental regulatory agency.\textsuperscript{99} In the case of a hydroelectric dam project the application must be approved by the State Corporation Commission only.

2. Critical Environmental Areas

The General Assembly of Virginia, in enacting the Critical Environmental Areas Chapter, found that the coastal zone and estuary, flood plains, shorelands and other land which possess special, natural, historic and scenic characteristics were critical areas which should be protected and preserved.\textsuperscript{100} The Division of State Planning and Community Affairs develops guidelines for the identification of these critical areas, and develops and recommends the means by which standards may be applied and the land use of critical areas to be controlled.\textsuperscript{101}

3. Environmental Impact Reporting

This chapter requires all state agencies, boards, authorities and commissions to prepare and submit a report to the Governor's Council on the Environment on each major state project.\textsuperscript{102}


\textsuperscript{98} Va. Code § 10-184.2(a) (1950).


\textsuperscript{100} Va. Code §§ 10-187(c), 10-188 (1950).

\textsuperscript{101} Va. Code §§ 10-190, 10-193 (1950).

project is one which entails the acquisition, construction or expansion of any state facility in which the cost is $100,000 or more, with the exception of highway or road projects, any industrial development authority or any county, city or town in Virginia. 103

The reports required for major state projects are to include but are not limited to:

(1) Environmental impact of the major state project;
(2) Any adverse environmental effects which cannot be avoided if the major state project is undertaken;
(3) Measures proposed to minimize the impact of the major state project;
(4) Any alternatives to the proposed construction; and
(5) Any irreversible environmental changes which would be involved in the major state project. 104

H. Commission of Game and Inland Fisheries

Under this Commission's authority, dams which obstruct navigation or the passage of fish may be deemed a nuisance, unless it is deemed useful to the public and allowed by law or court order. Any person owning a dam which interferes with the free passage of fish, must provide the dam with a suitable fish ladder. 105 The Commission has no authority to grant or deny permits, however, it is usually consulted with regard to major electric power generating stations.

I. State Historical Landmarks Commission - State Antiquities Act

The power of the State Historical Landmarks Commission is to designate historic landmarks and take steps to protect and preserve them. 106 The State Antiquities Act requires a permit for anyone who wishes to conduct field investigations, explorations or recovery operations involving

the removal, destruction or disturbance of any object of antiquity on state controlled land.\textsuperscript{107} Neither of these, however, require permits for general excavation pursuant to construction permits.

J. \textit{Virginia Endangered Species Act}

Under the Virginia Endangered Species Act, it is a violation of Virginia law to take, transport, or sell any threatened or endangered species which is listed under the Federal Endangered Species Act of 1973 or listed in the Virginia Register of Endangered Species.\textsuperscript{108} To take, as used in the Act, means to kill or destroy either the species directly or the habitat of the endangered or threatened species. The Commission of Game and Inland Fisheries may, on its own motion, declare by regulation that species not appearing on the federal lists are an endangered or threatened species in Virginia.\textsuperscript{109} Anyone violating the Act may be fined up to one thousand dollars and/or be imprisoned for up to six months.\textsuperscript{110} Anyone contemplating building a dam in Virginia should consult both the federal and state register to determine if the proposed construction area is within the critical habitat of an endangered species.

K. \textit{Zoning}

Virginia has local planning commissions to promote the orderly development by local governments of transportation, utility, health, education, industrial, agricultural, commercial and recreational facilities.\textsuperscript{111}

\textsuperscript{107}Va. Code § 10-150.5(B) (1950).


The local commission prepares a comprehensive plan for the physical development of its territory, designating areas of proposed land use, designating systems of transportation, designating systems of community service facilities and designating historical areas and areas for urban renewal. 112

Also on the local level are specific zoning efforts. The governing body of any county or municipality may, by ordinance, regulate, restrict, permit, prohibit, and determine the uses of lands, buildings, and structures, and the areas and dimensions of land, water and air space to be utilized. 113 There is also historic area zoning on the local level to protect landmarks, buildings and structures. 114

L. Conclusions

While none of the above authorities have specific authority to either grant or deny a license or permit to construct or operate a hydroelectric facility, it is important that a developer consider each one thoroughly before beginning construction. Many of the commissions discussed above, may, through comment and recommendations, have a significant effect on the State Corporation Commission's decision of whether or not to grant a permit and license, and should not be overlooked by the prospective developer.


IV. Continuing Obligations

A. Liability for Dam Breach in Virginia

The issue of the extent of a dam owner's liability for the breach of that owner's dam is an important consideration. While the precise issue of a dam owner's liability for breach has yet to be statutorily determined in Virginia, cases arising under similar situations have held in favor of a negligence theory. In a 1926 case, the Supreme Court of Virginia applied a negligence standard when a culvert within the City of Richmond breached and caused property damage.

Under negligence theory, the dam owner would not be held to be an insurer, but the measure of his duty in the construction and conduct of operations of the dam must be carried out in a non-negligent manner. A breach caused solely by an Act of God would not result in liability. If the dam owner's negligence were coupled with an Act of God, even though had the Act of God not occurred the dam would not have breached, the owner will be held liable. 116

This theory of liability contrasts with the theory of strict liability as has been recently adopted in Massachusetts. 117 Under strict liability, a developer would be held liable for those damages caused by dam breach regardless of any fault on his part. 118 The result of application of the strict liability theory to dam breach is that the risk of development is greatly increased.

115 Wright v. City of Richmond, 146 Va. 835, 132 S.E. 707 (1926).
118 Id.
While Virginia adheres at this time to the negligence theory for
dam breach, the trend appears to be heading toward a use of the strict
liability theory. If the rationale of the Massachusetts Court is found
persuasive to the Virginia Courts then Virginia dam developers may find
themselves faced with strict liability if their dam were to breach.

V. Taxation and Financial Incentives

A. Taxation

1. Taxing Authority

The state derives its authority to tax from the Virginia
Constitution. The Virginia Constitution allows for the taxation of all
property within the state at uniform rates within various classes of sub-
jects, unless exempt by statute. All assessments of property within
Virginia are to be made based at their fair market value. The Supreme
Court has held that in assessing all tangible property for tax purposes,
the property should be assessed at its highest and best use and the
Commission must assess real property at the fair market value.

The Virginia Courts have also held that there is a presumption in
favor of the correctness of a tax assessment and the burden is on the


120 Id.


property owner to show that the value fixed by the assessor is excessive.\textsuperscript{124} While the Virginia statutes provide for various exemptions to the property tax, it does not appear that dams would fall into one of the exceptions to the tax.

2. Taxation of Water Power

The Virginia statutes allow for the taxation by state and local taxing authorities of real estate and tangible personal property of water, heat, light and power companies.\textsuperscript{125} The statute also allows for an annual state franchise tax and local license taxes on water, heat, light and power companies.\textsuperscript{126}

The statute authorizing a levy on power companies of a franchise tax requires that each such corporation must pay the state for each tax year a franchise tax equal to "one and one-eighth per centum of its gross receipts from all sources up to one hundred thousand dollars of such gross receipts and three and one-half per centum of all such gross receipts from all sources in excess of one hundred thousand dollars, for the privilege of exercising its franchise in [the] state."\textsuperscript{127} This provision of the Virginia code also allows any city, town or county to levy a license tax upon power companies for the privilege of doing business in

\begin{footnotesize}
\textsuperscript{124} Supra, note 4. \\
\textsuperscript{125} Va. Code § 58-602 (1950). \\
\textsuperscript{126} Va. Code § 58-603 (1950). \\
\textsuperscript{127} Id. 
\end{footnotesize}
any city, town or county within the state. The maximum amount of license tax which may be levied is one half of one percent of the gross receipts of the power company.

The Virginia code allows for the assessment of real and tangible property of a power company by the State Corporation Commission with county, city, town and magisterial district levies. Virginia law requires all power companies to file on or before April fifteenth (15) of each year an annual report to the State Corporation Commission listing all of its real and personal property of every description located in the state and where all such property is located. Every power company must also report all gross receipts from all business done in the state for the prior year. Electric companies must also file a special report listing particularly "(a) land and improvements, (b) generating and substation equipment, (c) transmission and distribution lines, (d) underground conduits, conductor and devises, (e) line transformers, (f) services, (g) meters, (h) street lighting and signal systems, (i) general equipment, (j) materials and supplies, (k) merchants' capital, and (l) all other property.

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132 Id.
Virginia allows for the levy of local taxes on consumers of power from power companies.\textsuperscript{134} Any city, town or county is permitted to impose a tax on consumers of a utility service and such tax is limited to an amount not to exceed twenty percent of revenue and may not be imposed to any revenue in excess of fifteen dollars per month for residential customers.\textsuperscript{135} Counties may not impose a tax on customers of utilities owned by municipalities.\textsuperscript{136}

It is clear that dam developers and owners of small-scale hydroelectric dams will be required to pay property taxes on their site and equipment, and franchise taxes on a percentage of their gross receipts. Assessments will be made on the property by the State Corporation Commission at the local situs of the property based on the fair market value of all real property and tangible personal property with an obligation on the power company to file the necessary information.

B. Financial Incentives

1. Division of Industrial Development (D.I.D.)

The Division of Industrial Development (hereinafter cited as D.I.D.) was established by statute to carry out the state's program of industrial development with specific duties of: (a) industrial advertising and promotions and to respond to inquiries of the same; (b) to make available to prospective new industries information regarding industrial sites, natural resources and labor supplies; (c) to formulate and carry out plans for encouraging the location of new industries in the state and the expansion

\textsuperscript{134} Va. Code § 58-617.2 (1950).


\textsuperscript{136} Id.
of existing industries; and, (d) to apply for and accept and utilize grants
and other assistance from any public or private source. 137

The resources of D.I.D. may be very valuable to developers of
small-scale hydroelectric dams. Not only would the dissemination of inform-
Nation from D.I.D. be valuable for SSH developers, but there appears to be
no statutory limitation placed on D.I.D. regarding loan contracts or other
more direct financial assistance.

2. Virginia Industrial Building Authority (V.I.B.A.)

V.I.B.A. was created by statute based on a finding that a
need exists in Virginia to stimulate and promote the economy of the state
by encouraging and assisting in the location of new businesses and indus-
tries and rehabilitation and expansion of existing businesses and indus-
tries. 138 The specific purposes of V.I.B.A. are: To accept gifts, loans
and grants from any public or private sources; to guarantee loans for in-
dustrial projects; and, to acquire, purchase, manage and operate and enter
into contracts, leases and arrangements to encourage and assist in the
location and rehabilitation of new and existing businesses and industries. 139

The Virginia code sets forth the conditions subject to the
authority granting guaranteed loans. 140 If the V.I.B.A. determines that
an industrial project will further the public good, they may contract to
guarantee a loan not in excess of forty percent of the cost of the project. 141


141 Id.
Such loans are subject, however, to the following conditions:

(a) The principal of the loan to be guaranteed together with the principal of all other loans guaranteed by the Authority shall not exceed an amount equal to ten times the value of the loan guaranty fund.

(b) The principal of the loan to be guaranteed shall not exceed five hundred thousand dollars or or twenty-five percent of the value of the loan guaranty fund, whichever is greater.

(c) The loan to be guaranteed shall have a maturity satisfactory to the Authority but in no event later than thirty-five years from the date of the instrument evidencing the loan.

(d) A firm commitment shall have been secured for funds equal to the full cost of the industrial project and adequate provision shall have been made to obtain all machinery and equipment necessary for the operation of the industrial project.

(e) The proceeds from the loan to be guaranteed shall be used only to pay a part of the cost of the industrial project.

(f) The maker of the loan is willing to enter into such contracts, leases, mortgages, deeds of trust or other security agreements as the Authority may deem necessary.\textsuperscript{142}

Before the V.I.B.A. can contract to guarantee a loan, it must have received an application in writing and must have a hearing or examination to determine if the public good will be accomplished by the guarantee.\textsuperscript{143}

The Virginia code also establishes a premium for all guaranteed loans.\textsuperscript{144} The premium is based on an annual basis and is computed as a percentage of the principal obligation outstanding. The premium can be not less than one-half percent and not more than two percent to be determined by V.I.B.A.\textsuperscript{145}

\textsuperscript{142} Va. Code § 2.1-64-9(a)-(f) (1950).

\textsuperscript{143} Va. Code § 2.1-64.10 (1950).

\textsuperscript{144} Va. Code § 2.1-64.11 (1950).

\textsuperscript{145} Id.
While V.I.B.A. is not authorized to loan any monies of the Authority, the guarantee of loans made by funding agencies will make loans more readily available to SSH developers so long as they follow the requirements and fit the purpose of the statute.

3. Industrial Development Corporations (I.D.Cs.)

Virginia law allows for any bank, trust company, savings and loan association, industrial loan association or insurance company to incorporate within the state for the purpose of selling stock and debentures to finance the location and rehabilitation of new and existing industrial and business projects within the state.\textsuperscript{146} Small-scale hydroelectric developers in need of financing can check the public listing to find out which financial institutions have been incorporated under this act and will be able to receive substantial loans or other financing to suit their specific needs.

4. Certified Pollution Control Equipment and Facilities

Another possible, but less certain, financial incentive for SSH developers would be to have their facility and equipment exempted or partially exempted from state and local taxation by having either the facility equipment or both classified as certified pollution control equipment and facility.\textsuperscript{147} The Virginia code defines such equipment or facility "as any property, including real or personal property, equipment, facilities, or devices, used primarily for the purpose of abating or preventing pollution of the atmosphere or waters of the Commonwealth and which the state certifying authority . . . has certified to the Department of Taxation as having been constructed, reconstructed, erected, or acquired in conformity


\textsuperscript{147} Va. Code § 58-16.3 (1950).
with the state program or requirement for abatement or control of water
or atmospheric pollution or contamination.\textsuperscript{148} The certifying authority
for water pollution is the Water Control Board.\textsuperscript{149} While at first glance
it would not appear that small-scale hydroelectric plants would qualify
for "pollution control" status as defined in the statute, the argument has
been made successfully in a situation involving a hydroelectric dam in
Massachusetts.

VI. Interstate Compacts and Commissions

A. Potomac River Basin Compact

The Potomac River Basin Compact was approved by the Virginia
Legislature to aid in the protection of agricultural lands and other pro-
erty from damage caused by floods and increased sedimentation in the
Potomac River Basin.\textsuperscript{150} Other purposes of the compact are to increase the
quality of the waters, to provide for water-related recreational facilities,
to enhance the preservation of fish and wildlife, and to promote related
forestry, agriculture, soil conservation and watershed projects.\textsuperscript{151}

The Potomac River Basin Compact is an agreement between the states
of Maryland, Pennsylvania, Virginia, West Virginia and the Commissioners of
the District of Columbia. The Commissioners of the compact are directed to
coordinate and develop comprehensive plans which will be responsive to all
the interests and jurisdictions of the basin.\textsuperscript{152}


\textsuperscript{149}Va. Code § 58-16.3(c)(2) (1950).

\textsuperscript{150}Va. Code § 62.1-69.1 (Preamble).

\textsuperscript{151}\textsuperscript{Id.}

\textsuperscript{152}\textsuperscript{Id.}
Article ten (10) of the compact deals specifically with hydroelectric power. 153 This section of the compact states that under the general powers of the Commission, it is not intended that the Commission will not engage in constructing and operating hydroelectric generating and transmission facilities as a primary purpose. The compact does provide however, that "hydroelectric generating components and appurtenances may be installed in any project of the Commission either by the Commission, or by others under such terms and conditions as may be agreed upon with the Commission, whenever the Commission deems their inclusion either desirable or necessary in view of the prevailing or anticipated economic operational or regional circumstances. Such facilities may be operated by the Commission or may be operated by others under its authority and direction." 154

The compact also authorizes the Commission to provide means for the transmission of hydroelectric power and energy produced by a Commission facility, where such means are not available upon reasonable terms to market the power wholesale. The Commission is not authorized to sell power directly to retail customers. 155 In order to carry out the purposes of the compact, the Commission is authorized to take property through condemnation under the power of eminent domain of the state. 156

B. Ohio River Valley Water Sanitation Commission—Ohio River Basin Commission

To aid in the regulation of water pollution and the coordinated development of the Ohio River Basin, the Virginia Legislature authorized


Virginia to become a signatory to both the Ohio River Valley Water Sanitation Compact \textsuperscript{157} and the Ohio River Basin Compact. \textsuperscript{158} The Ohio River Valley Water Sanitation Compact requires a pledge of each signatory state to cooperate in the control of future pollution and the abatement of existing pollution from the rivers, streams, and waters in the Ohio River Basin. Each state under the compact also agrees to enact necessary legislation for providing a policing mechanism to maintain the waters of the basin in a satisfactory sanitary condition, suitable for recreational use and capable of maintaining fish and other aquatic life. \textsuperscript{159}


I. State Reports

a. Preliminary analysis of legal barriers to small scale hydroelectric power for each of the following states:

Maine
Massachusetts
New Hampshire
Connecticut
Rhode Island
Vermont
New York
New Jersey
Maryland
Pennsylvania
Delaware
Virginia
West Virginia
Kentucky
Ohio
Michigan
Illinois
Indiana
Wisconsin

b. Executive Summary - Legal and Institutional Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in New England and in the Mid-Atlantic States.

c. Legal and Institutional Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in each of the following states:

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<td>Virginia</td>
</tr>
</tbody>
</table>

II. General and Federal Reports


c. Recent Federal Action on Dam Safety (As of August, 1978).

III. Economic Reports

a. Fundamental Economic Issues Involving Small Scale Hydroelectric Power.

b. Monopsony and the Supply of Power From Small Generating Stations.

c. The Contribution to System Reliability of Small Scale Hydroelectric Facilities.

IV. NPDES Reports


June 13, 1979

THE GASOLINE SHORTAGE:
WHY THE SYSTEM WENT "TILT" IN LOS ANGELES

The world oil market suffered a net loss estimated at two to three million barrels per day between December and March as a result of the revolution in Iran. This created a temporary gap between supplies and apparent demand of about 4% world-wide. By early spring, this 4 percent gap had been translated into a gap in total U.S. gasoline supplies of between 8 and 10 percent. And in late April, this nationwide shortfall of less than 10 percent ballooned into a regional shortage at the retail pumps in Southern California of between 15 percent and 20 percent, causing Los Angeles service station dealers to restrict business hours, which in turn caused long lines at the pumps, panic buying, and hoarding.

The "Tilt" sign has flashed on the complicated machinery that produces and distributes gasoline for American motorists. Widespread confusion, long gas lines, angry motorists, and severe economic dislocations have become the order of the day in several regions of the country. In recent weeks, at least five widely differing explanations of the cause of the gasoline shortage have been advanced by various public and private sources. The situation has been described as the result of:

a) withholding of supplies by the major oil companies in anticipation of the June 1st start of President Carter's decontrol program;

b) deliberate action by the major oil companies last year to draw down U.S. crude oil and petroleum product inventories to dangerously low levels, thereby leaving the nation especially vulnerable to the Iranian cut-off;

c) diversion of crude oil and product supplies away from the U.S. market by oil companies seeking higher profits from sales in Europe and Japan;

d) unabatedly profligate energy consumption by gas-guzzling U.S. motorists who have failed to heed repeated warnings about the seriousness of the energy crisis; and

e) exploitation of the Iranian situation by oil companies using it as an excuse to raise prices and profits, even though there actually isn't any shortage at all.

The first of these theories can be disposed of immediately. There is no financial reason whatsoever for U.S. oil companies to hold back supplies of
gasoline in anticipation of decontrol. President Carter's decontrol program does not affect the price controls on refined petroleum products, which will remain in force until September 30, 1981, unless DOE asks that they be removed before then (which they have not done). Crude oil price increases attributable to the oil decontrol program can lawfully be used to justify higher prices for gasoline under the regulations anyway, but only for oil that was produced after June 1, 1979. Thus the only method by which an oil company could profit from awaiting decontrol would be to withhold domestic crude oil from the market, not refined products like gasoline. And DOE data shows that production of domestic oil in the first four months of 1979 was nearly 7 percent higher than in the corresponding period of 1978. This increase is primarily attributable to Alaskan oil. It is also apparent that no suppressing of other domestic production in anticipation of decontrol has taken place, however.

As will be demonstrated below, the other theories suffer from equally severe defects. Some are based on a misinterpreted hodge-podge of statistics. Others depend on untenable assumptions about oil company and consumer behavior; still others rely on undocumented charges of conspiracies. And most significantly, none of these theories explain the truly relevant aspect of the gasoline situation: Why did the Ayatollah, conspiring oil executives, or Winnebago-wedded American motorists -- whichever is the chosen villain -- strike on the freeways of Los Angeles, but not in Detroit, Atlanta or Cedar Rapids, or for that matter, why not in Tokyo, Paris, Frankfurt or Papeete?

The answer lies in the fact that unlike that of the rest of the Western world, the U.S. petroleum market is saddled with an immensely complicated and rigid DOE regulatory structure. This regulatory structure is incapable of responding with the rapidity and flexibility necessary to meet the changes that have taken place in the world oil market over the past five months. Within our boundaries, that regulatory system has had the unintended effect of acting like a magnifying glass -- focusing the modest aggregate shortage on a few unfortunate parts of the country.

The fact that there was indeed a temporary disruption of substantial magnitude in the world-wide crude oil supply system, that this shortfall has caused substantial downstream turmoil in the refining and distribution network, and that it will take some months to bring the system back into supply/demand/price equilibrium; is a critically important starting point for understanding the U.S. gasoline shortages. The various withholding and conspiracy theories imply that the Iranian revolution didn't happen or that it has no relevance for gasoline availability in the U.S. This is palpable nonsense.

Iran: A Modest But Real Crude Shortfall

There is little dispute that Iran was not exporting oil for a period of between 60 and 90 days. This resulted in a one-time reduction in world oil supplies ranging from 300-400 million barrels. Since the resumption of Iranian production at reduced levels in early March, another 150-300 million barrels in otherwise expected supplies has been denied to world markets. Overall, the Iranian revolution has cost the world crude supply system nearly
one-half billion barrels of oil that would have otherwise been produced during this period. This shortfall exceeds the December-to-May production of all except three of the free world's major oil producing nations. Its implications for U.S. petroleum supply, however, depend initially on two factors: (1) how much was compensated for by increased production elsewhere; and (2) how the net shortfall was distributed among the major oil using nations of the world.

There is wide agreement that increased production in Saudi Arabia, Nigeria, Kuwait and Iraq during part or all of the December-May period has added 2.5 to 3.0 million barrels per day of off-setting supply, leaving a net shortfall of between 2.0 and 2.5 million barrels. But the question of how this net shortfall has been distributed is complicated by two factors.

First, the world-wide crude oil and petroleum product inventory "pipeline" is immense. Under ordinary conditions more than 4 billion barrels of crude and product -- an amount greater than the entire annual production of Saudi Arabia -- is held in an inventory and storage chain stretching from Persian Gulf port storage facilities, through tankers on the high seas and in port, to domestic import terminals, refineries, pipeline bulk terminals, and finally, to wholesale/retail and end-use storage points. Naturally, a sudden supply reduction of hundreds of millions of barrels of crude oil cascades through this huge, delicately balanced inventory pipeline in unpredictable ways. Under the best of circumstances, it would take months for this pipeline to be stabilized, and for world supply and demand to be brought into a new equilibrium at a higher price.

Secondly, there are no simple bilateral lines of supply extending from the point of production and sale to specific national oil-use markets. Thus, it is not correct to assume that, because in 1978 only 550,000 barrels of the 19 million barrels consumed each day in the U.S. were imported directly from Iran, the Iranian shutdown has reduced U.S. crude availability by only 2.8 percent.

The situation is further clouded by the complex workings of the international oil trade. Although only 2.8 percent of the oil imported to the U.S. was produced in Iran, a much larger share of U.S. imports was handled by companies that had a stake in the consortium that operated the Iranian oil fields. These companies had countless exchange agreements among themselves and other oil companies under which Iranian oil was delivered to a non-U.S. port in exchange for the delivery of some other producing nation's oil to the U.S. Under normal circumstances, these agreements introduce a great deal of flexibility into the international oil supply chain, which permits some economies in transportation and helps ensure that the proper grade of oil is delivered to refineries around the world at the right time.

Without Iranian oil available to fulfill exchange commitments, however, the companies found their ability to supply non-Iranian oil to the U.S. impaired. DOE officials estimated that as much as 17 percent of U.S. oil imports were indirectly tied to exchange agreements involving Iranian crude. Of course not all of this oil was lost to the U.S. as a result of the inability to make exchanges. But the loss of Iranian production meant that new
arrangements had to be formulated, new business relationships established, and most importantly of all, a new level of uncertainty was introduced into supply arrangements for many U.S. refiners.

Thus there is no easy way to make a direct correlation between the 2.8 percent of U.S. oil that was imported from Iran before the revolution and the amount of oil that was available to U.S. refiners during the period of the shutdown. Depending upon how the new arrangements made in response to the disruptions in the world oil market turned out, U.S. refiners could have been relatively better or worse off than our nation's direct dependence on Iran might indicate. But given the flexibility of the international oil market, the general expectation is that the shortages would be allocated more or less evenly.

The O'Leary Rule: Tilt of Crude Supply Away from the United States

The oil companies were not acting in a political or regulatory vacuum in this period of crisis, however. Through an informal process of consultation among U.S., European, and Japanese officials, a policy of restraint in bidding was devised in order to hold down the spot market price for oil and thus indirectly restrain OPEC posted prices. The principal manifestation of this policy for companies buying supplies destined for the U.S. market was the so-called "O'Leary Rule," named after Deputy Energy Secretary John F. O'Leary.

The "O'Leary Rule" was a series of informal promises extracted from the oil companies not to bid more than $5 per barrel over the posted OPEC price for spot cargoes of oil. DOE had little difficulty enforcing its informal rules during the crisis, of course, because in addition to taking advantage of the companies' desire to avoid bad publicity, DOE could punish those companies that did not comply by denying them the right to pass through higher crude oil costs under the price control ceilings. Failure to approve a pass-through would force the companies to sell the products refined from oil more costly than permitted under the "O'Leary Rule" at reduced profit, or possibly even at a loss. So the companies by and large abided by the "O'Leary Rule," thus not purchasing oil for the U.S. market in many instances in which they could potentially have outbid European or Japanese buyers.

It is now apparent that during the late winter and early spring months, other crude buyers -- national oil companies and European and Japanese importers -- did not exercise the same restraint imposed on the U.S. majors by the Department of Energy. As a result, the U.S. has borne a disproportionate share of this shortfall. The implied 700,000-800,000 barrel/day U.S. shortfall (the U.S. share of the free world export market) attributable to the worldwide crude shortfall of the past six months had thus been significantly enlarged by DOE meddling even before the reduced oil flow hit the internal U.S. market.

At this stage, one of the more simplistic conspiracy explanations requires refutation. Some critics have argued that despite the alleged Iranian disruption, U.S. oil imports during the first four months of 1979 were actually 400,000 barrels per day higher than in the first four months of 1978. They therefore suggest that it is manipulation of refinery utilization and
product availability in the internal U.S. market that accounts for current shortages rather than reduced crude oil supplies in the external market.

The inaccuracy of this charge lies in the simplistic methodology from which it is inferred: comparison of year-over-year statistics for oil import levels, refinery runs and product inventories is a somewhat more treacherous endeavor than walking on banana peels. The fact is that at the beginning of 1978, U.S. crude oil and refined product inventories were at abnormal, all-time highs in relation to current demand. As a result, during the first half of 1978, domestic refiners sought to bring their stocks down to desired levels by drastically curtailing import purchases and significantly reducing refinery utilization rates. During the first half of 1978, crude oil imports were thus nearly one million barrels per day below 1977 levels -- even though demand for refined products had grown at a 2 to 3 percent rate in the interim.

This cyclical and not unprecedented inventory correction therefore makes 1979 over 1978 comparisons essentially meaningless. Indeed, due to the continued growth in demand and the reduction in stocks that had taken place by the end of 1978, imports in the first quarter of 1979 would have had to increase by almost 1.1 million barrels per day from abnormally low 1978 levels in order to avoid any restrictions in product availability. Crude oil quantities in these magnitudes simply weren't available on world markets for the reasons given above.

The Gasoline Crisis in One City: An Artificial Outcome

In terms of external crude supply developments over the past six months, then, the minimum expected supply reduction to the U.S. should have been in the range of 4 percent. Until the DOE did a 180° turn and quietly lifted the "O'Leary Rule" in early May, the artificial diversion of crude and heating oil away from the U.S. market undoubtedly magnified this gap by an additional few percentage points. But even a temporary 7 to 8 percent aggregate shortage of gasoline and other refined products should not have produced the massive dislocations that occurred in Southern California. Even allowing for the alleged inelasticity of demand for gasoline, there is no inherent reason why a temporary shortfall of this modest magnitude could not have been accommodated by the workings of the marketplace. Indeed, supply shifts or interruptions of this limited magnitude are normally accommodated as a matter of course in a wide range of U.S. product and commodity markets.

As was suggested previously, the answer to this riddle lies in the fact that there is no effectively functioning gasoline marketplace in the U.S. today -- just a maze of constantly shifting DOE price control and allocation rules that are almost certain to produce severe shortages in some areas, normal or even surplus supplies in other areas and public confusion and misunderstanding everywhere.

The Variety of Gasoline "Shortages"

One of the most remarkable aspects of the current gasoline situation is the astonishing variety of conditions found in the various regions of the country. The nadir is Southern California, where buying gasoline on a week-
end is next to impossible and buying gasoline at other times requires Sisypheus-like patience; the zenith is New Mexico, where in May 50 percent of all the gas stations were open 24 hours a day. In between falls most of the nation, where conditions are more or less normal, restrictions on hours of operation rare but not unheard of, and the principal effect of the shortage has been to eliminate price competition and thus permit dealers to raise their profit margins to the legal maximum -- and above, in some instances.

On a state-by-state basis, DOE estimates that in May 1979, ten states had available over 95 percent of the volume of gasoline sold in those states in May 1978; 32 states had between 90 and 95 percent as much as in 1978; and 8 states had between 85 and 90 percent as much. The peak is Hawaii, which for some as yet unexplained reason managed to have 126 percent as much gas as last year; the bottom is Michigan, which had 84 percent as much available as was sold in 1978. California, which is estimated to have had 93 percent of its 1978 supply available, was slightly above the national average of 92 percent. Yet according to the American Automobile Association survey, during the week of June 1, 1979, 69 percent of the gas stations in Michigan were open on Sunday and 30 percent remained open 24 hours a day, while in California only 24 percent of the stations were open Sunday and just 2 percent were open 24 hours per day.

Unregulated Markets Normally Manage Shortages Efficiently

Commodity markets usually adjust to moderate supply disruptions with amazing rapidity, efficiency, and flexibility. Prices rise; some users withdraw from the market, reduce their consumption, or switch to substitutes; brokers and speculators even out regional disparities by buying supplies in areas with better availability and lower prices and reselling them in areas with lower availability and higher prices. In the case of internationally traded commodities, the rise in prices caused by the initial indications of a shortage provides strong incentives for brokers and traders to seek out additional supplies for the U.S. market from foreign sources.

For example, in 1977 the U.S. suffered a 25 percent reduction in its coffee imports because of two successive years of bad weather in the major coffee growing regions of the world. Yet this did not lead to long lines in supermarkets, let alone a drastic shortage in just one or two cities. Similarly, in 1977 cherry production dropped by 40 percent from the previous year's level without causing a disruption in supermarkets in just a few places. And from time to time the eastern apple crop is destroyed by a late spring freeze, with the only result being that some consumers switch to oranges or pears, others buy less fruit, and brokers ship in apples from Washington and the upper Midwest. In short, normally the incentives and price signals of the marketplace put nearly all its participants -- producers, brokers and consumers -- to work on solving the unexpected shortage and very rapidly bring the market back to equilibrium.

There is only one major distinguishing factor involved in the availability of gasoline: it is controlled by several hundred pages of complex Department of Energy regulations. Unlike the market forces that govern the allocation of most products, the DOE allocation regulations controlling the
distribution of gasoline are not driven by consumer demand. In fact, the DOE allocation regulations have absolutely nothing to do with consumer demand; their principal purpose is to attempt to protect the relative market position of the wholesale distributors and retail gas station owners who form the bottom two rungs of the gasoline marketing chain.

How DOE Allocation Regulations Made Matters Worse

In order to understand how the DOE allocation regulations caused a modest nationwide shortage to be translated into a severe regional shortage in Southern California, it is first necessary to understand how these regulations operate. The basic principle governing the allocation program is that every wholesale seller of gasoline has a continuing obligation to provide every business to which he sold gasoline during a certain period of time (the "base period") with the same amount of gasoline as he sold to that business during that base period. A simple example shows how the system operates: If refinery A sold wholesale jobber B one million gallons during April of the base period year, then refinery A must offer to sell 1 million gallons to jobber B in April of 1979. If the refiner cannot fulfill all of its obligations, it must add up the total of its obligations, find the ratio of its obligations to its available supply, and then provide each of its customers with the same proportion of their allotment. Thus in our example, if refiner A has 100 customers just like jobber B (1 million gallons per month base period volume) but today has available only 95 million gallons, it must offer each jobber 950,000 gallons, or 95 percent of their base period use. The "allocation fraction" that has been the subject of much attention lately is this ratio between a supplier's total obligations under the regulations and its available supply.

Although this system seems eminently fair to the people who sell gasoline, the regulations are not fair at all to the people who buy gasoline. The problem is that the "base period" -- which determines the amount any given supplier has available to sell -- is always out of date. New roads open, weather conditions change, planting is delayed or advanced by good weather in the farm belt, population shifts from cities to suburbs, within suburban areas, and from one region of the country to another. Since the allocation fractions are national for most companies (a handful use one fraction for east of the Rockies and another for the West), any area that has faster than average growth in gasoline demand will necessarily have a larger than average shortage. An area that has slower than average demand growth will have much less of a shortage or even no shortage at all.

The further the base period is from the period in which the allocation is being made, the greater the disparity between the supplies made available in a particular area and the demand in that area. Until January of 1979, DOE was using 1972 as the base period. To give a sense of how much conditions can change in just a few years, by 1978 only 60 percent of the gasoline distributed was given under the primary allocation derived from the 1972 base period. The remainder was distributed in second and third round allocations, which permitted the customers who needed more gasoline to take product not claimed by those who needed less because the demand in their areas had declined since the base period. Realizing that its base period had become so
detached from reality that it would cause an immense dislocation in the event of a shortage, DOE updated the base period to 1978 recently. But the fact of the matter is that even since 1978 there have been major changes in driving patterns, population patterns, weather, and all the other factors that govern the demand for gasoline.

In California, for example, there were 7.8 percent more vehicles registered in February of 1979 than in February of 1978, there were 1.9 percent more people living in the state, and 2.8 percent more licensed drivers. Particular communities within the state have experienced growth rates far in excess of this average, however, with some new suburbs of Los Angeles growing at 10 to 15 percent per year. Since the allocation regulations treat California exactly the same as New York -- which had an actual decline in population -- California necessarily has a shortage, while New York does not (although some fast-growing areas within New York have experienced problems).

So it is apparent that by design the allocation regulations create regional disparities during a shortage in their effort to "protect" the people who sell gasoline. If the inability of the national allocation fraction to reflect changing local conditions were the only problem with the DOE regulations, we would have a serious problem. But there is a second major flaw in the allocation system: it leaks.

It Pays To Be "Essential": The Priority User Leak

Perhaps the biggest single leak out of the allocation system comes from the so-called "essential use" or high-priority user regulations. DOE permits every person who sells gasoline to claim a special allotment for supplies that will be resold to persons providing public services such as police and fire departments. Agricultural producers and the Department of Defense have an even higher priority. Agricultural and defense users of gasoline are entitled to buy 100 percent of their current requirements at all times, regardless of their "base period" use. Moreover, the regulations contain no definition or limit on what constitutes current requirements. The supplies allotted to these special classes of gasoline users are subtracted from the supply pool before the general allocation fraction is determined. Thus every gallon that goes to a priority user reduces the amount that can be distributed through ordinary retail outlets and purchased by the general public.

In theory, this seems very reasonable; after all, no one wants the local fire department to run out of gas. The problem is that the system is totally unenforceable. The wholesale-jobber simply certifies to his refiner supplier that he has "high-priority" customers. Neither DOE nor anyone else makes much of an effort to find out whether in fact the gas is going to a farmer or to the fire department. The opportunities for leakage out of the normal distribution channel and into the priority channel are immense. Farmers can let non-farmer friends pull up to their bulk tanks; distributors can get more gasoline for their regular stations by claiming to be selling gas to farmers; even some local governments bend the rules and let employees pull up to their bulk tanks. Moreover, since there is no limit on "current needs," priority users can draw supplies not only for current consumption but for hoarding as well. The recent dramatic lengthening of delivery times on
large metal tanks suggests that this phenomenon may be widespread.

In practice, the priority use allocation skims at least 5 to 7 percent of the total supply off the top. Thus while in May in California the refiners had available an average of 92 percent of their 1978 supply, only 84 to 85 percent was available for allocation to non-priority customers -- that is, to the retail gas station network that serves the majority of motorists. The priority users' share of total consumption, according to preliminary data, appears to be at least 10 percent larger in 1979 than in 1978. Since the general demand growth for gasoline in California is estimated to be approximately 5 percent, demand from priority users is growing twice as rapidly as demand from the non-priority (general public) sector.

On a nationwide basis, the Lundberg Letter, an industry publication that surveys gasoline prices and supplies, estimates that the proportion of gasoline taken by priority users has risen from 4.7 percent in March to 8.9 percent in June. While the very laxity with which the priority use classifications and allocations are administered makes it impossible to say with certainty that all of this increase is due to leakage, the powerful incentive to accumulate excess supplies appears to be a principal reason behind the rapid growth in the volume of gasoline sold to priority users.

It Pays To Have Friends at the State Capitol: The Set-Aside Leak

The high priority allocation is not the only way in which the DOE regulations reduce the amount of gasoline distributed to stations through the normal channels, however. The regulations create a "state set-aside" equal to 3 percent of the total supply a company has available in each state. This too comes out of the supply pool before gas is distributed, thus further reducing the allocation fraction. In California, the state set-aside had the effect of reducing the general allocation fraction to 81 percent in May, even though 84 percent of the 1978 supply volume remained after the priority users had taken all they wanted.

What happens to this state set-aside gasoline? In a few states, nothing at all. These states simply do not have the resources available to decide what to do with the set-aside, not having had any need to deal with it since the Arab oil embargo of 1974. So these states don't tell the refiners where to send the gasoline each month, which causes it to revert to the supply pool in the following month. This of course creates a larger shortage in the first month of reduced allocations, but this even out if the shortages persist.

Most states do have a policy for allocating their state set-aside volumes of gasoline, however. They give it to priority users who do not quality under the "essential services" or agricultural priority, such as private trash collection, school buses, sewer repair services, and even building contractors and construction crews. Others use it to help gas station dealers whose allocation is inadequate because of very rapid demand growth, because their stations were closed during the base period, or for any other reason that satisfies the state officials administering the program. And of course a certain amount of state set-aside inevitably seems to find its way
into the stations of politically-connected dealers and jobbers, as was confirmed in a GAO report on the operation of the program during the 1974 embargo.

DOE recently amended its regulations to provide that states could increase their share of the supply for distribution under the set-aside to 5 percent from 3 percent. This action will simply decrease the amount of gasoline available under the general allocation by 2 percent, further aggravating the supply conditions faced by the average motorist.

The "leaks" from the allocation system reduce the amount of gas allocated to the ordinary dealer by a significant amount, as described above. But an even more pernicious feature of the allocation system is that it introduces an element of uncertainty into the decisions of the refiners who have to fill all of these allocations. Since they cannot know with certainty just how much will be claimed under the high-priority allocation and just how much the state will claim of its set-aside, the refiners set their general allocation fraction low at the beginning of the month and adjust it upwards toward the end of the month. This problem is compounded by the fact that DOE has been modifying the allocation regulations almost weekly since January, which causes still more caution in setting the allocation fraction.

The effect of this initial understatement in the allocation fraction is to give the retail dealers the idea that they will have less gasoline available than they actually end up getting, which of course causes them to adjust their marketing patterns accordingly. So they start closing earlier, on Sundays, and so on, thus leading to another major contributing factor in the gasoline situation: worried motorists.

The Difference Between Worried Motorists and Angry Motorists

The foregoing makes clear how the current price control and allocation system translates into an 8-9 percent shortage in gasoline availability relative to current demand, into a 12-15 percent shortage at retail pumps generally, and upwards of a 20 percent shortage in those areas experiencing unusually high rates of demand growth. While only a few rapidly growing urban markets experienced the full magnification effect during April and May, it has nevertheless been sufficient to intensify the distortions still further: sensational TV and press coverage of thousands of stranded motorists in Los Angeles has generated millions of worried motorists nationwide.

Motorists apprehensive about supply availability create three additional dislocations in the distribution system. First, motorists in many urban areas across the nation have started topping their tanks -- in a repeat of the 1973-1974 embargo period behavior. Since under normal conditions the motor vehicle fleet carries more than 1.2 billion gallons as a mobile inventory, even a 25 percent increase in the average tank fill-level can suddenly withdraw hundreds of millions of gallons from the retail supply system.

While there are obviously no figures on the increase in this mobile inventory during recent weeks, evidence from California indicates that the tank-topping reaction has been substantial. One major refiner reported that
its average credit card sale declined from over 8 gallons to 3 gallons. This also means that if these customers were doing the same amount of driving, they were buying gasoline more than twice as often. Since about 1 billion gallons of gasoline are sold each month in the state, if this happened generally it would mean that the number of purchases made at California gas stations would rise from 4 million per day to 10 million per day. Under these circumstances, it is apparent how there could be long lines even if there were no shortage at all, simply because the stations would be handling so many more customers.

Finally, worried motorists add one further level of dislocation to the distribution system. When motorists start worrying about closed stations and lack of availability, many of them alter weekend recreation and vacation plans. While this phenomenon is also impossible to quantify, there is already substantial evidence from motel and resort vacancy rates that urban motorists are sticking closer to home in their recreational pursuits -- especially on weekends. Thus, there has undoubtedly been an increase in Washington area weekend traffic to Great Falls and a reduction in traffic to the Eastern Shore -- especially to those areas beyond the round-trip range of an average car with a full tank.

Unfortunately, the gasoline allocation system distributes supplies on the basis of what consumers normally do, not on the basis of their altered behavior in response to fears of shortage. As a result, in relationship to current demand, the allocation system tends to create a syndrome that might be described as "drain the cities, flood the countryside." As visible signs of actual shortages are broadcast out across the country, urban areas that normally "export" traffic find that their already limited gasoline supplies are being burned up at an accelerated rate by worried motorists staying closer to home, while the traffic "importing" resort and recreation areas have ample gas supplies and a dearth of customers. Post-mortems of the 1973-1974 allocation program demonstrated a similar phenomenon.

These highly visible shortages and dislocations in major urban areas have one final effect: they cause consumers to temporarily stop buying larger cars, pickups, and various types of recreational vehicles. Thus during May, total domestic car sales were off 17.2 percent from a year ago, while large car sales were off 31.9 percent. Motor home sales plummeted by 57.7 percent in April, the most recent month for which data is available. This means in turn inventory build-ups, automotive industry worker lay-offs, and the further softening of an already recession prone economy.

The alternative to these costly, rippling dislocations caused by the worried motorist syndrome would be to simply abolish the cumbersome gasoline allocation and price control system. This would undoubtedly produce angry rather than worried motorists -- but the resulting economic dislocations and real costs to the economy and public would be substantially less severe.

In the period immediately prior to the Iranian disruption, the average nationwide price for unleaded regular gasoline was about 70¢ per gallon. Even if the short-run elasticity of demand for gasoline is as low as 0.2, as many economists argue, the present aggregate national gasoline shortage would
have produced a market-clearing price in the range of $1.00 to $1.10 per gallon. Since in some isolated areas prices have already breached the $1.00 per gallon level, have attained better than 90¢ per gallon in a growing number of areas, and average at least 85¢ per gallon nationwide -- despite price controls on refineries, wholesalers and retailers -- it is clear that the control system has not effectively protected the consumer in any event.

Yet had the gasoline price control and allocation system been lifted last summer as even some officials within DOE had proposed, the effects of the shortage would be far different:

(1) Retail gasoline users would be on an equal competitive footing with high priority users, causing demand reductions to occur among all gasoline users in response to price and cost considerations rather than permitting some privileged categories of users to actually increase their consumption and inventories, while retail pool users have been forced to drastically curtail consumption or wait in long lines;

(2) Allocation by price rather than queue would have prevented the waste of millions of man-hours in gasoline lines, and more importantly the spread of tank-topping and other counterproductive worried motorist behavior.

(3) If the refiner-wholesale-retail distribution system were unencumbered by rigid supply obligations and allocation fractions, the normal lubricators of tight markets -- traders and brokers -- would be moving gasoline from areas of lower demand to areas of higher demand in response to arbitrage opportunities, thereby causing all areas and regions to share in the shortage equally rather than magnifying it in a few areas like Los Angeles, Las Vegas, Washington, D.C., and so on;

(4) It is unlikely that the reduction in long distance recreational travel in response to higher prices would be nearly as great as the response to fears of physical shortage and being stranded, thus mitigating the current supply imbalance between countryside and city;

(5) Similarly, it is unlikely that the sudden, drastic downward lurch of large vehicle sales would have been as severe -- as fear of unavailability is a greater deterrent than price -- at least over the range of increase that would have occurred in an uncontrolled market under present conditions.

Don't Blame the Gas Guzzler

In light of this analysis, those who blame the current shortage on demand from "gas guzzling American motorists" (to use a favorite phrase of the Washington Post) can find little solace in hard facts. First of all, American motorists have had an exemplary record of restraint in increasing gasoline consumption over the years since the 1973 embargo when compared with
the supposed paragons of motoring virtue in Western Europe and Japan.

In 1978, for example, total consumption of motor gasoline rose by 2.9 percent in the U.S. But in Japan, consumption rose by 6.2 percent; in West Germany consumption went up 5.1 percent; and in France by 3.5 percent. The average increase for all of Europe was 4.9 percent.

What makes the relatively modest rate of demand growth in the U.S. even more remarkable is the fact that until very recently, the price of gasoline was rising more slowly than the price of other goods, thus causing the inflation-adjusted price of gasoline to decline. In constant 1972 dollars, the average selling price of leaded regular gasoline was 44.8 cents per gallon in 1974; 43.7 cents in 1975; 43.1 cents in 1976; 43.2 cents in 1977; and 41.0 cents in 1978. Only the recent sharp price increases have brought us back to even the 1974 level. Expressed in 1972 dollars, the current national average selling price for regular is or just two cents higher than in 1974. Thus despite receiving no further price signals after the abrupt upward adjustment of the real price in 1973-1974, the U.S. motorist has actually increased use of the product more slowly than his European and Japanese counterparts.

Still Less Gasoline: The Distillate Target

Another major factor that could soon begin contributing to the restricted availability of gasoline is the DOE program to build heating oil stocks for next winter. Like the "O'Leary Rule" on purchasing spot market crude oil, this is an "informal" program -- but one with which the refiners will cooperate because of the threat that DOE will issue regulations forcing them to comply.

On the basis of historical data, DOE decided that it would be necessary to have a nationwide inventory of distillate fuel oil of 240 million barrels by next October. This is slightly above the 233 million barrels on hand at the start of the winter last year. But the situation has changed dramatically from last year, because current stock levels are much lower than in the spring of 1978 -- 126 million barrels as opposed to 148 million barrels, or nearly 18 percent lower. This means that in order to meet the DOE target, refiners will have to produce 240,000 barrels per day more of distillate this spring and summer than in the comparable period last year. Since distillate production increases come largely at the expense of gasoline output, the distillate target program can be expected to cut still further into the availability of gasoline this summer.

DOE has operated on the assumption that gasoline is less necessary than distillate. This is based on surveys showing that as much as 20 percent of all driving is "non-essential," whereas distillate use in industry and for home heating is presumably more useful. While this basic assumption underlying the distillate target program may have some validity, the process by which the target was selected does not inspire confidence that DOE is making a conscious and carefully thought-out trade-off between gasoline this summer and heating oil next winter.
The problem is that the target is based only on "primary stocks," which are the stocks in the hands of the refiners. The "secondary" stocks, which are those in the hands of wholesalers, industry tanks, apartment buildings, and home fuel tanks, are at least as large as the primary stocks, according to industry estimates. But neither DOE nor anyone else has one shred of data on just how much fuel oil is currently stored in these secondary stocks, simply because no one collects it. If the holders of these stocks have been filling their tanks earlier in the year than usual or adding to their storage capacity, then the primary stocks could be abnormally low now without any actual threat to the availability of adequate supplies next winter. Indeed, given the present pervasive apprehension about shortages -- a fear largely generated by the allocation system itself -- it is highly likely that the robust growth of apparent demand for distillates so far this year represents not so much an increase in current consumption as it does the unrecorded movement of stocks from the primary to the secondary storage system. In short, DOE could easily have set a distillate target that is too high, and thereby have unnecessarily diverted supplies from the gasoline market, which we know is short.

Send the "Little Dutch Boy" Back Home: Get DOE Out of Gasoline Allocation

The present allocation system clearly has the dominant role in explaining how a 4 percent world-wide crude shortage became a 20 percent gasoline shortage in Southern California. DOE is now in the position of the "Little Dutch Boy," attempting through constant revision and updating of its regulations to duplicate the countless thousands of adjustments in supply allocation that an unregulated market would make automatically in a period of modest shortage. Since January, DOE has published over 50 amendments to the allocation and price control regulations. The "base period" alone has been modified four times. The Office of Hearings and Appeals is flooded with petitions: at last count over 6,000 were pending, and new ones were coming in at the rate of 100 per day. The likelihood that the agency can make timely adjustments to its procedures has proven to be zero. So long as the basic principle driving the allocation system continues to be the protection of sellers of gasoline, not meeting the needs of consumers of gasoline, DOE regulations will continue to impose an unpredictable pattern of disruption and unusual hardship on certain unfortunate parts of the country.

The buying public did an outstanding job of allocating gasoline by its purchasing decisions for over fifty years. DOE and its predecessors have done a miserable job in the seven years they have been in charge, and can be expected to do a worse job as the number and complexity of the decisions they must make increase. The parallels between the DOE allocation program and the Soviet State Shoe Factories -- noted for producing more left shoes than right on occasion -- become more apt with each passing day. If we needed further proof of the inability of DOE regulation to protect the public interest, the California gasoline situation has given us splendid new evidence.
THANK YOU FOR THE INVITATION TO APPEAR BEFORE YOU TODAY TO EXPLAIN
SALEM'S DISPOSAL FACILITY WHICH WE HAVE OPTIMISTICALLY NAMED, "SOLID
WASTE DISPOSAL -- ENERGY RECOVERY FACILITY." -- WHAT DO WE RECOVER --
ENERGY IN THE FORM OF STEAM -- TO CONSERVE A NATURAL RESOURCE. A
BRIEF HISTORY OF WHY WE ARE INTO THIS TYPE OF DISPOSAL AS OPPOSED
TO A LANDFILL:

FOR THOSE OF YOU WHO ARE NOT FAMILIAR WITH SALEM, WE ARE A COMMUNITY
OF SOME 25,000 RESIDENTS IN THE ROANOKE SMSA AND HAVE A FAIR BASE
OF INDUSTRIAL AND COMMERCIAL ENTERPRISES. SOLID WASTE AMOUNTING
TO AN AVERAGE OF 75 TONS PER DAY IS CURRENTLY COLLECTED BY THE
CITY AT NO CHARGE -- THE COST IS INCLUDED IN THE REAL ESTATE TAX.
RESIDENTIAL GARBAGE COLLECTION IS TWICE A WEEK, COMMERCIAL DAILY
AND OTHER TRASH IS COLLECTED ONCE A WEEK. THERE ARE TWO PRIVATE
COLLECTORS WHO HANDLE SOME OF THE INDUSTRIES AND APARTMENT COMPLEXES.

THE PAST DECADE HAS CAUSED THE CITY OF ROANOKE, WHICH IS ADJACENT
TO SALEM, TO SEEK A LANDFILL SITE WHICH WOULD HAVE SOME USABLE
LIFE AND, FINALLY, AFTER MUCH POLITICAL Rhetoric, A REGIONAL LAND-
FILL WAS FOUNDED. ITS LOCATION WAS SO REMOTE FROM SALEM THAT EITHER
WE WOULD HAVE TO BUILD A TRANSFER STATION OR ULTIMATELY SEEK ANOTHER
SOLUTION. THAT ULTIMATE TIME CAME QUICKER THAN WE EXPECTED, THE
SHERLOCK HOLMES OF THE COMMONWEALTH -- BETTER KNOWN AS THE STATE
WATER CONTROL BOARD -- BEGAN BREATHING DOWN OUR NECK ABOUT OUR
LANDFILL AND WE REALIZED THAT SOME SOLUTION TO THE SOLID WASTE DISPOSAL PROBLEM FOR SALEM MUST BE FOUND. THAT TIME WAS JUST THREE SHORT YEARS AGO, AND SO THE CITY OF SALEM IN 1976 WAS FACED WITH EITHER FINDING A NEW LANDFILL SITE OR SOME OTHER MEANS OF ADEQUATELY DISPOSING OF THE SOLID WASTE GENERATED BY ITS CITIZENS. THE ONLY GEOLOGICALLY ACCEPTABLE TRACTS, BASED ON CONSULTANT'S REPORTS, WERE IN THE COUNTY AND SOMEWHAT REMOVED FROM THE CITY. THE CITY RECOGNIZED THE POSSIBLE POLITICAL AND EMOTIONAL BATTLE IN TRYING TO SECURE PERMISSION FROM THE BOARD OF SUPERVISORS TO OPERATE A LANDFILL IN THE COUNTY AND BEGAN TO SEEK ALTERNATIVE METHODS OF DISPOSAL.

IT WOULD BE PRUDENT HERE TO ADD THAT THE SITES RECOMMENDED FOR SALEM'S LANDFILL WERE SOME 10 TO 7 MILES CLOSER THAN THE REGIONAL LANDFILL.

OFFICIALS OF MOHAWK RUBBER COMPANY IN SALEM WERE FAMILIAR WITH THE CONSTRUCTION THEN GOING ON IN NORTH LITTLE ROCK, ARKANSAS, OF A DISPOSAL PLANT SIMILAR TO WHAT WE NOW HAVE IN SALEM. HERE IT NEEDS TO BE ADDED THAT SALEM HAD INFORMED MOHAWK THAT NO MORE IMPERFECTION TIREs WOULD BE PERMITTED IN OUR LANDFILL WHICH REALLY CREATED A PROBLEM FOR THEM AND IN ADDITION, MOHAWK RUBBER COMPANY WAS IN THE PLANNING STAGES OF AN ADDITION TO THEIR PRODUCTION CAPACITY AND IN THE NEED OF ADDITIONAL STEAM.

AT THE REQUEST OF MOHAWK, A VISIT WAS MADE TO SILIO SPRINGS, ARKANSAS, TO INSPECT A VERY SMALL PLANT THAT HAD BEEN IN OPERATION FOR SOME SEVERAL YEARS. LATER, DURING THE TIME SPECIFICATIONS WERE OUT FOR BIDS, VISITS WERE MADE TO PENNSYLVANIA AND VERMONT
TO INSPECT CONTROLLED AIR INCINERATORS WITH SOME FORM OF ENERGY CONVERSION BY A VERY SKEPTICAL CITY MANAGER WHO HAD HAD BAD EXPERIENCES WITH A STANDARD MUNICIPAL INCINERATOR BUILT IN 1946. THE MAYOR AND CITY COUNCIL INSISTED THAT I FULLY EXPLORE THIS POSSIBILITY. BASED ON OBSERVATIONS AT THESE LOCATIONS AND RESEARCH OF PUBLICATIONS, A JOINT DECISION WAS MADE TO PURSUE THIS TYPE OF DISPOSAL TO ASCERTAIN ITS FEASIBILITY FOR SALEM. AN ENSUING CONSULTANT'S REPORT SHOWED THAT NOT ONLY WAS IT FEASIBLE, BUT ALSO VERY PRACTICAL IF A STEAM CUSTOMER COULD BE FOUND. THE CONSULTANTS, HAYES, SEAY, MATTERN AND MATTERN, FOUND TWO POTENTIAL STEAM CUSTOMERS, VALLEYDALE PACKERS, INC. AND MOHAWK RUBBER COMPANY. THE STEAM DEMAND AND ITS CONSISTANCY WERE ANALYSED FOR BOTH COMPANIES; MOHAWK RUBBER COMPANY WAS THE LOGICAL CUSTOMER BECAUSE OF THE STEADY DEMAND FOR STEAM. AFTER SEVERAL MEETINGS, A TWENTY-YEAR CONTRACT WAS NEGOTIATED TO SELL ALL OF THE CITY'S STEAM PRODUCTION TO MOHAWK CALCULATED ON THE COST OF GAS OR NO. 2 FUEL OIL. THIS SALE OF STEAM WILL ULTIMATELY REDUCE THE COST OF DISPOSAL TO, OR LESS THAN, THAT OF OPERATING AN APPROVED PERMITTED LANDFILL.

SO, WHAT DO WE HAVE AND HOW DOES IT WORK? I SHALL TRY TO EXPLAIN THE PROCESS AS BEST I UNDERSTAND IT SINCE MY BACKGROUND AND TRAINING ARE NOT ENGINEERING.

THE INCINERATOR DESIGN IS BASED ON CONTROLLED AIR COMBUSTION PRINCIPLES. THE UNITS ARE ENGINEERED, PRE-PACKAGED SYSTEMS WHICH ARE MODULAR IN CONSTRUCTION. THE EQUIPMENT IS NOT SUBJECT TO THE PERFORMANCE LIMITATIONS IMPOSED BY CONVENTIONAL (OR EXCESS AIR) INCINERATION SYSTEM.
THE SYSTEM EMPLOYS TWO CHAMBERS TO ACCOMPLISH THE CONTROLLED AIR INCINERATION PROCESS. THESE CHAMBERS ARE DESIGNATED LOWER, OR PRIMARY, AND UPPER, OR SECONDARY. THE PERFORMANCE OF THE ANTI-POLLUTION FEATURES OF THE SYSTEM DEPEND ON CONTROLLING THE CONDITIONS IN THESE TWO CHAMBERS. THE LOWER CHAMBER IS REQUIRED TO OPERATE AT LOW INTERIOR GAS VELOCITIES AND UNDER CONTROLLED TEMPERATURE CONDITIONS. THIS IS DONE BY LIMITING THE AIR INTRODUCED INTO THE PRIMARY CHAMBER TO LESS THAN REQUIRED FOR COMPLETE COMBUSTION. (HENCE, THE SYSTEM IS SOMETIMES CALLED, "STARVED-AIR INCINERATION"). THIS GIVES THE LOWER CHAMBER THE OPERATING CHARACTERISTICS OF A PARTIAL OXIDATION SYSTEM. THE HEAT RELEASE IN THE LOWER CHAMBER IS SUFFICIENT TO SELF-SUSTAIN THE PARTIAL OXIDATION REACTIONS. THE GASES FROM THE LOWER CHAMBER, WHICH WILL INCLUDE VARIOUS PYROLYTIC AND OSIDATIVE COMPOUNDS, PASS INTO THE UPPER CHAMBER THROUGH A TURBULENT MIXING ZONE WHERE IGNITION TAKES PLACE AND ADDITIONAL AIR IS ADDED TO COMPLETE THE OXIDATION REACTIONS.

THE TWO CHAMBER-CONTROLLED AIR DESIGN OF THESE INCINERATORS IS INHERENTLY NON-POLLUTING. NO SPECIAL SCRUBBERS, PRECIPITATORS, OR OTHER AIR POLLUTION CONTROL DEVICES ARE REQUIRED. THESE INCINERATORS ARE IN CONFORMANCE WITH THE REQUIREMENTS OF THE VIRGINIA STATE AIR POLLUTION CONTROL BOARD AND THE U.S. ENVIRONMENTAL PROTECTION AGENCY. THE SOLID RESIDUE OR ASH FROM THIS SYSTEM IS INERT, STERILE, ODORLESS, AND NON-PUTRESCIBLE. IT IS EASILY AND SAFELY DISPOSED OF IN A NON-ORGANIC LANDFILL.
ONLY MINOR ODORS ARE ASSOCIATED WITH THIS TYPE OF FACILITY AND THESE ARE CONFINED TO THE INCINERATOR BUILDING. AS A PILE OF RAW GARBAGE ON THE TIPPING FLOOR IS CONSUMED, THE REMAINS ARE SWEPT UP AND, AS NEEDED, THE FLOOR IS HOSED DOWN. ONLY VERY RARELY WILL ANY GARBAGE REMAIN ON THE TIPPING FLOOR MORE THAN THREE DAYS. THE ASH IS SUBMERGED IN WATER BEFORE EXPOSURE TO THE AIR AND HAS NO DUSTING OR SMOKING POTENTIAL.

A MINIMUM OF 4,800 POUNDS OF STEAM IS PRODUCED FROM EACH TON OF GARBAGE. THE NET HEATING VALUE OF GARBAGE IS ESTIMATED TO BE 4,200 TO 4,500 BTU'S PER POUND. THE OPERATION OF THIS FACILITY AT FULL CAPACITY WILL SAVE 174 MILLION CUBIC FEET OF NATURAL GAS OR ITS FUEL OIL EQUIVALENT PER YEAR. THE PRESENT PLANT'S CAPACITY IS 480,000 POUNDS PER DAY (20,000 POUNDS PER HOUR) OF SATURATED STEAM AT A PRESSURE OF 250 POUNDS PER SQUARE INCH OR 100 TONS PER DAY OF SOLID WASTE. SPACE IS AVAILABLE WITHIN THE INCINERATOR BUILDING FOR FUTURE ADDITIONAL INCINERATORS AND BOILER TO GIVE A TOTAL BURNING CAPACITY OF 150 TONS PER DAY AND A TOTAL STEAM PRODUCTION CAPACITY OF 720,000 POUNDS PER DAY. ALL AUXILIARY FACILITIES SUCH AS WATER SOFTENERS, STEAM MAINS, STEAM AUXILIARIES, AND AIR COMPRESSOR WERE SIZED FOR ULTIMATE CAPACITY.

THIS IS THE FIRST FACILITY OF ITS TYPE ON THE EAST COAST AND PROVIDES SALEM'S CITIZENS, INDUSTRIES AND BUSINESSES WITH AN ENVIRONMENTALLY SAFE, LOW COST DISPOSAL SYSTEM FOR SOLID WASTES AND AT THE SAME TIME HELPS CONSERVE A VALUABLE NATIONAL RESOURCE -- NATURAL GAS.
HAVE WE ACCOMPLISHED WHAT WE SET OUT TO DO? IT IS EARLY IN THE GAME TO REALLY DETERMINE IF ALL THE GOALS WILL BE MET. IN ANY OPERATION INVOLVING MECHANICAL EQUIPMENT WHICH IS BASICALLY AUTOMATED, THERE WILL BE MAINTENANCE PROBLEMS AND WE HAVE HAD OUR SHARE. THE PLANT WAS DESIGNED TO OPERATE 24 HOURS PER DAY, 5 DAYS A WEEK. TO DATE, WE HAVE NOT HAD A FULL MONTH'S OPERATION WITHOUT SOME PROBLEM. THESE PROBLEMS HAVE BEEN SOLVED AS THEY HAVE OCCURRED AND I AM SURE THAT WE WILL HAVE OTHERS AS TIME PASSES. IN MY OPINION, SOME OF OUR PROBLEMS WERE PERSONNEL PROBLEMS WHICH I FEEL HAVE NOW BEEN CONQUERED. SOME OF THE PROBLEMS WERE MECHANICAL FAILURES, SUCH AS: A COMPRESSOR BLOWING UP, BEARINGS FAILING, HYDRAULIC LINE RUPTURES AND SIMILAR OCCURRENCES. HOWEVER, HAVING THE FACTORY IN MECHANICSVILLE HAS FACILITATED REPAIR.

THE REASON THE LOW BID WAS NOT ACCEPTED WAS BASED ON THE EXCEPTION TAKEN TO THE AMOUNT OF AUXILIARY FUEL NECESSARY TO RUN THE SYSTEM. TWO BIDS WERE RECEIVED AND THE TWO EQUIPMENT MANUFACTURERS REPRESENTED WERE: CONSUMAT SYSTEMS, INC. AND ENVIRONMENTAL CONTROL PRODUCTS, INC. THE LOW BID WAS APPROXIMATELY $110,000 LESS: HOWEVER, IF THE EXCEPTION WAS TAKEN AT FACE VALUE, THE ADDITIONAL COST OF AUXILIARY FUEL OVER 20 YEARS WOULD BE APPROXIMATELY ONE MILLION DOLLARS. SALEM'S FINAL INVESTMENT IN THE FACILITY, INCLUDING $349,000 OF E.D.A. FUNDS, IS APPROXIMATELY TWO MILLION DOLLARS.

EVEN WITHOUT FULL OPERATION IT IS INTERESTING TO LOOK AT WHAT WAS DONE. IN JANUARY, FEBRUARY AND MARCH, ACCORDING TO MOHAWK RUBBER COMPANY'S RECORDS, A TOTAL OF 9.1 MILLION CUBIC FEET OF NATURAL GAS WAS SAVED. DURING THE SAME PERIOD THE DISPOSAL PLANT CONSUMED 1.8 MILLION CUBIC FEET FOR A NET SAVINGS OF 7.3 MILLION CUBIC FEET OF GAS. ACCORDING TO ROANOKE GAS COMPANY, AN AVERAGE 2 BEDROOM RANCH HOUSE BUILT TO TODAY'S STANDARDS, WILL CONSUME 80,000 CUBIC FEET OF GAS A YEAR TO HEAT IT. THEREFORE, IT APPEARS THAT WE HAVE MET ONE OF THE GOALS -- TO CONSERVE A NATURAL RESOURCE. IF WE ASSUME THAT THE ROANOKE GAS COMPANY'S ESTIMATE IS CORRECT, THEN ENOUGH NATURAL GAS WAS SAVED IN THREE MONTHS PARTIAL OPERATION TO HEAT 90 HOMES FOR ONE YEAR. SHOULD WE BE ABLE TO REACH FULL CAPACITY, THEN ENOUGH NATURAL GAS TO HEAT 2,175 HOMES WILL BE SAVED. THERE ARE SOME SLIDES FOR YOUR REVIEW IF YOU WISH AND THEN I WILL ANSWER ANY QUESTIONS YOU MAY HAVE.
Use of Trash to Make Energy Urged for Va.

By DAVID LOWERY

"I think everyone, somewhere down the road, has to realize we can't keep buying this stuff. The environmentalists are going to make us stop."

The "stuff" Del. J. Paul Councell Jr., referred to is solid waste — less euphemistically, garbage.

The Virginia Coal and Energy Commission today was told that garbage disposal in the commonwealth is expensive and increasingly subject to federal regulations and has risky and costly alternatives.

The commission heard testimony concerning one of those alternatives — resource recovery systems, the use of trash as a form of energy.

EVEN MORE EXPENSIVE

However, resource recovery is even more expensive than landfills or incineration, both now under strict federal laws that are getting stricter.

"It's not cheap," explained Charlotte Ryan, an official with the U.S. Department of Energy. "It's remarkable if you can pull off a system that is as cheap as the current cost of disposal."

One of the more efficient resource recovery operations in the United States is the Salem municipal system.

Salem City Manager William J. Paxton said the plant cost $2 million to build and last year cost $179,000 in taxpayer money to operate. The plant burns garbage to produce steam which is sold to the adjacent Mohawk Rubber Co., he said.

But even Paxton said there are problems with the Salem system. Maintenance problems have persisted, he told the energy commission members, and disposal of the ash residue has not been solved.

Commission Chairman Sen. J. Harry Michael asked Paxton what the general assembly could do to promote such efficient resource recovery in Virginia.

INITIAL COST CITED

Paxton explained that the scariest part of any resource recovery system is the initial cost of building the highly technological plants. The bigger the systems, he said, the more expensive the technology becomes.

Paxton suggested that the state consider direct grants to areas interested in resource recovery or tax breaks for private industries that develop their own trash disposal systems.

Dr. Robert R. testin, chairman of the Virginia Solid Waste Commission, suggested to the energy panel that Virginia consider sharing the risk with any locality that wishes to build a resource recovery plant.

Dr. Testin said the risk-sharing plan could be operated through full-faith-and-credit revenue bonds issued by the commonwealth.

Dr. Testin, a general manager for Reynolds Metals Co., Inc., said the assembly should beef up the enforcement division of the State Health Department, which is saddled with the task of inspecting landfills in Virginia for compliance with state law.

Dr. Testin said a new federal law that goes into effect in January will make it much more difficult for localities to dispose of trash in landfills. He said most of the existing landfills today would not comply under the new federal statute.

But such laws are likely to move communities toward consideration of resource recovery plants because of the cost of new landfills and because the restrictive laws that will apply to them, he added.

Currently, Virginia awards to each city and county $2,500, plug a nickel per capita to help ensure local compliance with state laws on solid waste disposal.

Such a small amount of money, though, will not propel very many localities to consider the expensive and risky resource recovery operations.

However, Dr. Testin said, it is a beginning and the state probably should consider other forms of financing to allow cities and counties to embrace resource recovery for the future.
Can low-head hydro

Robert Smock
Senior Editor

The two-year old drive to revitalize electrical production from small, low-head hydroelectric facilities in the U.S. is in danger of losing momentum. The effort was launched by President Carter with considerable fanfare in his original National Energy Plan in early 1977. A widely publicized study issued by the U.S.Arm Corps of Engineers in July, 1977 intensified interest by identifying a potential for adding 5,000 MW of electrical generating capacity at existing dam sites, half as small dams. The ball was kept rolling by the U.S. Dept. of Energy which helped pay for engineering studies and promised to help pay for hundreds of millions of dollars of hydro construction. It began to look as though small low-head hydro was one of the few renewable energy sources that might be able to make a significant, near-term contribution to the energy crisis.

In recent months, however, the outlook has dimmed. The problem, as with just about all the alternate forms of energy, is cost. Many of the economic feasibility studies just now being completed are showing that small, low-head hydro is so expensive to build that it can't compete with oil-fired generation on a cost basis. The Carter Administration, under intense pressure to balance the budget, has apparently reneged on the commitment to spend hundreds of millions on hydro construction. The federal government is looking to potential users of hydro energy to carry the ball, while private companies and local government units wait for federal help.

The 56 feasibility studies

The focal point of the endangered small hydro effort is the DOE program, particularly a group of 56 feasibility studies. In April of 1978 DOE announced that it would contribute nearly $3 million to 56 studies of the feasibility of installing hydro generators at existing dams. The projects were small — meaning less than five megawatts — and low head — meaning less than 50-ft high dams. The projects were located in 30 different states and the studies were done largely by public bodies such as municipal governments, although a few privately owned utilities participated. Small hydro advocates eagerly awaited the results. The studies, it was hoped, would prove that small, low-head hydro was a viable technology. They would show the skeptics who felt that small hydro was an outdated, 19th century concept that they were wrong. Unfortunately, it didn't quite work out that way.

Results were announced this spring. Farewell Smith, a DOE official in the small hydro program, says, "It's quite difficult to determine what we've got here. About one-quarter of the projects will definitely go ahead they're so promising. Another quarter definitely won't. The rest I don't know."

Does this mean that only one-fourth of the most promising sites are viable? Were these studies the cream of the crop?

That's not so, says Smith. The 56 studies were chosen from a total of 224 proposals. DOE did not pick the most promising 56, Smith explains. Selections were made in a "vast" number of categories such as projects sponsored by Indian tribes, projects in specific geographic areas, and very low head projects. DOE picked the most likely proposals in each category, meaning that a project ranking high in one category may have been less promising than a low-ranking, rejected project in another, more competitive category.

That may explain why there were so many losers in the group, but it doesn't mollify chagrined small hydro advocates. At a recent seminar sponsored by the University of Wisconsin's Milwaukee Extension, Warner Wayne, chief hydraulic engineer for Stone & Webster and a leading spokesman for small hydro development, said, "Some of those studies..."

DOE eyes hydrogen storage system for low-head dams

It's been suggested that energy produced at rehabilitated low-head hydro sites be used to electrolyze water to produce hydrogen. DOE funded studies done by the Institute of Gas Technology and the Pennsylvania Gas and Water Co. showed that, although quite costly, the technology has some promise.

The most attractive aspect is that "merchandise" hydrogen — hydrogen used as a chemical feedstock — is worth the equivalent of $50 a million Btu. Since this hydrogen is currently made from natural gas, development of hydrogen produced would conserve a non-renewable resource.

Another reported advantage of hydrogen production, rather than electrical production, from small dams is that distribution problems are simpler. Interfacing low-voltage electrical output from a remote dam site often poses an unsolvable problem. Electric utilities. Hydrogen, on the other hand, can be blended into an existing natural gas pipeline (up to 10 percent, according to the DOE study) or it can be stored for later shipment to industry.

As mentioned, the major obstacle is cost. Even by assuming that 85 percent efficient electrolyzers costing half as much as existing types will be developed, the DOE study found that hydrogen cost would range from $5 to $10 per million Btu, too expensive as a fuel.

However, since it does have promise as a feedstock, DOE has decided to proceed with technology development. The agency recently commissioned the New York State Energy Research and Development Authority to design a system that could be installed at an existing hydroelectric site near Potsdam, New York. The site would be rehabs to produce 70 kw of electrical power, half for direct use by municipal facilities and about 20 kw for production of hydrogen to be sold.

Another contract was signed with Air Products and Chemicals, Inc. to design another dam-powered electrolysis system at an unspecified site.
never should have been done. Contracts were awarded on the basis of politics. As a result, he added, "the present program has turned out to be somewhat disastrous. Studies were made on sites that didn't have a chance of being used. I have told them that with the studies.

Seminar participants were also unhappy about the loss of federal construction money. The lure of several hundred million dollars from Uncle Sam spurred a lot of interest in hydro two years ago.

Richard McDonald, manager of DOE's small hydro program, explains what happened. Originally, $500 million was authorized for spending on hydro projects in 1973. The authorization came too late for spending in 1973, so McDonald said. Then he added, DOE did not request construction money for 1974.

What does that mean? ELF asked McDonald. Why the abrupt shift? "That's a long story," the official said. I can only say that right now there are no plans for additional construction money in DOE." McDonald's small hydro program is in DOE's Office of Resources Application. That's the branch of the DOE bureaucracy that deals with technologies that are supposedly well under way for commercialization, technologies that only need a little nudge, a little RL&D to get to the potential users of the technology to start paying for development themselves.

"My own personal view," McDonald adds, "is that DOE's proper role is research, design, and development. The benefits from building these projects flow to local users and it may not be appropriate for DOE to be paying for construction." That doesn't mean that DOE isn't supporting any small hydro construction. The highlight of the DOE effort right now is a joint venture with the city of Idaho Falls, Idaho, to rebuild three plants on the Snake River that were badly damaged in the Tetons. Total cost is $67 million. Power output will be boosted from 8 MW to 22 MW.

Last February, DOE announced that it would spend $7 million to pay for 75 percent of the cost of small hydro projects at existing dams. Another round of shared construction cost demonstration projects in the works. This time DOE will contribute a total of $5 million for a 15 percent of the cost of projects up to $35 million in size.

The major emphasis will be on demonstrating feasibility. DOE will share the cost of engineering studies with possible site developers. DOE will devote $10 million to these studies in a "forgivable loan" program. If a particular study shows a project is feasible, it has to be built and generate revenue, then the loan will be repaid from the proceeds. If the study shows the site isn't feasible, the loan will be forgiven.

So, where does this leave small, low-head hydro? It looks like DOE will keep interesting in the feasibility studies by contributing a little to feasibility studies and construction as a few of product promotion for Allis-Chalmers' Hydro-Turbine Div. James Ramer, a project manager with the Corps of Engineers, told how he found the potential for a total of 1500 MW in small, low-head hydro sites, but the federal agency isn't going to subsidize low-head hydro. It expects private industry and other agencies to carry on the development.

At the U of Wisconsin seminar, speaker after speaker talked about the difficulty in justifying small, low-head hydro projects on an economic basis. "The economics of low-head hydro have been marginal, particularly for the smaller installations," said Howard Mayo, manager of product promotion for Allis-Chalmers' Hydro-Turbine Div. James Ramer, a project manager with the Corps of Engineers, told how he found the potential for a total of 1500 MW in small, low-head hydro sites, but the federal agency isn't going to subsidize low-head hydro. It expects private industry and other agencies to carry on the development.

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One of the roadblocks to small hydro development, as with virtually all energy projects, is regulatory. Unlike in the public utility regulatory policies act of 1978, the Federal Energy Regulatory Committee has already slashed some requirements for getting a small hydro license. Even FERC officials admit it needed streamlining. The FERC system, according to Ronald Cobb, deputy chief, division of licensed projects, "is an overly involved and lengthy process." However, recent changes, he claims, will reduce licensing time from the current 12 to 24 months down to as little as three months.

In a three-step reform, FERC initiates a "short-form" process last fall that simplifies licensing for larger projects at existing dams. Step two, taken this last spring, eased requirements for larger projects at existing dam sites. The final step will be to reform requirements for projects quitting new dam construction. FERC explains that the previous requirements for those licenses were described in 12 itemized paragraphs in the regulations and in as many as 23 exhibits. The new regulations have only a brief initial statement and seven exhibits. "This reduction," says the agency, "is accomplished by eliminating unnecessary requests for information, consolidating and organizing requirements according to related subject matter, and reducing the requirements, where possible, to simple objective descriptions of what is desired.

hydro? The reason is that on paper it makes a lot of sense. It is particularly appealing when you consider the potential for small hydro at existing dam sites. Use of an existing dam


tential in the face of our current energy dilemma. Not only is this approach attractive to those who are fervently searching for the so-called "cleaner" and more appropriate technologies based on renewable energy resources; it also represents a means by which these resources can be utilized without conflict with existing power supplies.

Low-head technology advocate Norman H. Lapp says that these higher initial investment costs make the technology "marginally feasible" right now, on a cost basis, but he feels that raising initial costs would make it competitive. "Where low-head hydro can be developed and managed systematically to supply peak power, as may be possible, for instance, on irrigation systems in areas where the irrigation season coincides with the seasonal peaks in electric demand, the primary reason for its use is the alternative cost of constructing and operating oil and gas fired peaking units. The cost projected for 1965 units will probably be in the range of 70 to 120 mills per kilowatt-hour."

Review of feasibility on selected projects which can be assumed to be reasonably typical would seem to indicate that low-head development with capital costs ranging from $700 to $2500 per kilowatt of capacity, carrying costs of 8 percent over a 30-year period, and capable of achieving a plant factor of 50 percent, can produce energy at costs ranging from 20 to 40 mills per kilowatt-hour. This looks pretty good compared to oil-fired capacity at 120 mills in 1985.

There is no question that this promise has sparked a substantial renewal of interest in small-scale hydro since publication of the Corps of Engineers study. As an indicator, reported Ronald C. Corso, an official with the Federal Energy Regulatory Commission, at last winter's Energy Technology Conference, 170 applications for hydro development were filed with FERC in the eight-year period prior to September, 1977. The next 101 applications were received in the next year and four months. Another indicator reported by Corso is the number of small hydro installations in the nation. Of the 71 now pending, 57 involve the use of existing dams, and 40 are for small-scale projects.

To get a better understanding of this trend, let's look at some of the projects that are being planned.

Rebuilding at Green Mt. Power

One of the seven demonstration projects in DOE's low hydro program is Green Mountain Power Co.'s Bostwick Falls Dam on Vermont's Winooski River. The dam and original powerhouse were built in 1936, dammed in a flood in 1947, rebuilt, then abandoned in 1958. The dam has suffered superficial wear and tear, as shown in the photo, but it's still there.
and is structurally sound. It's an ideal site for demonstrating the viability of refurbishing existing dams, according to Green Mountain Power.

The plan is to build a new powerhouse capable of generating 6.6 MW. The 41-ft high dam will be repaired and raised by adding a four-foot concrete apron and five-foot flashboards. The utility calculates that the firm flow (occurring 95 percent of the time) during the peak demand period (December through January) is sufficient to produce 6.5 MW six hours a day, five days a week. Average annual capacity factor is estimated to be 49 percent.

Installation cost is estimated to be $905 per kw, for a total of $5.89 million (of which DOE is paying one-fourth). Levelized operation and maintenance cost will be about $150,000 per year. Levelized production cost per kilowatt hour is estimated to be 43.2 mills per kw. A comparison of these costs with the alternative costs of gas turbine, combined cycle, and coal-fired capacity is shown in Table 6. The result is a benefit-to-cost ratio for the hydropower plant ranging from 1.55 to 1.65.

"We've felled all along that Bolton Falls presents an excellent opportunity to determine, if redevelopment of low-head hydropower sites is economically practical in the Northeast," says utility vice president, John Cleary, "and we're very pleased that DOE shares our enthusiasm."

Another project in the DOE is $250,000 per kw. Plant factor is about 57 percent. These three projects are good examples of small-scale hydro sites with refurbishing costs low enough to provide a favorable benefit-to-cost ratio. Unfortunately, it's beginning to look as though most of the potential sites don't enjoy that advantage. Developers are finding it hard to justify the high initial expense, even at sites with usable dams.

In the absence of federal subsidies, the growth of small-scale, low-head hydro depends largely upon the future price of fossil fuels, or the expected future price. For the time being, the technology is definitely being revived and a handful of the most promising projects is being developed. If the price of oil continues to skyrocket, the trend toward low-head hydro could readily develop into a boom.

**TABLE 3**

<table>
<thead>
<tr>
<th>Hydroelectric Capacity at Existing Dams</th>
<th>Capacity (Millions of KW)</th>
<th>Generation (Billions of KWH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developed</td>
<td>67.0</td>
<td>271.0</td>
</tr>
<tr>
<td>Under construction</td>
<td>8.2</td>
<td>16.8</td>
</tr>
<tr>
<td>Total installed</td>
<td>65.2</td>
<td>287.8</td>
</tr>
<tr>
<td>Potential rehabilitation of existing hydropower</td>
<td>6.1</td>
<td>24.4</td>
</tr>
<tr>
<td>Potential expansion of existing hydropower</td>
<td>15.0</td>
<td>20.9</td>
</tr>
<tr>
<td>Potential at existing non-hydro dam greater than 5,000 kw</td>
<td>7.0</td>
<td>20.4</td>
</tr>
<tr>
<td>Potential at existing non-hydro dam less than 5,000 kw</td>
<td>26.6</td>
<td>84.7</td>
</tr>
<tr>
<td>Total</td>
<td>119.2</td>
<td>447.1</td>
</tr>
</tbody>
</table>


**TABLE 4**

| Economic Data - Bolton Falls Dam Project (Levelized 1979 Dollars) |
|------------------------|------------------------|
|                         | Gas Turbine | Combined Cycle | Coal |
| Project Annual Cost    | $1,116,000 | $1,116,000 | $1,116,000 |
| Annual Debt            | 140,000     | 140,000       | 140,000     |
| Total                  | $1,256,000      | $1,256,000 | $1,256,000 |
| Annual Benefit         | $245,000    | $245,000     |
| Fuel @ 7.22 MW/yr     | 2,056,000   | 2,056,000    |
| Operation and Maintenance | 45,000   | 45,000        |
| Total                  | $2,314,000     | $2,314,000    |
| Capacity @ 50% of KW/hr | 322,000     | 322,000        |
| Fuel @ 80 KWH/MW/yr/hr | 1,406,000   | 1,406,000     |
| Operation and Maintenance | 101,000   | 101,000        |
| Total                  | $1,939,000     | $1,939,000    |
| Capacity @ $124,500/KW | 812,000     |
| Fuel @ 52 MW/yr/hr     | 902,500     |
| Operation and Maintenance | 274,000   |
| Total                  | $2,088,500     |
| Annual Benefit-Cost Ratio | 1.83        | 1.83          | 1.83  |

Source: Gilchrist Commonwealth's feasibility study.

Although it would seem that small-scale, low-head hydro power would be particularly attractive in New England, it isn't, according to J.W. Leslie, of the Boston consulting firm, Charles T. Main, Inc. In a paper presented at the IEEE's Winter Power Meeting, Leslie said that virtually no new hydro capacity is planned in the region.

New England appears to be a natural for low-head hydro for two reasons: its heavy dependence on expensive, imported oil and the large number of old dam sites. It's been estimated that there are 9000 old dam sites, according to Leslie.

However, he said that NEPOOL, the association of New England electric utilities, plans almost no increase in hydro capacity of any size over the next 10 years. "The prospects for major implementation of the hydropower potential in New England, both conventional and/or pumped storage, seem limited at this time. Federal sponsorship by responsible agencies is lacking, influenced by financial criteria and environmental conflicts. Investor owned utilities evidence no intent. The restoration of new small dams has eluded commitment for a few small developers to reactivate a few." Lesie added that even if all the old dams that could practically be refurbished were refurbished the total new generating capacity, at an average of 250 kw per site, would only be 500 or 600 Mw.
PROPOSALS FOR APPROPRIATE ENERGY LEGISLATION

Presented to the Coal and Energy Commission

Ferrum College August 14, 1979

1. Tax Credits

   Residential

   The installation of appropriate energy equipment in private homes will entitle the owner to a credit on the Virginia state income tax equal to 25% of the capital cost of the system. The maximum tax credit will be $2500 on a $10,000 system and will carry over into subsequent tax years until full credit has been realized. If not fully utilized by original installer, the credit will pass on to subsequent transferees. This credit will be active for all systems installed after January 1, 1980, and will expire unless renewed before December 31, 1984. Appropriate energy systems are briefly defined here as active solar, passive solar, (as determined in Va. Solar energy criteria for tax exemption, (Oct. 1978) wind systems, hydroelectric, conservation efforts, and bio-conversion excluding wood stoves.

   Business

   The installation of appropriate energy systems in the industrial, commercial and agricultural sectors will entitle the owners to a Virginia tax credit equal to 25% of the capital cost of the system. Appropriate energy systems are defined as in "Residential Tax Credits" list and also include waste heat recovery, and improvements in the efficiency of existing equipment. Limitations on this credit in terms of time and cost are the same as in "Residential Tax Credits."

2. Renewable Energy Disincentives

   There should be established a study resolution to identify and regulatory
or legal disincentives to the use of renewable energy and conservation, such as building codes, and zoning ordinances. This study should target those disincentives most obstructing, and identify strategies for correcting action.

3. On public building considerations will be given to life cycle costing and the requirement of at least one renewable energy bid for new construction.

4. Solar Energy Center
The Solar Energy Center, established out of House Bill No. 1451, will be seed funded so the law will be amended to read, "The intent of the General Assembly is to provide an organization for the purposes set out in this act and to receive $1.1 million of State funds for a two year period for these purposes." The duties of the center will be to promote renewable energy in Virginia, to coordinate Federal, State, and Local programs, and shall be assisted in this task by a voluntary citizen advisory commission chosen from a list submitted by the appropriate energy community.

5. Commission Representation
Two persons from the solar appropriate technology community with technical expertise and selected from a list submitted by representative of the appropriate energy industry will sit on the Coal and Energy Commission.

6. Use of Renewable Energy Systems
There should be established a study resolution to determine the feasibility of requiring all state funded building construction to utilize conservation and renewable energy systems when competitive with conventional sources, as required in similar federal statutes.

Presented to the Coal and Energy Commission
Ferrum College August 14, 1979
Rough Draft-Presentation of Tax Credits Cost To Coal and Energy Commission

The DOE and VSC this summer surveyed the Commonwealth for solar and appropriate technology projects. As detailed in the August 14th 1979 presentation to the Coal and Energy Commission, that survey estimates that 2000 appropriate energy projects in Virginia save almost $1 2 million of energy each year. When considering any incentive legislation, it would be useful to project the anticipated cost in Virginia revenues against the expected savings in energy and new jobs generated.

It is difficult to anticipate the future growth of renewable energy capacity in Virginia exactly, but a ceiling for the most optimal case can be readily examined. This case can detail a maximum cost to state revenues. Such an optimistic treatment would see an annual doubling in the number of appropriate technology projects in the state during the life of the proposed tax credit bill. The VSC, in a more conservative assessment, believes a doubling time of 2 years is most appropriate. This means in 4 years, legislative encouragement, the number of projects would grow at most from 2000 to 22,000.

Based on historical trends the VSC has determined that of the 20,000 projects covered by the proposed tax bill, conservation would be by far the most utilized, and 50% of the credits claimed would fall in this category. We estimate 35% would be applied for domestic solar hot water (DHW) installation, and 15% would go for other projects such as active solar, wind etc. The average cost for maximal conservation efforts and weatherstripping are around
$500/project, solar DHW is $2000/project, and the maximum tax credit for larger applications is $10,000/project. The cost per project then to Commonwealth funds with a 25% credit is $125 for conservation, $500 for DHW, and $2500 for the maximum projects of any type.

Table I shows the high case growth in each category on a year by year basis.

Table I - High Case Growth of Appropriate Technology in Virginia 1980 - 1983

<table>
<thead>
<tr>
<th>Year</th>
<th>Total #</th>
<th>Total New # Projects</th>
<th>New # Conservation Projects/Year</th>
<th>New # Solar Domestic Hot Water/Yr.</th>
<th>Other New # Renewable Energy Projects/Yr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980</td>
<td>4,000</td>
<td>2000</td>
<td>1000</td>
<td>700</td>
<td>300</td>
</tr>
<tr>
<td>1981</td>
<td>8,000</td>
<td>4000</td>
<td>2000</td>
<td>1400</td>
<td>600</td>
</tr>
<tr>
<td>1982</td>
<td>14,000</td>
<td>6000</td>
<td>3000</td>
<td>2100</td>
<td>900</td>
</tr>
<tr>
<td>1983</td>
<td>22,000</td>
<td>8000</td>
<td>4000</td>
<td>2800</td>
<td>1200</td>
</tr>
</tbody>
</table>

Because the limit on how much these tax credits can draw on state monies each year is determined by the individuals' total state tax bill, we anticipate $500/year will be the average demand, or 20% of the maximum $2500 credit. In this case, it would take 5 years for an individual to fully utilize the maximum benefit of the proposed tax, although we do assume conservation and DHW will utilize the full credit in one year. Therefore because of the 5 year utilization period the real impact on the state will be spread over a 8 year span, even though the credit applies only to projects built from 1980-83. We also project that due to publicity problems, lag time, etc., only 50% of the projects will actually utilize the
credit.

With these assumptions, Table II shows the impact on the state on a year by year basis.

Table II - Yearly Cost in State Revenues of Solar Tax Credit Bills

(Assumptions Outlined in Text)

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Cost</th>
<th>Cost For Conservation Projects</th>
<th>Cost For Solar DHW</th>
<th>Cost For Other RE Projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980</td>
<td>$317,500</td>
<td>67,500</td>
<td>175,000</td>
<td>75,000</td>
</tr>
<tr>
<td>1981</td>
<td>700,000</td>
<td>125,000</td>
<td>350,000</td>
<td>225,000</td>
</tr>
<tr>
<td>1982</td>
<td>1,162,000</td>
<td>187,500</td>
<td>525,000</td>
<td>450,000</td>
</tr>
<tr>
<td>1983</td>
<td>1,700,000</td>
<td>250,000</td>
<td>700,000</td>
<td>750,000</td>
</tr>
<tr>
<td>1984</td>
<td>750,000</td>
<td>---</td>
<td>---</td>
<td>750,000</td>
</tr>
<tr>
<td>1985</td>
<td>675,000</td>
<td>---</td>
<td>---</td>
<td>675,000</td>
</tr>
<tr>
<td>1986</td>
<td>525,000</td>
<td>---</td>
<td>---</td>
<td>525,000</td>
</tr>
<tr>
<td>1987</td>
<td>300,000</td>
<td>---</td>
<td>---</td>
<td>300,000</td>
</tr>
<tr>
<td>Total</td>
<td>$6,130,000</td>
<td>625,000</td>
<td>1,750,000</td>
<td>3,750,000</td>
</tr>
</tbody>
</table>

At $500/Project, or $125 From State Tax Receipts, $2000/Project, or $2500 From State Receipts, $10,000/Project, or $2500 From State Receipts.

As projected, the tax credit bills will cost a total of $6,130,000 over a 8 year period, with the least draw of around $300,000 in both 1980 and 1988, and a peak expenditure of $1,700,000 in 1983.

Balanced against this investment is the potential energy savings and the new jobs generated by the growth of the industry. Based on an average savings per project of $700/year, Table III shows the expected savings in energy over the 8 year span of just those encouraged by the bill in its 1980-1983 lifetime. It can be
Table III - Yearly Energy Savings in $ From Tax Credit Bills

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount Saved (in Millions $)</td>
<td>2.5</td>
<td>5</td>
<td>8.75</td>
<td>13.75</td>
<td>13.75</td>
<td>13.75</td>
<td>13.75</td>
<td>13.75</td>
<td>85</td>
</tr>
</tbody>
</table>

seen that nearly $85,000,000 can be saved by Virginians through the 6 million dollar state incentive, the equivalent of around 1.8 billion kilowatt hours, or $4 billion barrels of oil @ $20/barrel.

The Ford Foundation in its 1977 ENERGY POLICY PROJECT found that there is one job generated by every $3000 spent on conservation. The Dunlop study for the Long Island Dept. of Environmental Control, and reviewed by the U.S. Committee on Government Operations in its April 26, 1978 report, shows an additional job for each $4687 spent on solar. From these figures, we can calculate the impact of the industry growth shown in Table I @ 5528 jobs through the life of the bill. If the industry continues this growth on its own after the bill expires, then by 1988, when the last tax credit is paid off, this appropriate energy industry could employ as many as 22,000 additional persons, and have nearly $195 million of energy, with an additional $66.5 million each year even if growth leveled off.

Besides the energy savings and the indirect job-and-economy benefit, the state tax revenues from these 5528 jobs will exceed $2 million/year, directly offsetting even the 1983 peak expenditure of $1,700,000 with a 15% direct return on investment.
COAL AND ENERGY RESEARCH

A MANDATE FOR MEETING THE NEEDS OF VIRGINIANS

The Virginia Center for Coal and Energy Research

Annual Report

1978

Virginia Polytechnic Institute and State University
Virginia's Land-Grant University
Blacksburg, Virginia 24061
Introduction

This report is designed to provide information about the Virginia Center for Coal and Energy Research (VCCER) located at Virginia Polytechnic Institute and State University, Blacksburg, Virginia, to describe the mandated role of the VPI and SU Research Division, and to identify some of the energy research and extension activities taking place at Virginia Tech.

Energy Concerns

Between now and the turn of the century we'll consume as much energy in the U.S. as the nation has used during its entire history. And while making up but 6% of the world's population, we consume over 34% of the planet's total energy and mineral production. In fact, the average American uses more energy in just a few days than half the world's people consume on an individual basis in a year.

Here in the Commonwealth, for instance, Virginia drivers use some 3 billion gallons of gasoline a year. Virginians consume over 39 billion kilowatt hours of electricity in a year, and 10 million barrels of oil plus 48 billion cubic feet of natural gas in home heating.

Our nation--and this is true of the Commonwealth of Virginia--has developed with affluent use of energy through Federal controls on price and supply. But there are ever-increasing indications that we can't continue the growth rate in energy consumption of recent years without major changes in our energy supply, demand, and utilization patterns.

Clearly, our need for vast amounts of energy right here in Virginia creates a lot of problems. These involve the environment, the economy, and our social life. The solutions to these problems call for sensible choices of technological alternatives and the right kind of realignment of our energy priorities. Thus, one of the major functions of the Virginia Center for Coal and Energy Research is to provide the right kind of leadership in energy research and to provide the kind of climate in which sensible energy solutions can be developed.

Virginia Center for Coal and Energy Research

The Virginia Center for Coal and Energy Research was created by an Act of the General Assembly of Virginia on March 30, 1977 (Appendix A). The Board
of Visitors of Virginia Tech authorized the establishment of the Center July 27, 1977, and appointed the director (Appendix B).

A VCCER advisory committee (Appendix C) was appointed by the Board of Visitors on November 16, 1977, as required by statute, to advise on matters of the Commonwealth of Virginia utilizing the full capabilities of faculty, staff, and libraries for the benefit of Virginians and the expansion of knowledge pertaining to coal and energy research and development.

More specifically, however, there are a number of statutory duties and functions assigned the Center that more completely indicate or describe the complexity and the scope of its mandated role. These are:

1) To develop a degree program in energy production and conservation research at the master's level in conjunction with the State Council of Higher Education.

2) To develop and provide programs of continuing education and in-service training for persons who work in the field of coal or other energy research, development, or production.

3) To operate in conjunction with other departments of Virginia Tech including but not limited to the Department of Mining Engineering.

4) To conduct research in the fields of coal, coal utilization, migrating natural gases such as methane and propane, and other energy-related work.

5) To collect and maintain data on energy production, development and utilization.

6) To foster the utilization of research information, discoveries, and data.

7) To coordinate the functions of the Center with energy research facilities in order to prevent duplication of effort.

8) To apply for and accept grants from the United States government and the state government and agencies and instrumentalities thereof and from any other source in carrying out the purpose of this Act. To these ends, the Center shall have the power to comply with conditions and execute such agreements as may be necessary.

9) To accept gifts, bequests, and any other thing of value to be used for carrying out the purposes of this Act.

10) To receive, administer, and expend all funds and other assistance made available to the Center for the purposes of carrying out this Act.
11) To do all things necessary or convenient for the proper administration of this Act.

The duty and function for developing and implementing the interdisciplinary degree program called for in Item 1 was delegated to the College of Engineering by the Board of Visitors.

The Virginia Center for Coal and Energy Research reports to the University Provost. In order to assist the Director of the Center, an advisory cabinet was formed that includes the Deans of Engineering, Arts and Sciences, Research, and Extension, and a Technical Advisory Committee was appointed (Appendix D).

The strength of the Center depends on the constructive interaction between the problem-focused work of the Center and the components and related disciplinary activities of the academic departments. The primary resource for the work of the Center is the faculty, students (Appendix E), and staff (Appendix F) members whose talents and interests are stimulated by participation in Center programs.

During 1978, the Center has been involved in numerous activities. These include:
1) Research in energy modeling, coal science, solar heating and cooling, and industry modeling (See Appendix G).
2) A workshop in solar heating and cooling (314 attendees).
3) Extension activities on small dams and on coal combustion.
5) Grant and proposal preparation.
7) A Directory of Energy Expertise (120 entries).
8) A listing of energy related courses (Appendix J).
9) A list of publications (Appendix K).
10) A list of seminars (Appendix L).
11) Consultation with the Virginia Energy Office

The Commonwealth funded operating budget is shown in Appendix M.

The Director and Associate Director reported the work of VCCER to the Legislative Energy Study Commission on September 22, 1978 (Appendix N) and to the Legislative Commission on Coal and Energy Research on October 27, 1978 (Appendix P). An activity report of the assistant director of the Center indicating primary interdisciplinary projects started is included (Appendix Q).
In the following sections Energy Related Research and Extension Activities are described as a portion of the VCCER information dissemination function.

The VPI and SU Research Division

One of the most important factors directing research into the energy needs of the people of Virginia, as well as into the broad spectrum of other needs and concerns of the Commonwealth, is the ability of Virginia's land-grant university to translate its knowledge and techniques into meaningful applications and solutions to these problems, needs, and concerns. Virginia Tech, like other land-grant institutions, is in a special position to provide these functions as a result of the integrated mission of the university involving instruction, research, and extension.

To ensure the development of a comprehensive research program directed toward meeting the needs and concerns of Virginians, the Research Division was established at Virginia Tech by the General Assembly in 1966 encompassing the Virginia Agricultural Experiment Station and the Virginia Engineering Experiment Station. The responsibilities of the Division now include the Virginia Water Resources Research Center, the University Center for Environmental Studies, the University Industry Center, and the University Center for Systematics Collections.

According to the Code of Virginia (23-135.2) the Research Division is authorized to "conduct researches and investigations and to establish, publish, and distribute results in such forms as will tend to increase the economy, efficiency, and safety of the various enterprises and activities of interest to the State and the Nation, and to promote the conservation and economic utilization of its natural and human resources." This research mission is carried out under two major sub-programs: core research and sponsored research.

Core research involves a problem-focused effort with its goals and objectives derived from legislation which established the Division and subsequent legislation which established the Virginia Centers assigned to the Division. Core research funds come from the State general fund appropriations and from Federal appropriations earmarked for Virginia's land-grant University. Coal and energy research is funded through a core program.
Sponsored research funding is awarded through Federal Grants and contracts from business and industry, and various foundations. This funding is awarded through competition with other institutions on a project-by-project basis.

Energy Research at Virginia Tech

Energy research at Tech covers a wide range of topics and programs that bear directly upon the energy concerns of Virginians. These include, but are certainly not limited to, such areas as the chemical makeup of coal, the more efficient use of coal, finding ways of burning coal so as not to adversely affect the environment, seeking alternative sources of energy, such as solar and wind energy, and the development of a comprehensive energy modeling system. The following is a more detailed sampling of energy-related research at Tech:

1) "Searching for Geothermal Energy in the Southeastern U.S."

This research focuses on determining the location and availability of geothermal energy beneath the surface of the earth along the coastal areas of Virginia and North and South Carolina. Numerous drilling operations have been underway in an effort to obtain data on heat flow, heat production, chemical properties, etc., of this potential source of energy.

J. K. Costain (703) 961-5096
Geological Sciences

2) "Finding a Substitute for Petroleum-Based Raw Materials"

Many items supplied by our chemical industries require the use of petroleum-based raw materials in their manufacture. Rising prices for imported oil or oil embargoes could threaten U.S. chemical industry production and deny us many necessary manufactured items. Research at Tech is seeking ways of efficiently converting cellulose, which is found abundantly in nature, into glucose that in turn can be converted into a raw material vital to the nation's petrochemical industries.

R. D. Brown (703) 961-5040
Biochemistry and Nutrition

3) "Modeling of International Long Range Energy Development and Supplies"

This research has resulted in the development of a highly sophisticated long-range energy modeling system that provides energy
projections through the turn of the century, and encompasses all
the energy systems, such as supply, demand, transportation, utiliza-
tion, and exploration.

L. A. Rapoport (703) 961-6550
Geological Sciences (VCCER)

4) "Solar Heat Collector Evaluation"

This project combines testing, experimentation, and analyses
required to develop a solar collector and to carry out the per-
formance certification testing in accordance with accepted
standards.

W. C. Thomas (703) 961-6801
Mechanical Engineering

5) "Reducing Times Required to Refine Coal"

This research was directed at finding means of reducing the time
that coal would undergo a refining process in order to reduce the
number of impurities in it. The longer the coal is within the re-
fining process, the more costly it becomes. The research demon-
strated the feasibility of developing a method for reducing such
refining times.

G. H. Beyer (703) 961-6756
Chemical Engineering

6) "Methane in Unmineable Coal Beds as a Source of Natural Gas"

This research is directed at identifying unmineable coal beds that
could be a source for methane and natural gas. This would estab-
lish the basis for methane and natural gas recovery and the utiliza-
tion of methane as a vital industrial product.

J. R. Lucas (703) 961-6671
Mining and Minerals Engineering

7) "Application of Windmills to Apple Cooling and Storage"

This investigation focuses upon determining the feasibility of
using wind power for major agricultural or other rural energy use
such that a windmill-generator-refrigerator system uses a minimum
of additional external power through the use of short-term energy
storage facilities.

D. H. Vaughn (703) 961-5897
Agricultural Engineering
8) "Waste Systems as Solar Energy Reservoirs"

The objective of this research is on developing a procedure for collecting energy from the sun, storing it as heat in a reservoir, reducing heat loss from the reservoir back to the environment, and extracting the remaining energy from the reservoir with a heat pump for use in temperature control of livestock structures.

D. H. Vaughn (703) 961-5897
Agricultural Engineering

9) "Development of Energy-Saving Construction Material"

This research is directed at finding the right combination of concrete mixture, foaming agent, and a method of curing that will produce prefabricated building material with significant thermal insulation values, acceptable structural strength, and structural serviceability. Such material would greatly reduce the need for insulation and thus save energy.

R. A. Hechtman (703) 961-5531
Architecture and Environmental Design

10) "Survey of Small Scale Coal Combustion Devices"

The principal investigators are surveying the world for small-scale combustion devices (furnaces) either already in commercial use or in advanced stages of development. The scale devices surveyed extend from a space heater to heat a single room to a furnace with an output up to 10 million Btu's per hour.

A. M. Squires (703) 961-5972
Chemical Engineering (VCCER)

11) "The Recovery and Use of Lignin"

Lignin is generally considered a waste product by the wood pulp industry. But is may provide an alternative raw material for our chemical industries in view of the depletion of U.S. fossil reserves. Considerable research is being directed toward finding increased use for this substance and of developing ways to more effectively develop it as a product.

W. Glasser (703) 961-5461
Forestry and Forest Products

12) "Improving Mine Safety and Production"

Tech researchers are investigating methods of reducing coal dust so as to restrict the danger of ignitions and explosions
in Virginia's underground coal mines. Attention is also being focused on developing better methods of shoring up walls and roofs of mines and of exploring the possibility of successfully utilizing the "long-wall" method of mining used in Europe.

J. R. Lucas (703) 961-6671
Mining and Minerals Engineering

13) "The Utilization of Coal as Fuel for Diesel Engines"

This research focuses upon developing means for fueling diesel engines with coal. The results suggest that the power and energy inputs will be about the same as with regular diesel fuel, but that there may be slightly more wear of moving parts.

H. P. Marshall (703) 961-7463
Mechanical Engineering

14) "Cooperative Study of Neutron Thermalization and Spectra Between Centro Atomico Bariloche and VPI & SU"

This research focuses on developing a better understanding of the neutron thermalization process which is fundamental to the design of nuclear power plants. The joint research effort is taking place both at Virginia Tech and at Centro Atomico Bariloche, Argentina.

15) "Evaluation of the Impact of a State-Wide Energy Conservation Program"

Do people believe there is an energy crisis and will they do anything to conserve energy? This research focuses on an analysis of the impact, both behaviorally and attitudinally, of an energy conservation packet. The results will be used in the design of subsequent communications so as to more effectively accomplish the intended purposes of the conservation packet.

S. P. Bowen (703) 961-6518
Physics (VCCER)

16) "Studies of the Great Gossan Lead Ore From Carroll County, Virginia"

This research focuses upon efforts to develop new processing methods that will recover all minerals from a resource. Such recovery could help reduce the country's dependence on foreign supplies and provide added economic incentive for commercial development of an ore body.

W. R. Hibbard (703) 961-6473
Director of VCCER
17) "Wind Loads on Solar Collectors"

This research involves a testing program to establish design criteria for solar-panel installations when exposed to high winds. The main thrust of the effort is directed toward wind tunnel studies to be performed at the Virginia Tech low-speed wind tunnel.

H. W. Tieleman (703) 961-6891
Engineering Science and Mechanics

18) "Improved Electronically Commutated Motor for Electric Passenger Vehicles"

In view of the critical oil and gas shortages, this research focuses upon investigating the development of electric motors that could be used effectively as power for passenger vehicles.

N. A. Demerdash (703) 961-6622
Electrical Engineering

19) "Energy Conservation and Alternative Energy Sources"

This project is designed to present to well-qualified science and vocational arts teachers from high school and community colleges in Virginia a thorough and practical course on energy conservation techniques in buildings. It will also include a laboratory-based introduction to solar energy.

S. P. Bowen (703) 961-6518
Physics (VCCER)

20) "Analysis of Cracks in Nuclear Reactors"

Prohibitive costs for safety analyses of nuclear reactor cracks have threatened the shutdown of nuclear power plants. This research has resulted in the development of a relatively inexpensive and accurate method of crack analysis and has resulted in a more thorough understanding of crack mechanisms and safety problems.

C. W. Smith (703) 961-6159
Engineering Science and Mechanics

21) "Development and Application of Analytical Techniques to the Chemistry of Solvent Coal Liquefaction"

This project is designed to investigate reaction mechanisms and reaction kinetics of donor solvent coal liquefaction with special emphasis on regressive reactions that sometimes convert significant positions of the coaly matter to mesophase and semi-coke.
A. M. Squires (703) 961-5972
L. T. Taylor (703) 961-6680
H. C. Dorn (703) 961-6491
J. G. Dillard (703) 961-6926

22) "Assessment of Alternative Sites and Alignments for EHV Station and Transmission Lines"

This project applies the Harvard GRID computer mapping program to the assessment of the environmental, social, economic, and aesthetic impact of the location of power stations and 765 KV lines for the transmission of electric power between various points within the State of Virginia.

L. J. Simutis (703) 961-5582
Environ. and Urban Systems

23) "Optimal Development of an Offshore Energy Resource"

A systems model is considered that could be used as a basis to determine policies and procedures which will lead to the optimum use of off-shore oil fields.

L. C. Frair (703) 961-5363
Ind. Engr. & Oper. Research

24) "Coal Flotation in Inorganic Salt Solutions"

R. H. Yoon (703) 961-6671
Mining & Minerals Engineering

25) "Methane Content in Unminable Coal Beds"

J. R. Lucas (703) 961-6671
Mining & Minerals Engineering

Energy Related Programs of the Extension Division

The primary function of energy programs of the Extension Division is education. Related to this function are several sub-functions which include retrieval, interpretation and dissemination of information; development and evaluation of written and visual materials and delivery mechanisms; provision of follow-up assistance; and assessment of program benefits and effectiveness.

The scope of this programming is quite broad and encompasses the energy situation, conservation practices and energy management, and applications of alternative energy resources. Programs concerning the energy situation are designed to increase awareness. These programs provide information on energy
supplies and usage, policy, fuel reserves, imports, current and projected costs, future technology and impacts on the standard of living and the environment.

A major portion of the programming is directed toward behavioral changes and conservation practices which reduce energy consumption and waste. This effort emphasizes "what should be done" and "how to do it". Specific topics include caulking, weather stripping insulation, moisture control, waste heat recovery, heating, cooling, ventilation, lighting, equipment maintenance, and life cycle costing. Coupled with this conservation effort is the concept of total energy management. This area emphasizes organization and structure of energy management teams, detailed energy audits, walk-through inspections, and evaluation of conservation activities.

Another program component focuses on the utilization of alternative energy sources. Topics include active and passive solar energy applications, wind energy, low-head hydroelectric power, small-scale coal combustion, wood stoves and fireplaces.

Extension's energy programs are varied to meet the needs of a number of different audiences. Programs are conducted for urban and rural areas, high and low income levels, large and small firms, and public and private organizations. Specific audiences include homeowners, youth, agricultural producers and processors, public schools, local government, engineers, architects, building inspectors, bankers, communities, business, and industry.

Because of the range of subject matter and audiences involved, many different methods are used to deliver program material. Some information is provided through radio, television, publications, slide-sets, and films. Other techniques are workshops, computer programs, simulations, demonstrations, exhibits, mobile vans, and one-on-one contact.

These activities are based on Extension's vast experience in educational programming. Clientele are involved in determining the program content. Follow-up information is provided and audience feedback and evaluation are a planned part of each program. The programs are conducted throughout the state utilizing the staff of Extension's 110 unit offices which are located in every county and most cities of Virginia. In addition, faculty members at Virginia Tech develop support materials for these programs and assist the
unit staff in their presentation. The magnitude of this effort is illustrated by the fact that over 50,000 people participated in Extension energy programs between October 1, 1977 and February 1, 1978.

The key contact for Extension energy programs is Dr. Robert H. Pusey, Director, Technical Resources. His telephone number is 703/961-6226.
Chapter 543

An Act to create a Virginia Center for Coal and Energy Research at Virginia Polytechnic Institute and State University; and to create the Virginia Coal Research and Development Advisory Committee

Approved March 30, 1977

Be it enacted by the General Assembly of Virginia:

1. § 1. The Virginia Center for Coal and Energy Research is hereby created to be located at Virginia Polytechnic Institute and State University, hereinafter referred to as the Center.

   § 2. The Center shall be an interdisciplinary study, research, information and resource facility for the Commonwealth of Virginia utilizing the full capabilities of faculty, staff, libraries and laboratories for the benefit of Virginians and the expansion of knowledge pertaining to coal and energy research and development.

   § 3. The Center shall be subject to the control and supervision of the board of visitors of Virginia Polytechnic Institute and State University.

   § 4. The board of visitors of Virginia Polytechnic Institute and State University shall appoint an executive director for the Center.

   § 5. The executive director with the approval of the board of visitors of Virginia Polytechnic Institute and State University shall have the following powers and duties:

      1. Exercise all powers and perform all duties imposed upon him by law; and
      2. Carry out the specific duties imposed upon him by the board of visitors of Virginia Polytechnic Institute and State University; and
      3. Employ such personnel and contract for such services as may be required to carry out the purposes of this act.

   § 6. The Center, under the direction of the executive director, shall have the following powers and duties:

      1. To develop a degree program in energy production and conservation research at the master's level in conjunction with the State Council on Higher Education;
      2. To develop and provide programs of continuing education and in-service training for persons who work in the field of coal or other energy research, development or production;
      3. To operate in conjunction with other departments of Virginia Polytechnic Institute and State University, including but not limited to the Department of Mining Engineering;
4. To conduct research in the fields of coal, coal utilization, migrating natural gasses such as methane and propane, and other energy related work;

5. To collect and maintain data on energy production, development and utilization;

6. To foster the utilization of research information, discoveries and data;

7. To coordinate the functions of the Center with the energy research facilities to prevent duplication of effort;

8. To apply for and accept grants from the United States government and the State government and agencies and instrumentalities thereof and from any other source in carrying out the purposes of this act. To these ends, the Center shall have the power to comply with conditions and execute such agreements as may be necessary;

9. To accept gifts, bequests, and any other thing of value to be used for carrying out the purposes of this act;

10. To receive, administer and expend all funds and other assistance made available to the Center for the purposes of carrying out this act; and

11. To do all things necessary or convenient for the proper administration of this act.

§ 7. The Virginia Coal Research and Development Advisory Committee, hereafter referred to as Advisory Committee, is hereby created to serve in an advisory capacity to the Executive Director of the Virginia Center for Coal and Energy Research.

1. The Advisory Committee shall be authorized to advise on those matters set forth in § 2 of this Act.

2. Representatives to the Advisory Committee shall be appointed by the Board of Visitors of Virginia Polytechnic Institute and State University.

3. The Board of Visitors of Virginia Polytechnic Institute and State University shall also appoint such other individuals as they deem necessary to the work of the Advisory Committee.

4. Representatives from the Department of Conservation and Economic Development, the Division of Industrial Development, the State Energy Office, the Department of Labor and Industry, the Virginia Port Authority, the institutions of higher education, excluding Virginia Polytechnic Institute and State University, and the Community College system shall serve as the Advisory Committee.

2. That an emergency exists and this act is in force from its passage.
Addendum to the Report to the Board of Visitors for its meeting on July 27, 1977.

VIRGINIA CENTER FOR COAL AND ENERGY RESEARCH

The 1977 session of the Virginia General Assembly enacted legislation providing for "the Virginia Center for Coal and Energy Research at VPI&SU, and to create the Virginia Coal Research Development Advisory Committee." The legislation calls for a statewide Center which shall be interdisciplinary in nature and shall perform four main functions, namely, (1) Instruction - master's level work in energy production and conservation; (2) Research - in the fields of coal, coal utilization, migrating natural gases, and other energy-related work; (3) Extension - continuing education and in-service training for persons who work in the field of coal or other energy research, development, and production; and (4) archival - for the storage of all relevant data on energy production, development and utilization. Thus, the Center is to be designed to perform all the functions that the University performs through its three agencies.

Coal is Virginia's main energy resource, and the Commonwealth's coal interests were mainly responsible for this legislation, even though the language of the bill is more inclusive. The Department of Mining of Virginia Tech is specifically mentioned in the legislation, but in a context which clearly implies that it should not be exclusively employed.

The legislation calls upon the Board of Visitors of VPI&SU to name an executive director and an advisory committee. The committee membership is specified by 'agency', but the Board of Visitors can appoint such others as is deemed necessary.

To respond to this legislative mandate, it is necessary for the University to create an organizational framework for the Virginia Center for Coal and Energy Research which will (a) make manifest its University-wide character; (b) adequately reflect its concern for the totality of the energy problem facing the Commonwealth and the nation; and (c) still provide ample scope for a visible effort in coal research, extension and instruction. Because the Center's mandate encompasses all three missions and because of its intercollegiate character, it is recommended that the Center be placed under the University Provost, with a director approved by the Board of Visitors and an internal advisory cabinet named by the Provost to assist the director in policy formulation.
Dr. Walter R. Hibbard, Jr. is currently serving as interim director of the Center for Energy Research, a center established by Board action on May 7, 1974. It is therefore appropriate at this time for the Board to rescind this earlier action and formally to approve the new Virginia Center for Coal and Energy Research. It is recommended that Dr. Hibbard's leadership in this new and broadened effort be recognized by his formal appointment as director.

It is further recommended that the work of the Center be focused in 'institutes' concentrating upon each of several major energy areas. The first of these (given its primacy in Virginia and its possible relationship to the Commonwealth's subsequent eligibility for special Federal funding) is to be concentrated upon coal production and utilization. The Center director will be asked to recommend to the Provost for his approval a coordinator of the Center's Coal Institute. He will also delegate to the Dean of the College of Engineering the primary responsibility for developing and implementing the interdisciplinary degree program called for by the legislation.

A broadly representative Advisory Committee, named in accordance with the legislative guidelines, will need to be appointed by the Board of Visitors at its November meeting. Recommendations for these appointments will be gathered from the director and his internal cabinet and will be presented to the Board at that time.

RECOMMENDATION: That the University Center for Energy Research be changed to the Virginia Center for Coal and Energy Research; that supervision of the Center be assigned to the Office of the University Provost; that Dr. Walter R. Hibbard, Jr. be appointed as Director of the Center; and that an internal Advisory Cabinet be appointed by the Provost to assist the Director in carrying out the requirements of the legislation.
VIRGINIA COAL RESEARCH AND DEVELOPMENT ADVISORY COMMITTEE

Chairman
Mr. John P. Fishwick
President, Norfolk & Western Railroad
Roanoke, Virginia  24009

Dr. Michael N. Bishara
Chairman, Division of Engineering
Southwest Virginia Community College
P. O. Box SVCC
Richlands, Virginia  24641

Mr. J. Robert Bray
Counsel and Administrative Assistant
Virginia Port Authority
1600 Maritime Tower
Norfolk, Virginia  23510

Mr. Samuel C. Brown, Jr.
Vice President of Power Station Engineering and Construction
Virginia Electric and Power Company
Richmond, Virginia  23261

Dr. Robert Milicic, Commissioner
Division of Mineral Resources
Department of Conservation and Economic Development
P. O. Box 3667
Charlottesville, Virginia  22903

Dr. Herbert Funsten
Professor of Physics
College of William and Mary
Williamsburg, Virginia  23185

Dr. John E. Gibson, Dean
School of Engineering and Applied Science
Thornton Hall
University of Virginia
Charlottesville, Virginia  22903

Director
Dr. Walter R. Hibbard, Jr.
University Distinguished Professor of Engineering
Virginia Polytechnic Institute and State University
Blacksburg, Virginia  24061

Mr. Mark R. Kilduff
Assistant Director of Research Division of Industrial Development
1010 State Office Building
Richmond, Virginia  23219

Mr. Frank A. Linkous
Acting Chief Mine Inspector
Division of Mines and Quarries
Department of Labor and Industry
P. O. Drawer V
Big Stone Gap, Virginia  24219

Mr. Peter G. Marozzi, III
Vice President and Chief Engineer
United Coal Companies
Grundy, Virginia  24266

Mr. Ray Marshall
President, District 28
United Mine Workers of America
P. O. Box 28
Castlewood, Virginia  24224

Dr. Gordon A. Melson
Associate Professor of Chemistry
Oliver Hall, Room 4027
Virginia Commonwealth University
Richmond, Virginia  23284

Dr. A. Sidney Roberts
Department of Mechanical Engineering and Mechanics
Old Dominion University
Norfolk, Virginia  23508
Mr. Donald W. Jones  
Manager, Coal Preparation  
The Pittston Coal Group  
Lebanon, Virginia  24266

Mr. George Jones  
Director of the State Office for Emergency Services  
823 E. Main Street, RM 300  
Richmond, Virginia  23219

Mr. Jack Kepner  
Executive Assistant to the Executive Vice President  
Appalachian Power Company  
P. O. Box 2021  
Roanoke, Virginia  24009

Dr. Noel C. Taylor  
Mayor, City of Roanoke  
215 Church Avenue, S.W.  
Roanoke, Virginia  24011

Mr. J. R. Tomlinson  
Property Manager  
Virginia Iron, Coal & Coke Company  
Roanoke, Virginia  24008
Members of Advisory Cabinet

Dean W. J. Fabrycky, Research
Dean H. H. Bauer, Arts & Sciences
Dean P. E. Torgersen, Engineering
Dean W. R. Van Dresser, Extension

Members of the Technical Advisory Committee

Prof. John Cairns, Jr.
Prof. J. K. Costain
Prof. B. H. Evans
Prof. R. H. Giles, Jr.
Prof. G. C. Grender
Prof. J. B. Jones
Prof. H. A. Kurstedt, Jr.
Prof. J. P. Mason
Prof. A. M. Squires
Prof. L. T. Taylor
FACULTY AFFILIATES

Faculty working on projects in Center. Those who wish to be affiliated and who have significant research accomplishments in energy.

Presently

G. H. Beyer, Prof. of Chemical Engineering
S. P. Bowen, Assoc. Prof. of Physics
Larry Burton, Assoc. Prof. of Electrical Engineering
J. R. Craig, Assoc. Prof., Geological Sciences
J. G. Dillard, Assoc. Prof. of Chemistry
H. C. Dorn, Asst. Prof. of Chemistry
M. C. Edlund, Prof. of Mechanical Engineering
G. C. Grender, Prof. of Geological Sciences
W. R. Hibbard, University Distinguished Prof. of Engineering
J. R. Lucas, Prof. of Mining Engineering
Robert McConnell, Instr. of Geological Sciences
W. H. Mashburn, Assoc. Prof. of Mechanical Engineering
L. A. Rapoport, Prof. of Energy Resources
M. W. Rohrer, Research Associate, Geological Sciences
Lyle Slack, Assoc. Prof. of Ceramics
A. L. Soyster, Assoc. Prof., Ind. Engr. and Oper. Research
A. M. Squires, Frank C. Vilbrandt, Prof. of Chemical Engineering
L. T. Taylor, Assoc. Prof. of Chemistry
W. C. Thomas, Assoc. Prof. of Mechanical Engineering
Bernie Style, Systems Analyst, Geology
Alan Carroll, Graduate Student, Materials Engineering
Miguel Kelly, Graduate Student, Ind. Engr. and Oper. Research
VCCER Staff

Dr. W. R. Hibbard, Jr., Director, University Distinguished Professor of Engineering

Dr. Samuel P. Bowen, Assistant Director, Associate Professor, Department of Physics

Dr. J. Richard Lucas, Coordinator of Coal Institute, Professor and Head, Department of Mining and Minerals Engineering

Dr. M. C. Edlund, Coordinator of Energy Institute, Professor of Mechanical and Nuclear Engineering

Dr. R. H. Pusey, Coordinator of Extension and Information Institute, Director, Extension Technical Resources

Ms. Barbara Johnson, Secretary

Ms. Shelby Davis, Secretary

Ms. Helen Hatcher, Secretary (Physics)
## Projects (Accumulative)

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Minutes
Virginia Coal Research and Development Advisory Committee
May 3, 1978
Donaldson Brown Continuing Education Center
Virginia Polytechnic Institute and State University
Blacksburg, Virginia

Present:

Committee: Messrs. Bishara, Brown, Calver, Fishwick, Funsten, Donald Jones, George Jones, Kepner, Kilduff, Marozzi, Melson, Roberts, Taylor, Tomlinson, Vinces (for Gibson)

Center: Messrs. Hibbard, Edlund, Lucas, Pusey, Bowen

VPI & SU: Provost Wilson, Deans Fabrycky, Gilmer, Torgersen, Van Dresser

Absent:

Committee: Messers. Bray, Gibson, Linkous, Marshall

Chairman Fishwick called the meeting to order and asked each person to introduce himself to the group.

Provost Wilson welcomed the committee to the campus on behalf of President Lavery who was ill.

The committee was reminded of its statutory responsibilities as described in the Act of the General Assembly dated March 30, 1977 and the action of the Board of Visitors of VPI&SU on July 27, 1977 and November 16, 1977. Copies of the statute and the Board of Visitors action were distributed to each member.

Director Hibbard of the Virginia Center for Coal and Energy Research reported on the objectives of the Center as described in the statute and the organization of three institutes with coordinators (Prof. Lucas, Coal; Prof. Edlund, Other Energy and Prof. Pusey, Extension and Information). In addition, arrangements had been made to use the resources of the Virginia Energy Information Center.

An Advisory Cabinet consisting of four Deans (Arts & Sciences, Engineering, Extension and Research) was appointed to advise the Director in carrying out the requirements of the legislation. A pamphlet describing the objectives, organization and activities of the Center was given to those present.

A listing of the present projects ($1,536,986) and pending proposals ($2,278,000) was distributed and discussed, together with a listing of the faculty affiliates working on these projects. The operating funding for the Center for 1977-78 and the budget for 1978-79 was presented.
The Center has collected 44 prospectuses for coal and energy research from five Virginia Universities. They have been organized into disciplines so that support can be sought from three sources:

1) Federal government - DOE, NSF, DOI, EPA
2) State government - Coal and Energy Research Core Program
3) Industry

Efforts are underway to seek funding from Exxon, a Polish government joint venture, and a DOE institutional agreement.

So far, the Center's research has provided for one master's thesis, four technical papers and presentations at the Virginia Academy of Sciences.

Dr. Bowen was introduced as the Center's Assistant Director designate.

Chairman Fishwick led the discussion which followed, focusing upon the coal and energy research needs for the Commonwealth of Virginia and stressing the need for useful results.

Mr. Brown identified a need for research on siting for generating facilities. Dean Fabrycky suggested a conference on Virginia energy issues and opportunities. Prof. Bishara suggested a listing of industrial needs which academia can respond to. Dr. Pusey identified the NSF joint Industry/University program as a source of funding. Mr. Brown said there was no problem getting ideas from industry through EPRI. Mr. Marozzi stated that the new surface mining regulations may eliminate much of Virginia's surface mine coal production and result in a shock to coal, power, railroads and economic growth. Mr. Brown stated that regulation is leading to increased costs which are no longer attractive to bring in new industry and new jobs. Mr. Kepner stated that AEP can share some of their problems with universities. Mr. Don Jones stated that the problems with regulations include waste disposal, roof control, coal haulage, processing and safety, and raised the question of how to double coal production to fill the energy gap. Mr. Tomlinson stated that 50 out of their 60 mines were strip type and faced problems. They are stripping with a continuous miner. Mr. George Jones said that the Virginia Energy Office wants to be active in the development and promulgation of comprehensive energy planning, policy, relationships and the identification of complexities and issues which impact National and State policy. Prof. Edlund noted that the LORENDAS computerized energy model can be modified to do this kind of analysis. Mr. Jones indicated a willingness to support this kind of work. Dean Fabrycky also indicated support. Mr. Kilduff stated a need for more of the Center's effort be directed toward Virginia's problems.

Prof. Melson said there was a need for background information on energy related
problems which are potential projects. Prof. Lucas pointed out that Virginia was the 5th largest coal producing state with a value of $1.3 billion which supports the utilities, railroads and ports. Last year, Norfolk and Western hauled more coal from Virginia than from West Virginia. He stated that there was a need for coal mining industrial development, and a serious lack of information on Virginia's coal resources. Mr. Calver stated that four biennium budgets in a row had turned down his requests for funds to do coal mapping in Southwest Virginia. Presently the state is mapping one quad and the USGS is mapping three. There is a fundamental need for geologic work here. Mr. Marozzi noted a 208 project which had collected and summarized this kind of information from industry.

The committee voted to sponsor a seminar on "Coal and Energy Needs and Issues in the State of Virginia" to be held either on October 17 and 18 or November 8 and 9, 1979 and directed Prof. Hibbard to develop arrangements working with Mr. George Jones, Brown, and Marozzi as a subcommittee. Dean Fabrycky noted that the Research Division would help sponsor it. Dr. Bishara noted that the committee was distributed into three geographical groups; Southwest, Central, and Tidewater. He suggested that each group get together locally to discuss and generate a listing of Virginia's needs. Prof. Hibbard agreed to meet with these groups at their pleasure. In addition, he will write to the committee asking that they submit lists of Virginia's needs which might be addressed by the Center.

The committee selected May 3, 1979 as the date for its next annual meeting. The meeting was adjourned at 3:30 p.m.

Respectfully submitted

Walter R. Hibbard, Jr.
Director, VCCER
Summary: Workshop on Coal and Energy Needs and Issues in Virginia - November 8, 9, 1978

The Virginia Center for Coal and Energy Research, the VPI and SU Research Division, and the State Office of Emergency and Energy Services, co-sponsored a workshop on "Coal and Energy Needs and Issues in Virginia" on November 8-9, 1978 at the Donaldson Borwn Continuing Education Center, Virginia Polytechnic Institute and State University, Blacksburg, Virginia. It was attended by 69 representatives of Industry, Government, Universities, and Public Organizations.

W. J. Fabrycky, VPI and SU Dean of Research, welcomed the attendees and urged them to participate freely in open discussions to expose all ideas. E. F. Wilson, representing the Commonwealth Department of Commerce and Resources, emphasized the need for careful energy planning and the need to let the market forces work. William Jeffrey of the Department of Highways and Transportation discussed the State coal haul system and the need for road maintenance. Grant Hollett of the Division of Mined Land Reclamation discussed the cost of reclamation, its benefits and the need for additional dirt moving engineers. George Jones, Director of the Office of Emergency and Energy Services, stressed the need for policy development and realignment of conflicting policies. He discussed the need to participate in the national and regional scene to reach proper decisions. J. W. Kepner of Appalachian Power discussed the rising costs of equipment and fuel, the difficulties in capital formation and the demise of the power reserve in the future. Peter Marozzi of United Coal Company emphasized the high cost of the new Surface Mine Control and Reclamation Act and the need for research to evaluate the regulations and the loss of overseas markets.

Before dinner, there were tours to see the small Fluidized Bed Combustion Project, the Solar Heating and Wind Energy Experiments, and the Rock Mechanics Laboratory. After dinner, Senator Harry Michael of Charlottesville, Chairman of the Commission on Coal and Energy Research, described the work of the Commission and stressed the need for a national solution to the energy problem. Stanley Ragone of VEPCO identified the need for more coal and nuclear power facilities, discussed the high investment costs, and the difficulty in attracting investors.
Professor Michael Bishara of Southwest Virginia Community College discussed the nature of University Research, both discipline and problem oriented. Professor Phil Mason of VPI and SU discussed the small Coal Combustion project, Professor Albert Hendricks of VPI and SU discussed the environmental evaluation project, Professor Sam Bowen of VPI and SU discussed the energy extension information projects, Professor Sid Roberts of Old Dominion University discussed regional energy analysis, Professor Sterling Vines of the University of Virginia discussed the solar energy, wet scrubber, and fluidized bed gas distribution Projects, Professor Antoine Hobeika of VPI and SU discussed the gasoline consumption project aimed at estimating tax revenues, Professor Leo Rapoport of VPI and SU described the energy simulation modeling and forecasting project, Professor Scott Geller of VPI and SU described his project on social behavior and attitudes toward the energy situation, Professor Clark Lewis of VPI and SU described his studies of the burning of coal as an ablation phenomena, Professor Bishara then summarized the session by describing the role of university research and stressing the need for industry to identify problems so that they can be translated into research projects.

Ms. Fran Kieffer of the League of Women Voters then described the League's Consensus on Energy and emphasized that they can now speak out on issues such as Virginia's lack of a long range plan. Joe Kaestner of the Energy Advisory Council described their studies on energy issues including: 1) conservation, 2) effect of regulatory process on efficiency of utilities, and 3) lack of performance data. Rev. Richard Austin of the Coalition of Appalachian Energy Consumers attacked VPI and SU and Appalachian Power for the environmental study of the possible pumped storage facility in Bumley Gap. Dr. Robert Pusey of the VPI and SU Extension Division discussed the quadruple A's of energy: Awareness, Alternatives, Analysis, and Action. Delegate Don Dunford of Tazewell presented the closing remarks at lunch.

A survey of the workshop participants showed that the major energy issues facing the Commonwealth include: 1) the need for alternative coal mining techniques, 2) the need for a coordinated enlightened energy policy, 3) the need for public awareness, and 4) the need for policy to consider the realities and needs of Virginians. The consensus was that Virginia does face a severe energy situation and that the combined efforts of industry, utilities, state government, and universities are needed to assure the energy requirements of Virginians will be met in the next decades.

Proceedings of the Workshop are being prepared and will be available from the sponsors.
VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

Energy-Related Courses

PHYSICS

Principles of Nuclear Physics
Energy, Energy Resources, and Energy Policy
Energy Utilization and the Near Future
Energy Utilization and the Far Future

ELECTRICAL ENGINEERING

Energy Conversion
Energy Conversion Laboratory
Energy Conversion

ENGINEERING SCIENCE AND MECHANICS

Micromechanics of Reactor Materials
Adv. Nuclear Engineering Materials

INDUSTRIAL ENGINEERING AND OPERATIONS RESEARCH

Nuclear Fuel Cycle Management

MATERIALS ENGINEERING

Materials, Energy and the Environment

MECHANICAL ENGINEERING

Power Generation I
Power Generation II
Advances in Energy Systems
Energy Utilization in Modern Society
Solar Energy Engineering

NUCLEAR ENGINEERING

Utilization of Atomic Energy 2010
Utilization of Atomic Energy 2020
NUCLEAR ENGINEERING (cont'd)

Fundamentals of Nuclear Reactors
Nuclear Reactor Lab
Nuclear Engineering
Introduction to Reactor Theory
Nuclear Engineering Lab
Nuclear Fuel Cycles
Nuclear Fuel Cycle Management
Introduction to Fusion Reactors
List of Publications


S. P. Bowen, "Mace and its Derivatives," Report detailing the computer program for analyzing home energy use. International Conference of Agricultural Engineers


List of Seminars

Coal and Energy Needs and Issues in Virginia, November 8-9, 1978, Blacksburg, Virginia

Invited Speakers

V. Tennery, ORNL, Ceramic Fuel Recycle, March 2, 1978
Funding 1977-78

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1978-80 Biennium Budget

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Staff

- 1 FTE Faculty  - Director and Asst. Director
- 1 Clerk Steno C - Secretary
AGENDA

ENERGY STUDY COMMISSION
House Room C
General Assembly Building
10:00 a.m.
September 22, 1978

1. Call to order and opening remarks, Chairman, C. Don Dunford.

2. "Energy and Emergency Services," Mr. George L. Jones, Coordinator, Emergency Services

3. "Solar Energy", Dr. C. James Bier, Department of Chemistry, Ferrum College

4. "Work of the Coal and Energy Research Center" and "Director of Energy Competence," Dr. Walter R. Hibbard, Director, Virginia Center for Coal and Energy Research, VPI & SU.

5. Other business.

6. Adjournment.

C. Don Dunford
Charles J. Colgan
Virgil H. Goode, Jr.
Claiborne D. Gregory
George R. Jones
W. S. Kerr
Madison E. Marye
Glenn B. McClanan
James F. Almand
Lewis W. Parker, Jr.
Stanley C. Ragone
Eugene M. Scheel
Frank T. Sutton, III
Report to the Commission on Coal and Energy Research - October 27, 1978

The Virginia Center for Coal and Energy Research was created by Act of the General Assembly of Virginia on March 30, 1977 as an interdisciplinary study, research, information and resource facility for the benefit of Virginians and the expansion of knowledge pertaining to coal and energy research and development. The Board of Visitors established the Center at VPI and SU and appointed the Director on July 27, 1977. The Statutory Advisory Committee was appointed on November 16, 1977. There is also a Technical Advisory Committee and an Advisory Cabinet. A folder describing the Center is attached, together with listings of the various advisory committees.

During the first year, the Center's activities included:


2) Workshop on solar heating and cooling.

3) Grant and proposal preparations.

4) Preparation of a directory of Energy Expertise

Eighteen faculty are conducting research associated with the Center. Prospectuses for 44 research projects were delivered to the Department of Energy for evaluation. The Statutory Advisory Committee is organizing a workshop at Blacksburg on November 8 and 9, 1978 to provide a forum to identify the energy needs and issues for the state. A copy of the program is attached. The Assistant Director, also was appointed July 1, 1978, is responsible for the workshop.

We seek the advice and counsel of the Commission relative to our activities and our initiatives for the coming years.

Respectfully submitted,

Walter R. Hibbard, Director
Activity Report of Assistant Director of VCCER

Dr. Dan Textoris of Office of Energy Research, DOE, visited the Center. A representative of Batelle visited the Center to discuss energy related research activities on this campus.

VPI and SU has participated in the Citizen's Workshop program, an extension program of the Department of Energy. During this school year VPI and SU, primarily through the efforts of its extension agents, has been one of the top 3-5 sites in numbers of people reached with some exposure to the Energy Environment Simulators.

In the fall quarter five preliminary proposals were submitted to Title I all relating to energy and energy conservation. Two of these proposals were invited for a formal proposal submission. All of these pre-proposals involved more than one college.

A DOE faculty development program proposal was submitted through the Center as a program spanning the Colleges of Arts and Sciences and Architecture. This program was funded and will be presented this summer. Professor Robert Chiang and Robert Schubert are co-principal directors of this proposal.

A large interdisciplinary intercollege proposal was written to Brookhaven National Laboratory in December to undertake an evaluation of energy use in a developing country. The country chosen was the Dominican Republic. Colleges involved in this project were Arts and Sciences, Agriculture, Home Economics, and Engineering. This project was not funded.

A formal proposal involving the the College of Arts and Sciences, the Water Center, and the Energy Center was submitted to the Title I agency as a VCCER project through the Extension Division. This project was conceived to study and prepare materials and methodologies for encouraging water and energy conservation. This proposal was funded and is proceeding. Professors Scott Geller, Jerry Kehoe and Bill Walker are in the team of principal directors.

A second formal proposal was submitted to Title I, but thankfully was not funded. The proposal was to prepare a series of workshops on safety and reliability of nuclear power plants. The proposal would have involved some Arts and Sciences departments with collaboration in Engineering.

An interdisciplinary group to examine the possibility of developing a feedback energy monitoring system for residences was formed and met several times. The group included faculty from Home Economics, Architecture, Engineering (EE) and Arts and Sciences. An electronics manufacturer, Zerntronics
Corporation was consulted about Collaboration in developing an innovative machine. Because of time constraints the group chose to not submit a proposal, but interest and a good opportunity still is possible here.

Another interdisciplinary group involving Arts and Sciences, Urban Planning, Architecture and Engineering was formed to write a proposal to Oak Ridge (Union Carbide) to conduct a solar assessment of a whole community. Time constraints again were very severe, but a proposal was submitted.

Several trips were made to Richmond to discuss and consult with the Energy Office on energy conservation programs and, in particular, to consult on the state's plan for the Energy Extension Service.

From one of these visits an informal working conference involving the energy office staff and the Energy Extension Service planner was scheduled and held at Tech. This meeting was extremely productive in that it ultimately led to a contract between Agricultural Engineering and the Energy Office to examine energy use in Virginia agriculture.

A second outcome of this meeting was a proposal to the Energy Office to establish a program of energy information delivery using a new Personal Energy Use Simulator. This program will involve all of the state's Extension agents and will result in 6 of these machines being brought into the state.

Informal consultations with the Energy Office staff have resulted in significant changes in the original energy extension service proposal which had been written four months ago.

Recently, an interdisciplinary proposal to DOE was written to collect, evaluate, and summarize the existing experimental literature on water related energy saving devices and methods. This unsolicited proposal was written by an interdisciplinary group involving Arts and Sciences, Architecture, Vocational Education, and Engineering. The proposal has not been funded as of its original starting date (May 15), but DOE contacts are insisting they will fund it in the near future.

Another part of DOE has shown interest in our submitting a proposal to create a center for energy information dissemination through use of Extension Agents. This proposal is in the process of being developed.

An address on alternative energy sources was presented at a recent Energy meeting sponsored by Senator Warner and Congressman Saterfield in Richmond. This will result in an article in a proceedings to be widely distributed.

VEPCO is beginning to study solar facilities and has invited the Center to discuss participation in the project by an interdisciplinary team.
Negotiations are underway with the Energy Office, the Virginia Solar Association and the Virginia Solar Council to pool all of the existing operational data on solar facilities into a carefully crafted publication showing the operational experience of these facilities. At present, we are considering four levels of evaluation in the project: (1) a simple description, (2) actual operating data, (3) heat flow analysis based on minimum-maximum thermometers, and (4) electronic instrumentation.

The University's Coal Research Laboratory proposal to DOE is being developed.

Some 15-20 faculty members have been interviewed in order to bring groups of faculty together to work on energy problems in an interdisciplinary fashion.
APPENDIX R

Newspaper articles concerned with Virginia Center for Coal and Energy Research Activities
Energy Commission Head Says State Faces ‘Crisis’

VPI News Service

Referring to a recent energy study by Virginia Tech, Sen. Harry Michael, chairman of the Virginia Coal and Energy Commission, said the state not only faces a "crisis situation" with regard to energy, but also that the Tech study "is the bleakest report that I have ever heard."

His comments were made during a keynote address at the "Coal and Energy Needs and Issues" workshop held recently at Tech.

The two-day workshop, sponsored by the Virginia Center for Coal and Energy Research (VCCER) at Tech, provided the opportunity for energy professionals to get together and discuss the Commonwealth's energy problems. The participants represented leaders from business and industry, the utilities, government, and universities.

A major point that came out of the workshop was that Virginia must cease to play "follow the leader" in response to federal energy policies and regulations.

The report to which Sen. Michael referred came out of a sophisticated energy modeling system called LORENDAS, which stands for "Long Range Energy Development and Supplies." The projections by the system call for brownouts during the mid-1980s, gas shortages, and a generally dismal energy picture over the next several decades.

The LORENDAS project, funded by a grant from the National Science Foundation, was initiated by an interdisciplinary team of senior faculty at Tech in 1974.

Michael contended that efforts to develop badly needed energy resources often run into stringent federal and state regulations. Citing plans to develop the state's geothermal resources as a case in point, he said "we find the state Water Control Board saying 'well, if it is feasible, you'd better be damned careful how you do it.'"

Both VEPICO and APOC said the utility's objective is to provide electricity at the lowest cost. But, while the company has been able to hold down rates in the past, "it is virtually impossible to do so in today's energy climate."

From the state government's position, George Jones, director of the state Office of Emergency and Energy Services, said "we need research which supports policy development and which assists in the realignment of conflicting policies."
Energy Future 'Bleak'

BLACKSBURG—Referring to a recent energy study by Virginia Tech, State Sen. Harry Michael, chairman of the Virginia Coal and Energy Commission, said the state not only faces a "crisis situation" in energy but the Tech study "is the bleakest report that I have ever heard."

His comments were made during a keynote address at the "Coal and Energy Needs and Issues" workshop recently held at Tech.

The two-day workshop, sponsored by the Virginia Center for Coal and Energy Research (VCCER) at Tech, provided the opportunity for energy professionals to get together and discuss the Commonwealth's energy problems. The participants represented leaders from business and industry, the utilities, government and universities.

A major point from the workshop was that Virginia must take a strong and active role in solving its energy problems. It must cease to play "follow the leader" in response to federal energy policies and regulations.

Furthermore, the Commonwealth must develop a coordinated energy plan that considers the environmental impact of energy use and the energy needs of Virginians over the next several decades.

The report to which Sen. Michael referred came out of a sophisticated energy modeling system called LORENDES, which stands for "Long Range Energy Development and Supplies." The projections by the system call for brownouts during the mid-1980s, gas shortages and a generally dismal energy picture over the next several decades.

The LORENDES project, funded by a grant from the National Science Foundation, was initiated by an interdisciplinary team of senior faculty at Tech in 1974.

Michael also elaborated on the fact that efforts to develop badly needed energy resources often run into stringent federal and state regulations. Citing plans to develop the state's geothermal resources as a case in point, he said, "We find the state Water Control Board saying, 'Well, if it is feasible, you'd better be damned careful how you do it.'"

Addressing himself specifically to the often conflicting Federal Energy Administration and the Environmental Protection Agency regulations and policies, he added, "We find ourselves ground in between."

With regard to the best approach to a solution to the state's energy dilemma, Michael said the Virginia Center for Coal and Energy Research at Tech "in my judgment has as much promise for effect or work in the energy field as anything we have done in Virginia."

Both VEPCO and APCO representatives said that they saw no benefit from utility rate hikes in the future. Jack Keiper of APCO said the utility's objective is to provide electricity at the lowest cost. But while the company has been able to hold down rates in the past, "it is virtually impossible to do so in today's energy climate."

APCO, he added, is a "coal-oriented" company, which means it is constantly faced with the problem of air pollution and conflicting environmental regulations and bills. As a result of recent strikes, the logistics of coal production, and new surface mining regulations, "APCO will not be able to meet the projected energy needs of its customers in spite of new plants being developed."

Stanley Bagone, president of VEPCO, said the company is investigating a "mix of nuclear, coal, pumped storage, and conventional hydro-electric generating plants in order to reduce its reliance on oil."

With regard to rate hikes, he said, "Electricity costs to the customer should remain about even with the inflation rate—unless some major disruption of the fuel supply occurs."

From the state government's position, George Jones, director of the state Office of Emergency and Energy Services, told conferences, "We need research which supports policy development and which assists in the realignment of conflicting policies."

"There must be," he added, "the proper interrelation of research and energy policies." One of the primary responsibilities of the state, he explained, "is to provide the leadership in developing a sound energy policy."

Responding to the coal industry's concern over environmental regulations, Pete Marozzi III, vice president and chief engineer, United Coal Companies, said in some instances companies have had to shut down because they could not operate with a profit in the face of such regulations. "When we do comply with the environmental regulations," he added, "the cost of implementing them is going to be paid for by you, the customer."

A poll of workshops participants showed that the major energy issues facing the Commonwealth included the need to develop alternative surface coal mining techniques, the need to develop a coordinated energy policy based on accurate information, the need to develop a state energy policy that takes into consideration the needs of Virginians and the realities of finite energy supplies, and the need to develop a public awareness of the state's energy issues.
Power shortages termed inevitable

By FRAN COOMBS

The United States cannot avoid energy shortages in the 1980s because it hasn't built sufficient reserves to meet its future needs, the director of the Virginia Center for Coal and Energy Research at Virginia Tech said Thursday night.

"We're headed for energy disaster in both cost and confusion," Dr. Walter Hibbard told Roanoke Rotarians.

Hibbard, who is also a university distinguished professor of engineering at Virginia Tech and former director of the U.S. Bureau of Mines, said the country has not kept pace even with its modest annual rate in energy demand of 2.5 percent.

"There's no way we're going to avoid brownouts," he said. For example, Appalachian Power Co. has a zero reserve and is forced during peak demand periods to buy power from its parent company, the American Electric Power Co., at premium prices, Hibbard said.

Based on a study begun at Tech in 1973, Hibbard concluded that the U.S. already in the last three years has fallen the equivalent of 70 large utility plants behind where it should be in energy development.

Violence is likely to result when those shortages become a reality, he said, citing the example of current gas limitations in California. "When people get frustrated... they pick up a club and slug somebody," Hibbard said.

The country's energy future is very bleak, he said, "unless we do something to develop an orderly plan that isn't based on looking at today's voter and saying, 'what do you want?'

Today's gas shortage is due primarily to the intervention of government, Hibbard said. Also the opposition of environmentalists has prevented the construction of any new oil refineries in the U.S. in the last 10 years, he said.

"Anytime the government gets its cotton-picking claws into anything... they foul it up," Hibbard told the group.

He urged the restoration of an economy free of government restriction as a solution to the country's energy needs. "It might be more expensive, but at least it'll be there."

The U.S. now pays $100 billion a year for regulation. "That buys us nothing," he said.

Hibbard said the percentage of Iranian oil imported into the U.S. was "peanuts," representing only 15 percent of the amount lost during the Arab embargo several years ago. Less restriction in this country would allow for more and cheaper use of domestic crude oil, he said.

The U.S. also is not using enough coal, and solar energy is not practical unless a 30-year plan for its implementation is developed, Hibbard explained.

The speaker decried media coverage of the Three Mile Island nuclear reactor accident. "While there's certainly a need for redesigning nuclear reactors, particularly Babcock and Wilcox's, there was more debris put in the air by the media than by the reactor."

"I've never seen such a horrible performance," Hibbard said. "When they didn't understand it, they made it up as they went along."

The radioactivity released from the reactor was "well within the limits of health" and less than what experienced during an airplane flight to the west coast, he said.

The country either has to establish a 20-year program to phase out nuclear power or work to make it safer, Hibbard said. "We cannot do without nuclear power."
Coal research chief predicts brownouts

Staff Writer

"There's no question brownouts are coming" predicts the director of the Virginia Center for Coal and Energy Research (CER) at Virginia Tech.

"Get out your kerosene lamps, a good book and a bottle of bourbon and settle back," CER Director Walter R. Hibbard Jr. told a meeting of the Virginia Society of Professional Engineers at Tech. Hibbard was speaking Tuesday on "Is the Energy Crunch Real or Manipulated?"

He said the United States is choosing to have an energy shortage.

"The national policy today is to use as much imported oil as we can, to use as much natural gas as we can, to use as little coal as we can, and to use as little nuclear power as we can," he said.

There is a difference between U.S. energy policy and its energy laws, Hibbard explained, and it's the policy that counts.

"Energy policy is what's enforced," he said. The 55 mile per hour speed limit, for instance, is law, but since it's not enforced very well, it's not policy.

"The U.S. was and still is short of their full refining capacity," Hibbard said. This was only one part of the oil problem, he explained. "The demand for gasoline is up 10 percent over government expectations."

Meanwhile, refinery production is down seven percent from predicted levels. We are using more petroleum today than ever before.

"If demand keeps up, we're going to pay an awfully large import bill." There's a problem with natural gas, too. The big gas bubble in Texas is expected to last only three more years. After that, a 10 to 20 percent shortage is possible, Hibbard said.

"If anyone builds a house and decides to use natural gas heating in it, he may regret it in two to three years," he said.

According to Hibbard, though, even nuclear power won't be able to pick up the slack.

"Nearly 30 billion watts of new nuclear power are required, but there's no way we're going to reach that," Hibbard said.

The problems in building new nuclear reactors include tough regulations, resistance from environmental groups and a long construction time. Hibbard said that it takes an average of 12 years to build a nuclear power plant.

Hibbard also felt that the recent accident at the Three Mile Island nuclear plant in Pennsylvania was overrun by the news media.

"My favorite saying is that the

See HIBBARD, Page B-12

★ Hibbard ★

Continued from page B-5
media filled the air with more debris than the reactor," he said.

Hibbard also felt that coal wouldn't be able to fill the energy gap.

"Our coal production is down because of strikes in the industry," he said. "The whole sector is depressed.

"We are simply not building enough coal generating plants. There are only two or three going on-line next year."

Hibbard concluded that there would be severe energy problems in the 1980s. The biggest one, he said, would be in electric power generation.

"We'll keep on paying for the oil," he said. "We're behind in coal and nuclear power and using too much natural gas."

And Hibbard felt there were more problems beyond that.

"I feel that beyond 1980 there's going to be a shortage of Middle Eastern oil," he said. "The first problem we will encounter will be transportation as the price of gasoline becomes prohibitive."

Hibbard was asked what he would recommend if he were building today.

"I'm heating with oil. I know I'm going to get it. I'll pay through the nose for it, but I know I'm going to get it for a while. Gas and electric heat, I just don't know."
Too Few Power Plants Predicted by Mid-80s

BLACKSBURG (AP) — A developing shortage of power generating facilities will lead to brownouts, gas shortages and increased dependence on foreign resources by the mid 1980s, an energy study group has concluded.

The study, which is called LORENDAS for Long Range Energy Development and Supplies, was developed by five senior faculty members at Virginia Tech. The four-year project was paid for by the federal government.

The study said the reason for the bleak outlook is that "immediate and decisive action is not being taken to develop essential energy facilities over the next 15 to 20 years."

The cost of the inaction will be more dependence than ever on foreign oil — to the tune of over $1.5 trillion in the next 25 years, according to the study. This, the study projects, will raise oil imports from today's 5.5 million barrels a day to 14 million barrels a day by 1986.

W. R. Hobard, professor of engineering and director of the Virginia Center for Coal and Energy Research at Virginia Tech, said, "The unfortunate thing about our energy future is that on the one hand there are nearly sufficient energy resources to meet most of our needs..."

"But on the other, facilities are not being developed to use these resources and to avert an energy crisis over the next several decades."

The group also says that the energy plan passed recently by Congress will not greatly stimulate natural gas production, and that full decontrol of natural gas would have "no appreciable effect on increasing production levels at least into the early 1980s, and possibly through the turn of the century."

LORENDAS projections say there will probably be a significant drop in U.S. gas production around 1985, but production will probably regain present levels by the early 1990s.

Project chief Leo Rapoport, professor of geological sciences, said the alternative fuels left for development are coal and nuclear power.

But Rapoport said a marked increase in nuclear power would have to take place through 1996 to begin to meet demands, while coal-fired power plants would have to produce increasing amounts of electricity through 1990.