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Testimony Presented to the U.S. Environmental Protection Agency's Public Hearing on Environment and Conservation in Nonnuclear Energy Research and Development March 31, 1978 Washington, D.C.

Chester R. Richmond

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TESTIMONY PRESENTED TO THE U.S. ENVIRONMENTAL PROTECTION AGENCY'S PUBLIC HEARING ON ENVIRONMENT AND CONSERVATION IN NONNUCLEAR ENERGY RESEARCH AND DEVELOPMENT

MARCH 31, 1978
WASHINGTON, D.C.

Chester R. Richmond
Associate Director for
Biomedical and Environmental Sciences

Date Published - May, 1978

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ABSTRACT

This report is the text of an invited testimony given by the author before a hearing panel convened by the U.S. Environmental Protection Agency. These public hearings were mandated by Public Law 92-577, The Non-nuclear Energy Research and Development Act of 1974, as a forum to review the energy conservation and environmental implications of the Federal energy research, development, and demonstration program.

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TESTIMONY PRESENTED TO THE U.S. ENVIRONMENTAL PROTECTION AGENCY'S PUBLIC HEARING ON ENVIRONMENT AND CONSERVATION IN NONNUCLEAR ENERGY RESEARCH AND DEVELOPMENT

Chester R. Richmond

Mr. Chairman, Panel Members, Ladies and Gentlemen:

My name is Chester R. Richmond. I am Associate Director for Biomedical and Environmental Sciences at the Oak Ridge National Laboratory (ORNL), which, as you know, is one of the major multipurpose scientific research and development institutions operated by various private contractors for the U.S. Department of Energy. As Director of a large biomedical and environmental program, I have had the opportunity to personally participate in both the planning and implementation of health, safety, and environmental research related to both nuclear and nonnuclear energy technology. I have also participated, during the past several years, in the planning, organization, and implementation of a life sciences program in support of synthetic fossil fuels which can be considered to be a major national research effort.

In November 1975, I presented testimony to the House Committee on Science and Technology's Subcommittee on Environment and the Atmosphere (ORNL/TM-5277, 1976). The subject of the hearing, "Effects and Costs of Long-Term Exposure to Low-Levels of Manmade Pollutants," included consideration of pollutants from energy generating systems. My comments today will address the planning and implementation of energy-related research and development activities that deal specifically with environmental, health, and safety aspects of developing technology for converting coal to gaseous or liquid products. Because I have not participated to any major extent in conservation-related research, I will not attempt to comment on that area for which I do not feel properly qualified. I am pleased to state, however, that ORNL is actively engaged in a strong and expanding research and development effort in this extremely important area.

Public Law 92-577, The Nonnuclear Energy Research and Development Act of 1974, mandates this Public Hearing as a forum to review the adequacy of emphasis on energy conservation and environmental implications of the Federal energy research, development, and demonstration program. I believe the Congress displayed much wisdom by embodying this important Public Hearing and review process into PL 92-577. I believe that the Congress was reflecting public concern that energy development (and other scientific and technological endeavors) should proceed with proper attention directed towards the health, safety, and environmental considerations. Research and development conducted towards the important goal of energy independence must be undertaken with proper regard for health, safety, and environmental factors. We must not compromise or mortgage the future health of our citizens and their environment while we strive to achieve independence. These goals are not mutually exclusive as some would prefer to believe. Neither is this a simple problem. However, I believe that virtually everyone benefits if we can satisfy both goals such that energy independence can be gained by developing the technologies in a way that is socially and environmentally acceptable; that is, with minimum societal and environmental costs. I should point out, however, that no energy producing technology will be environmentally benign. The nation must learn how to use its collective wisdom to decide what level of potential harm or detriment is socially acceptable in exchange for the energy produced to sustain the needs of our industry, our cities, and all our many institutions. This need, incidentally, applies to many other human activities that result in harm to man or his environment. In addition, we cannot afford to be wasteful of energy as each wasted unit adds an unnecessary increment to the societal costs (health and environmental) we pay nationally for obtaining energy.

I believe the DOE fully appreciates the need for pursuing both goals. The official DOE seal contains a green, blue, and gold color scheme which, I am told, is derived from nature symbolizing both the source of energy and the support of man's existence. The DOE enabling legislation also states that the DOE Assistant Secretary for Environment is responsible for assuring that all DOE programs are consistent with environmental and safety laws, regulations, and policies. The Assistant Secretary also provides guidance for the DOE Secretary to assure compliance with environmental protection laws and is responsible for review and approval of all environmental impact statements prepared by the DOE. Also, the Assistant Secretary must monitor DOE programs with respect to the health and safety of both workers and the general public.

In May 1977, President Carter presented an Environmental Message to the Congress in which he called for a variety of efforts relating to the environment including those related to the effects of pollution, toxic chemicals, and damage caused by the demand for energy. Five major areas were addressed:

- Pollution and Health
- Energy and the Environment
- The Urban Environment
- Natural Resources
- The National Heritage

Of these five, the second deals most directly with my presentation since it directs the Administrators of the Energy Research and Development Administration (ERDA, now the Department of Energy), Environmental Protection Agency (EPA), and the Secretary of Health, Education and Welfare (HEW) to establish a joint program to identify the health and environmental effects of each advanced technology that is the subject of federal research and development. President Carter also directed ERDA (now DOE) and EPA in May 1977 to jointly develop procedures for establishing environmental protection standards for all new energy technologies and asked that the procedures be agreed upon within one year.

The National Energy Plan reaffirmed the policies of attaining and maintaining the environmental goals set forth in the Clean Air Act, The Federal Water Pollution Control Act and the National Environmental Policy Act (NEPA). I believe the mandates and intents are clear. However, it takes people to make things happen and we all share the responsibility of seeing that these goals are realized.

I have attempted to discuss both the general and specific issues that were provided as part of the guidelines and supplemental information supplied to Hearing participants. I will first discuss the general issues before addressing the issues specific to the subject of oil shale and synthetic fuels from coal.

GENERAL ISSUES

What decision strategy should be used to best achieve stated program goals commensurate with environmental protection? What analysis should tie program elements together?

A decision strategy in which environmental issues play an equal role with technology feasibility and economic costs would be most useful. This necessitates that the Assistant Secretary for Environment be fully and meaningfully incorporated into the management team to ensure that environmental issues are identified and the necessary research initiated to ensure their resolution at all stages of process development. I also believe that there is a need for increased interagency cooperation and coordination since there is a need to develop environmental protection guidance, regulations, or standards for pollutants associated with some developing technological processes.

An important element in the achievement of program goals commensurate with environmental protection is the fostering of the concept of environmental assessments as management decision tools. Presently, the program and project decisions are typically based on economic, engineering, and technological factors while the environmental analyses enter the picture as an add-on. A very general environmental impact assessment, not a really detailed one, would be of benefit to decision makers and ultimately lead to better long-term economic and engineering decisions. For example, the maps of Gulf Coast environmental resources with the overlays for the Geopressure Wells of Opportunity program is a management decision tool that is playing an important role in the selection of geopressure wells. Another example is the use of computer interactive techniques for combining much information with modern computer graphic display techniques to aid in management decisions related to facility siting.

The preparation of these aids to management and the encouragement of these as benefits, not as roadblocks, is worth pursuing. Too often environmental impact assessments and environmental impact statements become nothing more than the critical path in the project because they are often started late or because they are only done to comply with the law.

How can the Federal resource constraints on technology development and application best be balanced to assure the environmental problems of energy technologies are minimized?

By implementing a management strategy that ensures early identification of potential issues and problems and providing sufficient resources to allow the research necessary to resolve the problem. Assigning the technologists the sole responsibility to conduct this research probably will not work. One can look at coal conversion demonstration facilities as an example of this problem. They have been sited in environments currently heavily impacted by man's activities. Thus, their value as a tool for demonstrating environmental acceptability (or identifying potential problems early on) is inherently limited. Some of these facilities could be sited with environmental issues in mind to allow their use also as an environmental demonstration rather than solely as a technology process demonstration.

How should decisions on environmental tradeoffs be made and implemented?

By encouraging strict implementation of the spirit of NEPA following adoption of a strategy that ensured development of necessary environmental research within time constraints of technology decision making. I would also encourage more intermixing of private and federally-supported research and development whenever possible at specific sites so that a combined approach can be adopted early on and more views and needs considered.

What are the appropriate roles of the Federal Government, other governmental levels and the private sector in addressing the balance between the need to develop new technology and the need to assure technologies will operate without unduly impairing environmental quality? For example, what is the appropriate role of the Federal, state, and private interests in commercialization and siting decisions?

The development and demonstration of new energy technologies must proceed in concert with research supporting process design. Research to ensure protection of environment and human health should be initiated during the early stages of process conception and continued through operation of demonstration plants. A serious concern is that in the haste of developing new demonstration units, the technologist may not consider environmental issues of significance until the licensing procedure has to be initiated. Environment is sometimes viewed as an obstacle to be overcome, rather than a partner in the design of new facilities. Environmental research needs should not be left to the technologist — for either the identification of needs or as a source of resources to conduct research. Close coordination between technology development and demonstration and environmental research must be effected at the appropriate management level to ensure that both are complementary and mutually reinforcing.

The Federal government should assume a primary role in not only the development, but also the siting of advanced technology facilities. Guidelines for operation and environmental surveillance need to be developed and uniformly applied. Working closely with state and municipal organizations is axiomatic.

Federally supported research products and findings need to be immediately transferred to industrial cooperatives who should play a major role in the construction and operation of new facilities. The Federal government can play a major role in coordinating and assisting state and private interest in commercialization of new technology so that the most advanced and environmentally acceptable process designs, siting criteria, and operating protocols are utilized.

Under our present system, private industry will not move into a new technology unless there is a positive profit foreseen. Therefore, the various governmental bodies must develop each technology to a point of lower risk. The transition to private industry should probably be encouraged by joint industry-governmental ventures (loan guarantee programs and demonstration). The siting and environmental control decisions might best not be left solely to private industry but perhaps be made by government, since only in this way can the environmental quality be in any way maintained.

Recent experience suggests that the Federal government take the lead in siting, but state, local, and private input be encouraged at the earliest point; i.e., decisions of this type will require full input from states to be successful.

SPECIFIC ISSUES — OIL SHALE AND SYNTHETIC FUELS FROM COAL

When must synthetic fuel technologies become available to ensure adequate energy supplies?

If energy independence rather than energy supply is the major criterion, then these technologies should be available today.

The maximum credible amount of synthetic fuels production that could be anticipated with an intense national effort in the absence of major dislocations in the economy is 1.7 million barrels/day (oil equivalent) by 1985. For comparison, we are currently importing about half of our oil (9 million barrels a day). Thus, synfuels alone cannot provide energy independence in the near term (see ERDA-1547). However, synfuels development should be viewed as an immediate need.

How can environmental issues — both those within a single plant and those which concern multiple, regional interactions — be adequately anticipated and solved?

Identification and solution of potential environmental issues surrounding emerging energy technologies can be accomplished only if environmental research is conducted parallel to and in concert with the technology development process. Over the past several years, the DOE (and predecessor agencies) have produced documents such as the Balanced Program Plan and Environmental Development Plans for the various developing technologies. The purpose of these documents was to identify the environmental issues. Recently, an interagency committee (DOE, EPA, and HEW) has initiated a plan whereby the specific research needs (at the project level) for the various environmental issues will be identified. Hence, planning the necessary research is well underway.

Undertaking this same research to provide solutions to the potential problems is not proceeding in as timely a fashion; primarily, I believe, because the environmental research is not progressing in concert with the technology development. A mechanism must be initiated which ensures that the environmental activities receive equal consideration in the process of technology development. This necessitates in DOE (as an example) that the Assistant Secretary for Environment prepare research plans concurrent with the plans produced in the various technology areas.

The development of coal conversion technology should include the following components:

- Determine technical feasibility
- Determine economic viability
- Determine environmental acceptability.

The determination of environmental acceptability must be given equal emphasis with respect to the other components at the earliest stage of evaluating this technology. The anticipation of environmental issues can be achieved at one level by providing interaction of environmental scientists and process design engineers at the onset of technology development planning. Environmental scientists can identify generic environmental issues based on appropriate design specifications and effluent source term characterization utilizing extant environmental data.

The second phase of anticipation of environmental issues necessitates a well-thought-out environmental research effort that keeps pace with the characterization of effluent source terms. This research effort should not only anticipate new environmental issues, but also work toward solving well-understood issues by providing feedback to the environmental control technology aspect of the overall effort.

The demonstration phase of coal conversion technology development will offer the first real opportunity for determining environmental acceptability of the specific process being tested. All of the above efforts working toward anticipation and solution of environmental issues regarding coal conversion technology development will come to focus during the preparation of a site specific environmental impact statement for a demonstration scale coal conversion plant. At that time, environmental issues will be anticipated to the degree that technology development and the most up-to-date environmental research allow. If well planned environmental monitoring programs _and_ plant-specific environmental research programs are implemented at demonstration scale facilities, the data generated should be sufficient to evaluate environmental issues. The environmental monitoring programs should attempt to evaluate predicted impacts, while the plant-specific environmental research should address the causes and affect those relationships that can determine, on a plant-specific basis, what additional control technology is needed to ensure environmental acceptability.

The elements of this plan necessary to ensure that we anticipate and solve environmental issues that are critical to determining environmental acceptability are:

- Participation of environmental scientists in the first stages of technology planning
- Carrying environmental research from the laboratory to the demonstration plants

Anticipation of environmental issues through laboratory research coupled with environmental impact statements can be confirmed, modified, and solved only through large-scale environmental programs at actual demonstration scale facilities. Environmental issues anticipated and solved through intensive coordinated environmental efforts at demonstration scale facilities should allow reasonable extrapolation to commercial size facilities.

The resolution of these environmental issues requires a multi-step research and assessment procedure which includes:

- Characterization of effluents. Contaminants released into the environment, either in effluents or in accidents or spills, must be identified and prioritized on the basis of their potential hazard. Initial screening of biologically active fractions may be the most reasonable means of ensuring that further research is focused on those constituents which are most hazardous to humans. "Characterization" thus entails both (a) biological screening, using such rapid and nonspecific tests as acute toxicity to specific test species and the Ames mutagenesis test; and (b) chemical analytical identification and quantification of potentially hazardous constituents.

- Estimation of effects of mandatory effluent treatment procedures. Existing regulations and federal New Source Performance Standards ensure that high concentrations of certain criteria toxicants will not be permitted to enter the environment. Some degree of effluent treatment and recycling, therefore, will be mandatory in all synthetic fuel facilities. Based on known treatment efficiencies of presently existing pollution abatement technology, reasonable estimates may be proposed for anticipated effluent release rates of major criteria pollutants, and also for certain non-criteria contaminants.

- Assessment of the environmental transport behavior of potentially hazardous contaminants. Based upon chemical form and other characteristics, different contaminants might be anticipated to impact biological systems in the environment differently. Microbial degradation, breakdown by sunlight, volatilization from water bodies (or precipitation into them), and settling out of air or water are processes which will determine levels of exposure of humans and other organisms to pollutants and will either mitigate or intensify possible toxic effects.
- Assessment of toxic effects of contaminants at multiple levels of response. Protection of humans and other organisms from contaminant levels causing immediate and acute toxicity may not be sufficient, particularly for contaminants which are degraded only slowly in the environment. Toxicity tests to individual species should also include long-term chronic tests for effects on growth and reproduction, as well as carcinogenicity and mutagenicity. Tests on supra-individual levels of organization are also important; some pollutants may manifest effects on entire ecological systems which are not apparent in individual test species.
- Assessment of interactive effects of contaminants. Releases from synthetic fuel plants will not occur *in vacuo*, but in regions already stressed with other airborne and waterborne pollutants. Prediction of combined effects of multiple stresses is only beginning to be attempted through use of model formulation and regional assessment.

- Integrated assessment of potential contaminant effects. Based upon anticipated release rates, environmental transport behavior (which will determine exposure doses to humans and other organisms), toxic dose-effect relationships, and potential regional interactions, decisions must be made on the acceptability of anticipated environmental effects. Where deemed necessary, criteria for acceptable discharge levels must be established, and required control technology and plant siting criteria modified to prevent unacceptable environmental deterioration.

Research on environmental problems must be tied closely to the developing synthetic fuel process technology; alterations in process and pollution abatement technology will modify anticipated contaminant release levels and possibly shift environmental and health research priorities. Environmental research must incorporate both laboratory studies utilizing identified contaminant compounds and field studies at small-scale conversion facilities or similar industrial processes to ensure development of an environmentally acceptable synthetic fuel industry. It is important that a holistic approach to solving this problem be adopted.

Will potential effects of short-duration events, such as catastrophic accidents, transients, and control system failures, be included in environmental assessments and in structuring the control technology development program?

It is essential that the various events identified above be included in both the environmental assessment and in the structuring of the control technology development program. The specific research approach identified under the previous question presents a functional approach to provide at least some of the necessary input. Ensuring that these parameters are included might require that the administrator in DOE responsible for the environmental, health, and safety research has an equal voice and sign off responsibility for the contracts necessary to initiate the larger scale demonstration facilities for the various emerging energy technologies.

It is imperative that the effects of short-duration events be included in any control technology development program. That this is an existing problem has been recognized (as in the promulgation of effluent regulations that may allow considerably higher releases over a short period of time). Due to the magnitude of the various waste streams, the toxic and/or carcinogenic nature of many of the compounds present and the intimate connections between the basic coal conversion process and any control schemes, the simple procedure of relaxing release limits over short periods of time will not be sufficient.

Initial programs are being developed (such as the DOE Gasifiers in Industry Program in cooperation with private industry) that will try to assess the reliability of present day control technologies for coal conversion processes. The effect of catastrophic accidents or failures on resultant effluent levels will be closely monitored and assessed.

Additional work will need to be conducted somewhere in the Federal or private establishment in a future control technology development and/or assessment program. As an example, one might consider biological oxidation units. Present operating conditions for biological units for municipal sewage and industrial wastes rely on a minimum amount of storage capacity to alleviate any failure of the microorganisms present from impacts such as toxic chemicals or extremely cold weather. Any untreated wastes that cannot be stored are often disposed in the nearest waterway with less-than-desirable effects.

New and innovative control technology, as well as sound engineering judgment, needs to be applied to the developing coal conversion industry. Again using biological degradation as an example, either biological units less susceptible to upsets and disturbances or methods for rapidly repopulating units will be needed. On-line monitoring equipment may be required to warn of imminent toxic conditions, thus temporarily bypassing effluent to a backup control system.

How can we include the assessment of socioeconomic, health, and other factors both in the production and use of these fuels?

The inclusion of socioeconomic and environmental (including human health) factors in the assessment of various energy technologies is assured by the NEPA. What is somewhat unfortunate is the fact that the data necessary to produce an accurate estimate of potential ramifications are not being developed as rapidly or completely as necessary. This problem goes back to the second specific issue I discussed. The environmental issues (necessary research) must be addressed concurrently with process development. The Assistant Secretary for Environment should be an equal partner in the development of new energy technologies if assessments are to be inclusive and accurate.

How can the development of synthetic fuel technologies best be managed to assure that the cost and capabilities of process configurations and pollutant control devices are fully explored and demonstrated?

I believe opportunities exist for more coordination and interaction between developers of technological processes and groups responsible for control technology and environmental assessment. In many cases, process development is far ahead of research and development efforts on control technology.

As the various synthetic fuel processes tend to produce sizeable quantities of gaseous, aqueous, and solid effluents, the toxic and carcinogenic nature of which is presently being tested, it becomes imperative that the various process configurations and pollution control devices be investigated fully in parallel with the development of the coal conversion process.

For those technologies in which existing processes are being installed and operated, only presently available control schemes are justified. The need here is for monitoring the operation of the various plants in a comprehensive fashion, both from the standpoint of the efficiency of any installed control devices and/or process configuration modifications, and to determine the environmental and health effects of the various levels and types of pollutants emitted.

In the developing technologies modifications of the process configuration may be the primary means of effecting a reduction in effluent discharges without sizeable increases in cost or complexity. Investigation into ways of reusing or recycling contaminated streams internally will be of considerable importance. As an example, the development of coal or char gasifiers units capable of using dirty recycle water rather than high quality steam would be a constructive measure.

For those technologies in which process modification is not practical, there is a need for the development of new control technologies (or modification of existing technologies) parallel to the development of the process. This concurrent development makes the integration of process and control technology much smoother without the more usual add-on type of effluent control. Retrofitting is generally an extremely expensive means of providing a corrective measure or action.

How can the chronic health problems, such as carcinogenesis of synthetic fuels, be detected before the occupational or general population is exposed?

No "fail safe" approach to this question exists. What can, and must, be done is to incorporate integration of chemical and biological screening of process, product, and effluents at the earliest stages of process development, even though validity of samples is questionable. This necessitates that health studies be developed parallel and concurrent with the process development time frame.

Longer term studies designed to validate screening procedures, determine mechanisms of effects for effluent types and determine form, source, and critical pathways whereby materials may reach man will also be drawn upon heavily to assess these potential problems.

I believe the key to early detection of chronic health problems of synthetic fuels is the integrated holistic approach of chemical <u>and</u> biological screening. "State-of-the-art" chemical methodology can be coupled with short-term tests such as microbial and mammalian cell mutagenesis along with cellular assays for toxicity. With the proper validating experiments in place <u>now</u> with higher organisms, these cellular assays will be useful <u>predictors</u> of potential health hazards. Furthermore, the biological experimentation will lead us to a better understanding of the chemical classes of materials involved and allow the deployment of more appropriate chemical monitoring.

There are two broader issues that I would like to address as the result of discussions with colleagues at Oak Ridge National Laboratory. One concerns our national difficulty in arriving at a broad consensus on acceptable tradeoffs between environmental protection and other goals of society such as the important ones of achieving energy independence and avoiding energy shortages. The second is the question of the Federal role in a situation where a vast number of impacts and decision-makers are either local, state, or regional in scale.

THE NEED FOR CONSENSUS-BUILDING

At a Congressional hearing last month, Lewis Branscomb suggested that the biggest single challenge to science and technology policymaking in the United States is that our consensus-building machinery has broken down. Facing national decisions on the use of new technologies that require far more than majority support before a strategy can be implemented, we find that we only know how to relate to each other as adversaries, sharpening our disagreements rather than arriving at a consensus view. Consequently, the movement of our nonnuclear energy research and development toward decisions on commercial utilization (pro or con) is delayed. Often, the focus of the controversy is the environmental acceptability of energy technologies.

I believe that a conscious aim of the Federal energy research and development program should be to help create a broad national agreement on an energy supply strategy, recognizing that our energy policy system is pluralistic, and we believe that there are some concrete ways to do this. For example:

- Technology demonstrations, at or near commercial scale, can be made the cornerstone of utilization decisions.

Confidence in data about the environmental impacts of a technology is highest when they come from an actual commercial scale facility, where the interested parties can verify information for themselves and resolve disputes about impacts by observing them together. In order to make full use of demonstrations as consensus-building activities, it is essential to anticipate the diversity of possible interests in phenomena and processes that need baseline information for evaluation, and it is important that the operator of the demonstration plant develop and use a plan for broad participation by parties-at-interest in verifying the resulting impact information.

- Technology assessments can be used to involve a wide variety of interests in the identification of environmental issues at a relatively early stage of technology development. At one or more decision points before a technology reaches the demonstration stage, a study can be prepared of its likely environmental, socioeconomic, and institutional consequences. Using representatives of the range of potentially interested parties as reviewers, it is possible to identify and discuss issues before the parties become adversaries, and the likelihood is increased that no serious questions will be overlooked.
- In environmental research programs, more emphasis can be given to anticipating future information needs. Because large-scale research on the environmental and health impacts of coal utilization was not begun until very recently, we find it necessary to make coal policy decisions without an

adequate knowledge of the hazards. For instance, research on possible genetic effects of coal compounds probably cannot be completed rapidly enough to make decisions about coal use in 1985. We are catching up as quickly as we can for coal, but what about the other energy options? They may look better to us partly because we know so little about many of them. In general, the further any technology is away from development or demonstration, the more benign it appears from the health, safety, and environmental aspects. As we learn more about a system we become more aware of its potential impact or, as I prefer, societal cost, relative to human health impacts and environmental deterioration.

THE FEDERAL ROLE

The extended discussion of the National Energy Plan in the past year has reminded us forcefully that many — and perhaps most — of the environmental issues associated with energy supply systems are regional: resource limitations, the impact of particular residuals on ecology and society, and sectional viewpoints about tradeoffs. There are increasing questions about the proper role of the Federal government in determining environmental protection policies and standards and the clear trend is toward more active participation by state and local governments in this field. The Resource Conservation and Recovery Act of 1976 and the proposed bill to improve the nuclear facility siting procedure are examples of federal initiatives along this line.

I believe it is inevitable that non-federal levels of government will become the foci of decisions on environmental tradeoffs of energy policy alternatives. Harmony between energy development and regional concerns will be largely defined at the regional level, with the Federal government playing a kind of "balance-wheel" role — defining boundaries of acceptability, offering incentives for decisions that are in the national interest, and helping to resolve conflicts between neighboring states and regions whose decisions affect each other.

In general, this is both appropriate and desirable, and we believe that it is time to take a systematic look at it as a broad federal policy. There is an urgent need to consider the structural relationships between federal environmental research and development programs and state government decision-makers. How do the needs of decision-makers in state government get incorporated into our programs? Who pays? Who does what? How does our specialized knowledge get used when conflicts arise between states or regions?

These are the types of interface questions that need to be answered so that our research on environmental and health protection will contribute to meeting both our national energy objectives and our national environmental objectives.

To conclude, I would like to provide an example of an integrated multi-disciplinary approach towards the goal of establishing an environmentally acceptable technology based on coal conversion (attachment 1). This illustration indicates the many facets of a program that by itself is inherently limited unless it is meaningfully linked to the developing technology in concert with the assessment of technical and economic feasibility. I am pleased that interagency programs are moving to site-specific demonstration applications where we can attempt this marriage of integrated assessment, including health and environment, as the technology under consideration develops in size and complexity.

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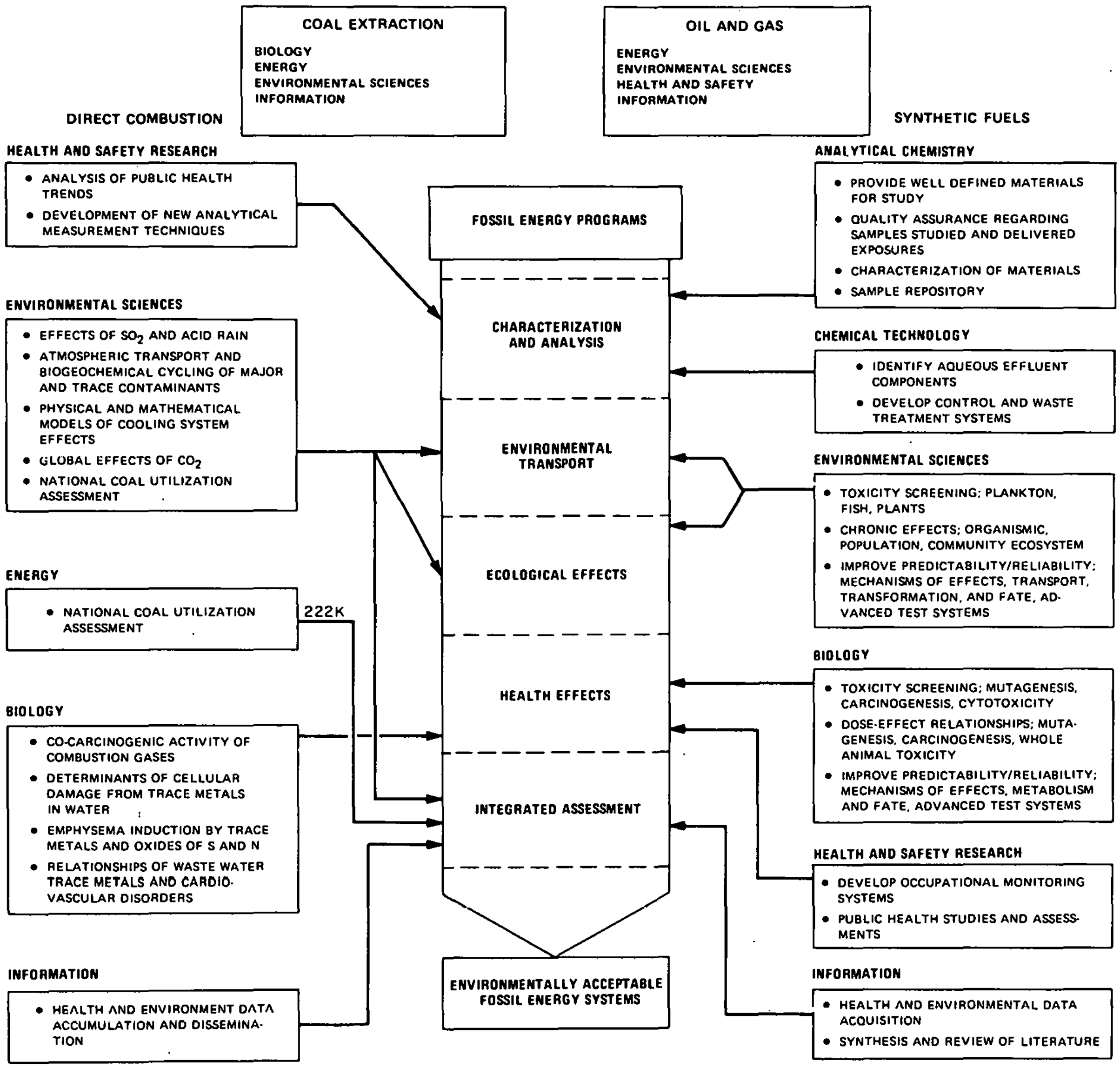

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