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PROGRAM SUMMARIES FOR 1979 -
NATIONAL CENTER FOR ANALYSIS OF ENERGY SYSTEMS;

December 1979

DEPARTMENT OF ENERGY AND ENVIRONMENT

BROOKHAVEN NATIONAL LABORATORY
UPTON, NEW YORK 11973

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PROGRAM SUMMARIES FOR 1979
NATIONAL CENTER FOR ANALYSIS OF ENERGY SYSTEMS:

B. MANOWITZ, Chairman
L.E. RUFF, Associate Chairman for NCAES

December 1979

NATIONAL CENTER FOR ANALYSIS OF ENERGY SYSTEMS
DEPARTMENT OF ENERGY AND ENVIRONMENT
BROOKHAVEN NATIONAL LABORATORY
ASSOCIATED UNIVERSITIES, INC.

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ABSTRACT

This report summarizes the activities and accomplishments of the National Center for Analysis of Energy Systems during 1979. The Center, founded in January 1976, is one of four areas comprising the Department of Energy and Environment at Brookhaven National Laboratory. The major ongoing activities of the Center concern integrated, quantitative analyses of technological, economic, and environmental aspects of energy at the regional, national and international levels.

This report describes the objectives, activities, and sources of support of each of the programs, and outlines the major accomplishments during the year. It also indicates some of the planned future activities of the Center, and lists recent publications.

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INTRODUCTION

The National Center for Analysis of Energy Systems (NCAES), established at Brookhaven in January 1976, performs quantitative, interdisciplinary studies of the technological, economic, social, and environmental aspects of energy systems. The Center staff consists of experts in the areas of science, technology, economics, planning, health and safety, information systems, and quantitative analysis. Although the U.S. Department of Energy (DOE) is the principal sponsor of the Center's programs, work is performed when appropriate for other federal agencies and for state and regional agencies, regulatory bodies, and planning groups.

The emphasis of the programs at the Center is on energy policy and planning studies at the regional, national, and international levels. This work is designed to assist several offices in DOE, including the Energy Information Administration, the Assistant Secretaries for the Environment, for Policy and Evaluation, for Conservation and Solar Applications, for International Affairs, and for Fossil Energy, and the Economic Regulatory Administration. A portion of the effort is devoted to the development of planning frameworks, analytical models, data bases and assessment methods that are required to give support to the energy studies. Thus, the program involves both operational support to DOE and original research in energy systems analysis.

Individuals associated with the Center participate in major panel and committee activities in the energy area. Analytical methods and data bases developed at Brookhaven and maintained by the Center are used by federal and state agencies, international organizations, and industrial and university analysts. This interchange of people and techniques serves to keep the Center at the forefront of the energy analysis area.

The primary objective of the NCAES is to contribute to DOE's capability to perform integrated, multi-disciplinary energy technology assessments and policy analyses on a continuing basis. Secondary objectives derived from this primary goal are:

- To develop improved data bases and quantitative methods for analyzing energy policy issues, and energy-economy interactions.
- To develop improved methods for describing and analyzing energy systems with technological, locational and dynamic detail.
- To analyze biomedical and environmental impacts of energy strategies, giving appropriate recognition to risk and uncertainty.
- To explore international and regional aspects of energy technology and policy as these relate to national energy issues.
- To work with other federal agencies, regional planning and regulatory agencies, universities, and industry groups in the analysis of special problems of mutual interest and in the development and dissemination of information and analytical methods.
- To provide support and facilities for workshops and special study groups assembled to address important topics.

SIGNIFICANT ACCOMPLISHMENTS - 1979

During 1979, the NCAES continued the basic program of quantitative, integrated studies of the energy system and its interactions with economic, environmental and social systems. The development of comprehensive analytical methods and data bases needed for such analyses remained an important part of the Center program. Increased attention was given during the year to more detailed analyses of specific policy issues and energy supply/demand subsystems and technologies.

Assessment of the environmental impacts of energy supply systems, and analysis of the technology and economics of energy conservation and solar energy, were the principal subject matter areas dealt with by NCAES during 1979. Analyses of fossil energy supply and conversion were smaller parts of the program, but are expected to become much more significant in response to increased national interest in synthetic fuels. International analysis and assistance continued to be an important area of NCAES activity.

Methods and Data Development

The NCAES maintains a comprehensive set of data bases and energy models that provide an integrated framework for analysis. This set includes the Energy Model Data Base (EMDB), developed under the auspices of the Council on Environmental Quality, the Energy Research and Development Agency, the National Science Foundation and the Environmental Protection Agency; the EMDB contains technical, economic and environmental data for 400 energy supply/conversion processes and 200 end uses. The Reference Energy System (RES), a network representation of energy flows from resource base to end services, has been combined with this data base in several computerized models, including the Energy System Network Simulator (ESNS), and the Brookhaven Energy System Optimization Model (BESOM).

Over the past several years, these data bases and models have been refined and extended. As part of an international cooperative effort housed at NCAES and sponsored by the International Energy Agency (IEA) (see below), the RES/BESOM concept has been used to develop a multiperiod linear programming model (MARKAL, for "Market Allocation"), and the technology data base has been updated and expanded; during 1979, the development effort was essentially completed, and each of the participating IEA countries used MARKAL to assess

the role of new energy technologies within each specific national energy system. In a smaller, internal effort during 1979, TESOM, a dynamic or "time-stepped" version of BESOM, was developed to provide a "rational expectations" alternative to clairvoyant optimization models such as MARKAL; TESOM includes an economics-motivated market penetration algorithm, and has been linked with the socio-economic model of Dale Jorgenson and Associates (DJA) for the purpose of assessing the long-term interactions between energy strategies, technology and the economy.

During 1979, the Center's capabilities in data system design were used in two DOE programs involving the organization and documentation of national data. In one, the RES framework was expanded to include more detail on transportation, storage, and refining, as part of the Energy Emergency Management Information System (EEMIS) being developed by the Energy Information Administration (EIA). And for the other DOE program, NCAES designed a format for collecting and documenting data characterizing diverse energy technologies in a way that would allow consistent treatment of these technologies in various models and analyses.

Evaluation and documentation of energy models for the Energy Information Administration continued during 1979. In particular, the NCAES project in support of EIA's Long-Term Energy Analysis Program (LEAP) helped to enhance EIA's long-range analysis capability and provided documentation of LEAP to EIA's standards.

In another information and data system program, a New York State Energy Information Analytical System (NYSEIAS) was completed during 1979. The NYSEIAS provides to the New York State Energy Master Plan county-level data concerning production, conversion, distribution and consumption of energy within New York State, along with the capability to project energy costs and environmental residuals in the ESNS format.

During 1979, the various quantitative methods used in evaluation of proposed nuclear power plant sites were assessed and compared in a NCAES program for the Nuclear Regulatory Commission. It turns out that different methods often produce different rankings of alternative sites; so the Center is developing criteria to be used in appraising nuclear power plant siting studies.

Environmental and Regional Impact Assessment

The energy system in the United States will change dramatically over the next years and decades, in ways that could have seriously adverse social, economic, environmental and health effects on the nation and for particular regions. At the NCAES, work has been under way for several years to identify and, where possible, quantify the damages and risks associated with existing or proposed systems for extracting, converting, transporting and using energy in its many forms, at both national and regional levels.

The basic approach used in this environmental and regional impact assessment work is to use the NCAES energy models and data, and other relevant information, to develop a comprehensive, detailed description of the energy system being assessed. This description identifies the locations and types of environmental residuals and other dangers associated with the energy system, from resource extraction to use of the services the energy provides. Models of pollutant transport, transformation and effects are then used to estimate where and how human health and other relevant factors might be affected. Of particular concern in these analyses is identification of the sources and extent of the scientific uncertainties--which are large, especially where effects on human health are concerned.

During 1979, this analytical approach continued to be applied to national and regional energy policies and scenarios. The health and environmental effects associated with the gasification liquefaction and direct combustion of coal were assessed. In the National Coal Utilization Assessment, completed in 1979, the NCAES played key roles in analysis of the long-range transport of sulfur oxides and the associated potential health effects. As part of the Regional Issues Identification and Assessment (RIIA) Program, the Center's role was expanded to include assessment of the solid waste implications for the entire U.S. at the county level, and an in-depth environmental assessment for the Northeast United States. Work was begun on an analysis of solar energy actions as part of the Technology Assessment of Solar Energy of RIIA; and an assessment of the health and environmental effects of solar photovoltaic energy systems is being undertaken.

In addition to participation in DOE's continuing program of health and environmental assessments, NCAES personnel continue to play important roles in international assessment activities. During 1979 these included the United Nations Environmental Program assessments of the environmental aspects of the

nuclear and fossil fuel cycles and on renewable energy sources, and the sulfur air pollution project of the Organization for Economic Cooperation and Development.

Conservation and Solar Energy

Analyses of various aspects of energy conservation and solar energy were a major part of the NCAES program in 1979. These activities ranged from assessment of the macroeconomic effects of a national energy strategy emphasizing conservation and solar, to analyses of the technical and economic feasibility of self-contained solar energy systems for homes.

At the macroeconomic level, during 1979 the Center completed an analysis comparing three broadly defined national energy scenarios for the rest of this century: a base case; a scenario involving rapid development of a large synthetic fuels industry; and a scenario emphasizing conservation and solar energy. The conclusions were that, compared to the base case, either the large-scale synthetic fuels or the conservation/solar strategy could significantly reduce oil imports, but that the national economic cost of the synfuels program would be higher, given the cost and effectiveness assumed for each strategy. More broadly, the implications of this study are that, since there is great uncertainty about the costs and effectiveness of both synfuels and solar/conservation, a mixed strategy encouraging both synfuels and conservation/solar, but in more modest fashions than postulated by DOE in the scenarios analyzed, would probably be more cost-effective than either strategy alone.

In order to help identify specific opportunities for solar and conservation, one program in the Center is developing detailed computer models of the technical processes and energy use in particular energy-intensive industries; during 1979 the model of the pulp and paper industry was completed and transferred to DOE. Another NCAES program is analyzing the use of vehicles in fleets to determine how the special characteristics of fleet operation might be exploited to encourage adoption of innovative vehicle concepts. In 1979, a program was begun to assess the potential for energy-conserving district heating systems using geothermal hot water sources--although other sources of hot water, such as waste heat from power plants, could also be used.

One drawback to use of solar energy is that it can deliver continuous, dependable source only in conjunction with storage devices or a utility system providing back-up service as needed. At the Center, a program on energy stor-

age has examined the possibility of using both solar-produced electricity and the inevitable reject heat associated with the electricity production to meet the energy demands of various residential complexes, ranging from single family homes to apartment buildings. The study considered systems disconnected from the electric grid and determined "breakeven costs" for the necessary storage devices as a function of fossil fuel prices, collector costs, and geographic location.

In another study, the fuel saving potential of a possible solar storage and collection device, suitable for retrofit to existing buildings and for incorporation into new structures, was estimated using several models representing the national stock of commercial and residential buildings. These results are being combined with cost data and with regionally disaggregated census data on housing and fuel types to permit accurate estimation of national oil and gas savings that might be obtainable through widespread use of such a device, and the associated costs.

If solar energy systems (or other decentralized sources, such as cogenerators) can purchase back-up energy at reasonable prices from a utility system, their economic viability can be greatly enhanced; but utilities often charge high prices for such back-up services, on the grounds that it is costly to maintain the standby capital facilities required. In a program at the Center, the cost situation of some actual electric utilities is being analyzed, using utility capital expansion optimization techniques. Data on local weather and the forecast load curve of the utility are used to determine whether demands for back-up power for solar energy systems would, over the long run, coincide with the system's peak demand more often than would the demand from other power users. The general conclusion, for utilities in climatic areas as diverse as New York and New Mexico, is that providing power for solar back-up would not necessarily be more costly in the long run than providing power for general use.

In another energy conservation program at the Center, analytical support is provided to DOE in the preparation of Building Energy Performance Standards (BEPS). A computer model has been developed at the Center to relate heat loss to building design, and during 1979 was used to perform cost-effectiveness studies of proposed BEPS.

In an energy emergency, extreme measures may have to be taken to curtail energy use. In a program supporting the Economic Regulatory Administration

(ERA), the Center is assessing some of the emergency curtailment plans in existence or proposed for electric utilities, and is developing methods for estimating their social and economic impacts.

Fossil Energy and Synthetic Fuels

The Center has a continuing, but small, program involving development and assessment of methods for analyzing fossil fuel conversion and utilization technologies. During 1979, the coal-to-synthetic-gas portion of the Materials Process and Product Model being used by DOE was validated. This effort is being expanded to include analyses in support of the electric utility technology program of DOE/Fossil Energy; present work involves a review of market penetration and utility expansion models to select those most appropriate for the task, and the development of a utility market data base to provide the degree of regional definition required for the study.

In another fossil energy-related activity during 1979, the Center began an assessment of domestic oil and gas supply modeling methods, in support of the energy modeling activities of the Energy Information Administration.

The Center's activities in areas described elsewhere in this report, particularly in environmental assessment and in method and data development, also relate to fossil energy and synthetic fuels. Given the growing interest in these subjects, it is expected that the Center's programs will deal even more with fossil energy and synthetic fuels issues in the future.

International Programs

The NCAES has for several years been involved in studies related to the energy situation in other countries. During 1979, the Center continued its participation in these programs, such as DOE's International Energy Development Program (IEDP), U.S. Agency for International Development (AID) Energy Management Training Program (EMTP), and the International Energy Agency (IEA) cooperative R&D analysis program. In addition, a program of technical assistance for energy analysts in foreign research institutions was continued.

Building on experience gained in the energy assessments carried out in 1978 in Egypt and Peru under the IEDP, the Center has worked to strengthen the existing methodological and analytical tools by adding closer linkages between the energy system and the economy. During 1979, a linked energy-economic model called the Brookhaven Energy Economic Assessment Model (BEEAM), specifically suited for assessing the impacts of future developments in the economy on

the energy system, was developed and validated with data obtained from Peru. BEEAM will be applied to other developing countries in future energy assessments to be conducted under the IEDP.

Work continued on projects for USAID initiated in 1978. Studies on energy use in the food system of Senegal and the Dominican Republic made progress, with results of the analysis expected in 1980. A second course in energy management for energy planners from developing countries was given in the fall of 1979 in collaboration with the Institute of Energy Research, State University of New York, Stony Brook (SUNY). This course brought 28 planners from 26 countries to BNL/SUNY for eight weeks and resulted in fruitful and mutually beneficial exchange between NCAES staff and the visitors on a wide range of Less Developed Countries' (LDC) energy problems, models and planning mechanisms.

The NCAES serves as host to a multinational energy systems analysis study conducted under the cognizance of the IEA. The primary objectives of the program are to develop an international R&D strategy and to identify new energy technologies that merit cooperative research and development effort by the IEA member nations. The program is conducted jointly with the Kernforschungsanlage (KFA) in Julich, West Germany. During the past year the participating countries and agencies working at the Center have included the Commission of European Communities (CEC), Canada, Ireland, Japan, Norway, Sweden, and the United States.

In the IEA program the future impacts of new technologies on the national energy systems are estimated with the aid of a multiperiod computer model, MARKAL. The analysis has concentrated on sixteen scenarios that represent various levels of policy decisions concerning oil import levels, environmental impacts, acceptable levels of nuclear power, etc. The results were presented to the IEA in a series of country reports during 1979. A Phase III for the project is in the planning stages.

The National Center is often requested to provide technical support to analysts in other countries in acquiring the RES and BESOM, and a program to support such activities is funded by DOE. As part of this program, a FORTRAN version of BESOM and instructions for its use and interpretation were made available to Greek personnel at their computing facility in Athens; in 1979, a

major coal assessment performed for the Greek Ministry of Coordination using the model was instrumental in the formation of policy in Greece. Also, Center staff provided technical assistance in the use and interpretation of BESOM for the Federal Nuclear Research Institution of Switzerland, where it is used by the Swiss Energy Department for energy policy analysis.

SUMMARY OF SIGNIFICANT ACCOMPLISHMENTS OF 1979
BY NCAES DIVISION/GROUP

Regional Studies Division

- Completed the second phase implementation of the NYS Energy Information Analytic System and its transfer to the New York Energy Office.
- Completed an assessment of state electricity demand curtailment planning and initiated an assessment of the socioeconomic consequences of long term electricity supply disruptions.
- Participated in DOE's first annual Regional Issue Identification and Assessment, in which a "business-as-usual" energy supply and demand projection was analyzed in detail, with emphasis on environmental effects.
- Provided assessments of selected energy conservation measures in terms of feasibility, desirability, and institutional constraints, and of a "maximum practical" solar energy utilization scenario.
- Continued an evaluation for the Nuclear Regulatory Commission of methodologies used in siting nuclear power plants to determine whether or not different methods produce different results and to develop criteria for judging nuclear power plant siting studies.
- Completed, in conjunction with the International Energy Agency project, a series of energy scenarios for member countries Canada, Ireland, Japan, New Zealand, Norway, Sweden, and the United States.

Economic Analysis Division

- Completed assessment of macroeconomic, national security (oil imports) and environmental effects of selected strategic energy policy alternatives.
- Evaluated projects of the Architectural and Engineering Systems program, along with other programs of the DOE Office of Building and Community Systems, using the Threshold Evaluation System.

- Extended the structure and applicability of the Brookhaven Energy Conservation Optimization Model (BECOM) to provide a market penetration analysis for DOE/Buildings and Community Systems; the model results were used to provide assistance to DOE in the development and analysis of BEPS.
- Constructed, validated, and documented a dynamic, five-period process model of the domestic pulp and paper industry, incorporating a new risk-adjusted discounting methodology for application to risky new technologies.
- Developed a model and data base for use in analyzing the rate of market penetration of electric and hybrid vehicles.
- Devised and computerized a methodology for the estimation of residential demand for geothermal district heating along with an associated piping design methodology and data base; a specific detailed economic evaluation of geothermal district heating for Salt Lake City was completed.
- Developed an analytic method for estimating long run incremental value (cost) of electricity provided to (taken from) electric utilities by facilities or residences using solar or cogenerating devices interconnected to a utility grid; this method was applied to several electric utilities.
- Analyzed the relationships among the prices of substitutable energy forms, the quantities of energy used and the performance of the U.S. economy through the comparison of two independent projects performed with the BNL/DJA (Dale W. Jorgenson Associates) modeling system and the FOSSIL2/DRI (Data Resources Inc.) modeling system.

Biomedical and Environmental Assessment Division

- Performed a comparative analysis of health and environmental impacts of coal gasification, liquefaction and direct combustion.
- Assessed impacts on the environment and on endangered species of solid waste from coal combustion and transportation of fuels and wastes.
- Evaluated differential effects of pollution and income on changing mortality rates by age, race and sex (at the county level) for the entire U.S.

- Developed a methodology based on path analytic techniques for analyzing relationships between water quality and energy supply and demand.
- Assisted the United Nations Environmental Program in preparing environmental assessments of the coal and nuclear fuel cycles, and contributed to a Seminar on Environmental Assessment of Energy Supply Scenarios held by the Organization of Economic Cooperation and Development.

Technology Assessment Group

- Assisted in the development of the Energy Emergency Management Information System for the Energy Information Administration, by designing the data structure and identifying the data requirements. EEMIS is designed to monitor and assess the U.S. energy system at a national, regional, or state level to assist in managing energy emergencies.
- Developed a format for a technology characterization data base in order to provide a consistent basis for collecting and maintaining data describing existing and future technologies. The format insures that comparable results will be obtained when the data are used for various analyses (i.e., technology assessment, economic modeling) across different disciplines and organizations.
- Completed an analysis of the potential role of decentralized energy systems in the near and long term U.S. energy system. Both technical and social issues were addressed.

Energy Data and Models Group

- Developed and documented resource submodels of oil, gas and coal for EIA's Long-term Energy Analysis Program (LEAP). The submodels incorporate the data and assumptions of EIA's Mid-term Oil and Gas Supply Modeling System and National Coal Model.
- Developed a "time-stepped" or dynamic version (TESOM) of the Brookhaven Energy System Optimization Model, and linked it with a long-term macroeconomic model, for studies of the impact of future technologies.
- Transferred NCAES models and methods to analytical groups in Greece and Switzerland, and advised the analysts during application of these methods to energy policy studies for their governments.

DEPARTMENT OF ENERGY AND ENVIRONMENT BROOKHAVEN NATIONAL LABORATORY

PROGRAM SUMMARIES AND PUBLICATIONS
BY NCAES DIVISION/GROUP

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I. REGIONAL STUDIES DIVISION

Title: Regional Assessment

FY 79: \$480,000

Principal Investigator(s):
F. W. Lipfert and J. S. Munson

FY 80: \$540,000

Sponsor: Environment/Office of Tech-
nology Impacts

This project is in support of the Regional Assessment Division (RAD), of DOE's Assistant Secretary for Environment. Brookhaven provides detailed assessments and analyses of the regional land use, water use, socioeconomic and residual management implications of energy technologies and activities. Particular attention is given to interrelationships between the natural and developed attributes of the Northeast, for the purpose of examining physical, environmental, and human resource constraints to technology assimilation. The major activities are:

Regional Characterization: This ongoing activity provides the basic data and information upon which all other activities are based. Data describing the geophysical, demographic, economic, ecologic, and cultural characteristics of the Northeast as they currently exist, are gathered in a format consistent with that used by the other national laboratories for their regions.

Issue Identification: Based upon the characterization of the Northeast and the various future energy scenarios developed by DOE, this activity quantifies the potential environmental and socioeconomic conflicts that may develop if the energy strategies are implemented as described.

Methodology Development: This activity adapts analytic tools, techniques, and structures developed under research-oriented programs so that they are suitable for assessment purposes. This includes structuring information and characterizing processes in a manner appropriate to regional environmental policy analysis.

Title: Technology Assessment

FY 79: \$430,000

Principal Investigator(s):
F. W. Lipfert and E. Kaplan

FY 80: \$490,000

Sponsor: Environment/Office of Technology Impacts

This project is in support of the Technology Assessment Division (TAD) of DOE's Assistant Secretary for Environment, which provides continuing overview of environmental, health, and safety aspects of energy supply and conservation technologies. Brookhaven's tasks both delineate environmental constraints that can be identified on the basis of existing information as well as identify additional R&D and data needs for TAD assessments. Within the TAD program of multi-laboratory technology assessments, Brookhaven is assigned lead responsibilities for analysis of the long range transport of air pollutants, health effects, and solid waste impacts. BNL has also provided technical assistance in preparation of Environmental Development Plans (EDPs) and Environmental Readiness Documents (ERDs). In cooperation with other national laboratories, BNL is also involved with health, environmental, socioeconomic and institutional assessments of conservation and solar energy scenarios. Other Brookhaven activities involve an assessment of industrial energy use (a lead lab responsibility), an assessment of the environmental impacts of enhanced oil recovery (EOR) techniques, and a study of health effects of carbon monoxide and fine particulate emissions related to the transportation sector.

Title:	Developing Country Energy Project: Methodologies Development		
FY 79:	\$465,000	Principal Investigator(s):	V. Mubayi and S. Kyle
FY 80:	\$230,000	Sponsor:	International Affairs/International Technical Programs

The development and extension of appropriate models and methodologies for energy system analysis in developing countries is an important part of the Developing Country Energy Project at Brookhaven National Laboratory (BNL). A linked energy-economic analytical framework called the Brookhaven Energy-Economic Assessment Model (BEEAM) has been developed specifically to address the analytical requirements of the DOE Country Energy Assessments Program. BEEAM is currently being tested with data from the Peru Assessment; the results will provide a better understanding of the connection between energy use and economic development and as a consequence provide useful input to future country assessments.

The overall approach in BEEAM is based on linking: (i) an interindustry matrix of transactions partitioned into energy product, energy services, and non-energy sectors; (ii) the Reference Energy System, augmented by a "Non-Commercial Fuels Estimator," which provides a framework for analyzing energy system characteristics such as technologies currently in use, fuel flows, fuel substitution possibilities, etc.; and (iii) a simple macroeconomic growth model of the type used at the World Bank, which calculates balances of savings and investments, imports and exports from value added, and growth rates that are derived from the solution of the interindustry matrix. The flexible design of the model allows its application to countries of widely divergent levels of economic development.

Title: IEA Systems Analysis Program

FY 79: \$410,000

Principal Investigator: V. L. Sailor

FY 80: \$170,000

Sponsor: Office of Energy Research
Program Analysis

Brookhaven National Laboratory (BNL) and the Kernforschungsanlage-Julich (KFA) have been serving as the American and European sites, respectively, for a multinational energy systems analysis program of the International Energy Agency (IEA). Close coordination has been maintained between the two programs, which report to the IEA Steering Group for Energy R&D Systems Analysis.

The primary objective of the program is to assess new energy technologies and to evaluate their possible roles and impacts on the energy systems of the member nations of the IEA. Data on new energy technologies are collected and evaluated in an international context. A computer model, MARKAL, has been developed especially for the purpose of analyzing the economic potential of the new technologies under various sets of assumed policies and world conditions using a linear programming approach. Each country is modeled separately, and then the collective aspects for the IEA nations as a group are evaluated.

In Phase III of the project, which began on January 1, 1980, the participating countries will share in the project costs at BNL and KFA. Participating countries at BNL will include Australia, Canada, Ireland, Japan, New Zealand, Norway, Spain, Sweden, and the United States.

Title: Continuing Efforts in Support of Electricity Demand Curtailment Planning

FY 79: \$200,000 Principal Investigator: J. Allentuck

FY 80: \$250,000 Sponsor: Economic Regulatory Administration/Office of Utility Systems

The regulatory assistance function of the Economic Regulatory Administration (ERA) of the Department of Energy (DOE) includes planning at the federal level for the mitigation of the consequences of electric supply inadequacy of substantial duration and/or extent. The formulation of a federal role required the assessment of existing state plans for electric demand curtailment in the event of such supply inadequacy. This assessment is nearing completion under a task started in FY 79. Tentative conclusions have been reached regarding an appropriate approach to demand curtailment planning and the corresponding federal role. The current program is concerned with implementing the federal role, by assisting states in electric demand curtailment planning and by integrating electric demand curtailment planning with other aspects of DOE programs for mitigating the possible effects of energy shortages.

Title: Socioeconomic Disruptions from Long-Term Electricity Supply Shortages

FY 79: \$35,000 Principal Investigator: J. Allentuck

FY 80: \$183,000 Sponsor: Economic Regulatory Administration/Office of Utility Systems

The objective of this effort is to quantify the cost of socioeconomic disruptions that may arise as a consequence of long-term (1-12 months) deficiencies in electric energy. The work is motivated by the Public Utilities Regulatory Policies Act (PURPA) of 1978 Section 109, which requires among other things that the Secretary of Energy report to Congress on the level of electric power reliability appropriate to adequately serve consumers, taking into account cost effectiveness and the need for conservation.

In this project electric supply deficiencies will be postulated for various regions of the country. These will be related to scenarios of energy shortages that are the consequences of events such as a coal strike of long duration, a drought, an Arab oil embargo, or a shutdown of a large fraction of the country's nuclear capacity. Resulting socioeconomic consequences will be examined for their effects on the residential, commercial, and industrial sectors.

Title: Regional Analysis Support for EIA Annual Report to Congress

FY 79: New

Principal Investigator: P. M. Meier

FY 80: \$10,000

Sponsor: Energy Information Administration/Office of Applied Analysis

This multi-laboratory program supports the short, mid, and long-term forecasting activities of the Office of Applied Analysis of the Energy Information Administration (EIA) by providing a coordinated regional analysis capability. Timely review and analysis are performed of the regional technical, economic, social, and other factors that affect regional energy development, for use in the annual EIA forecasting cycle.

In addition, the program will make recommendations for further work to improve the region-specific detail in terms of both data and modeling capabilities, and, as the program reaches maturity, conduct analyses of specific regional topics of significance to EIA forecasts.

Title: Continuing Analytical Support EECA/79

FY 79: New

Principal Investigator: A. Reisman

FY 80: \$100,000

Sponsor: Economic Regulatory Administration/Office of Regulations and Emergency Planning

The Emergency Energy Conservation Act (EECA) of 1979 mandates energy conservation actions by federal and state governments in the event of a Presidential finding that an emergency exists with respect to the availability of energy. The Department of Energy is charged with the development of a Standby Federal Conservation Plan (SFCP) defining measures and procedures required to carry out the provisions of EECA. The SFCP will contain specific guidance to the states for the preparation of their State Emergency Plans (SEP), outline the criteria employed to set state conservation targets and evaluate the SEPs, and provide a backup plan for states failing to provide their own plans.

In this program, BNL will assist the federal government in developing an analytic approach for meeting the requirements set forth in EECA. BNL will identify criteria for developing and evaluating SEPs and the SFCP, develop methodologies for estimating the effectiveness and impacts of specific short term conservation measures both singly and in the context of the entire energy system, analyze regional and temporal relationships of fuels and their substitutability, and identify requirements for and availability of supporting data.

In addition, technical assistance will be provided in the specific areas of electricity demand curtailment and the integration of electricity reduction measures into the curtailment plans developed for other fuels.

Title: Continuing Support EMPA

FY 79: New

Principal Investigator: A. Reisman

FY 80: \$100,000

Sponsor: Economic Regulatory Adminis-
tration/Office of Regulations
and Emergency

The principal objective of the Energy Management Partnership Act (EMPA) is to provide assistance to state and substate regions to develop and implement state energy plans. These plans are to be consistent with national goals and needs (for example, reduced dependence on foreign resource imports, improved environmental quality, and increased conservation) while at the same time reflecting the special circumstances and needs of each state and substate region. The Department of Energy is charged with presenting guidelines to the states on the criteria these plans must meet, as well as with providing overall program management.

BNL will assist DOE in preparing a program plan to implement the provisions of EMPA. In addition, BNL will develop generic methodologies useful for state energy planning, including the design of a state information system and associated models, which can be particularized for individual states. Workshops will be conducted to transfer the tools and methodologies to the states. Finally, criteria for evaluation of state energy plans and federally-mandated energy curtailment and conservation measures will be promulgated.

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Journal Articles and Conference Proceedings:

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P. M. Meier and V. Mubayi, "On the Application of Resource Allocation Models to the Problems of Regional Energy Policy in Large Developing Countries," Proceedings of the International Seminar on Energy, Administrative Staff College of India, Hyderabad, India, January 4-7, 1979.

B. F. Hobbs and P. M. Meier, "An Analysis of Water Resources Constraints on Power Plant Siting in the Mid-Atlantic States," Water Resources Bulletin 15, No. 6, 1666-1676 (1979).

P. M. Meier, "Long Range Regional Plant Siting Model," J. of the Energy Division, American Society of Civil Engineers 105, No. EY1, 117-35

W. C. Metz, "Socioeconomic Impact Management in the Western Energy Industry," Proceedings of the Inst. of Environmental Sciences, 1979 Environmental Science Meeting, Seattle, Washington, April 30-May 2, 1979.

P. M. Meier, D. Morell, and P. F. Palmedo, "Political Implications of Clustered Nuclear Siting," Energy Systems and Policy 3, 17-36 (1979).

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- BNL 25933 P. F. Palmedo, "A System Framework for Energy Analysis in Developing Countries," The Energy Management Training Program, Brookhaven National Laboratory, Upton, New York, Oct. 17, 1978.
- BNL 26390 H. Abilock et al., "MARKAL, a Multiperiod Linear-Programming Model for Energy Systems Analysis (BNL Version), International Conference on Energy System Analysis, Dublin, Ireland, Oct. 9-11, 1979.
- BNL 26397 J. Allentuck, "Automated Poolwide Economic Dispatch of Electric Generating Units and the Concept of Natural Monopoly," International Conf. on Energy Use Management, Los Angeles, California, Oct. 22-26, 1979 (to be published).
- BNL 26398 A. Reisman and J. Allentuck, "(A) Low Cost General Energy/Analytic Information System," International Conf. on Energy Use Management, Los Angeles, California, Oct. 22-26, 1979 (to be published).

BNL 26512 P. M. Meier, "Energy-Environmental Issues in the Northeast: A View of Future Developments," June 1979.

BNL 26721 V. Mubayi, J. Lee, and R. Chatterjee, "The Potential of Biomass Conversion in Meeting the Energy Needs of the Rural Populations of Developing Countries - An Overview," Symp. on Thermal Conversion of Solid Wastes, Residues, and Energy Crops, American Chemical Society Meeting, Washington, DC, Sept. 11-14, 1979.

BNL 26851 P. M. Meier and T. Le, "A Methodology for Regional Economic Analysis of Urban Refuse as an Energy Source for the Northeast," 1979 Annual Northeast Regional Science Association Meeting, Amherst, Massachusetts, June 1979.

BNL 26969 W. C. Metz, "Refuse=Energy: Can the Northeast Be Powered by its Own Municipal Refuse?," Dec. 1979, submitted for publication in The Professional Geographer.

BNL 27074 V. L. Sailor, "Technology Review Report," Dec. 1979.

BNL 27075 H. Abilock and L. Fishbone, "User's Guide for MARKAL (BNL Version), Dec. 1979.

BNL 27338 W. C. Metz, "Worker/Vehicle Ratios at Major Eastern Power Plant Construction Sites: A Time of Change," Dec. 1979, submitted for publication in Geographical Review.

BNL-NUREG 27180 B. F. Hobbs, "Multiobjective Power Plant Siting Methods," Dec. 1979, submitted for publication in Journal of the Environmental Engineering Division.

BNL-NUREG 27188 B. F. Hobbs, "A Theoretical and Empirical Comparison of Weighting Methods in Siting," Dec. 1979, submitted for publication in Decision Sciences.

BNL-NUREG 27455 B. L. Pierce and M. D. Rowe, "Nuclear Power Plant Siting," August 1979.

BNL 50988 N. S. Wake, "Directory of Energy-Related Educational Programs," Dec. 1978.

BNL 51006 P. Meier, B. Hobbs, M. McCoy and R. Stern, "The Brookhaven Regional Energy Facility Siting Model (REFS): Model Development and Application," March 1979.

BNL 51046 P. D. Moskowitz, T. W. Le, and B. Pierce, "Ranking Energy Conservation Measures to Establish Research Priorities: Synopsis of a Workshop," May 1979.

BNL 51065 W. C. Metz, J. Shyer, and K. Edgecomb, "A Preliminary Assessment of the Prospects for Use of Refuse-Derived Fuel in Maryland," Feb. 1979.

- BNL 51135 J. Brainard and J. S. Munson, "Regional Issue Identification and Assessment Program (RIIA): Environmental Impacts and Issues of the EIA Mid-Mid Scenario: Federal Region I," April 1979.
- BNL 51136 J. Brainard and J. S. Munson, "Regional Issue Identification and Assessment Program (RIIA): Environmental Impacts and Issues of the EIA Mid-Mid Scenario: Federal Region II," May 1979.
- BNL 51137 J. Brainard and F. W. Lipfert, "Regional Issue Identification and Assessment Program (RIIA), "Environmental Impacts and Issues of the EIA Mid-Mid Scenario: Federal Region III," May 1979.
- BNL 51138 J. Allentuck, O. Carroll, L. Fiore, N. Katz, R. Malone, R. Nathan
vation Measures to Establish Research Priorities: Synopsis of a
Workshop," May 1979.

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II. ECONOMIC ANALYSIS DIVISION

Title: Conservation Policy and Program Analysis

FY 79: \$748,000

Principal Investigator: P. J. Groncki

FY 80: \$575,000

Sponsor: Assistant Secretary for Conservation and Solar Application/Office of Program Policy Evaluation

In this program, Brookhaven National Laboratory (BNL) is providing and coordinating a broad range of support activities to the Assistant Secretary for Conservation and Solar Application (CS). BNL and its subcontractors, in close consultation with CS staff, conduct analyses of the impacts on resource use patterns, the economy, the environment, oil imports, and income distribution of existing and proposed policies which, at the point of end-use, affect energy consumption. The thrust of the analyses are to indicate how policy initiatives sponsored by DOE can aid in encouraging energy conservation and the use of solar energy in a manner consistent with other federal goals. The analytical framework of these analyses is a hierarchical system of economic and energy models and detailed sector models of energy consumption. Where appropriate, BNL models are supplemented by models from other groups. In addition to these analytical activities, the BNL effort includes other consultation activities as requested.

Title: Energy Strategy and Integrated Analysis

FY 79: \$400,000

Principal Investigator: P. J. Groncki

FY 80: \$170,000

Sponsor: Assistant Secretary for Policy
and Evaluation/Office of Ana-
lytical Services

The Energy Strategy and Integrated Analysis program, undertaken for the Office of Analytical Services (OAS-DOE/Policy and Evaluation), encompasses a broad range of studies in support of the design and evaluation of energy policy priorities and strategies. The program involves the coordination and integration of national and regional data and models and their application to comprehensive analyses of the effects of alternative energy technology and policy options. Feasible options are analyzed in the context of the social, economic, technical, environmental and security objectives of the nation and the uncertainty characterizing the planning environment, so that a balanced and diversified set of energy policy initiatives may be identified and developed.

The analytical techniques employed in this program are designed to provide a unified and comprehensive framework for policy planning, analysis, and evaluation. Among the applications are: integrated energy and economic analyses of the consequences of higher energy prices, alternative supply strategies, and conservation initiatives; probabilistic benefit-cost analyses of policy effectiveness and the value of information; comparative energy-economy scenario and projection analyses; multi-objective analyses of energy and energy RD&D policies and technologies.

In addition, advanced approaches to policy analyses are developed and employed with the active participation of the larger, scientific community. Such activities have resulted in the integration and application of several unique energy and economic models and data bases. Consistent with the objective to employ only the most advanced and apposite methodologies in the policy studies for this program, models and data bases developed elsewhere are applied.

Title: Regulatory Issues Associated With Solar Energy Commercialization

FY 79: \$165,000

Principal Investigator: H. Davitian

FY 80: \$250,000

Sponsor: Conservation & Solar Application/Market Analysis and Evaluation

In this task, Brookhaven National Laboratory (BNL) is studying a variety of regulatory and tax issues associated with solar energy commercialization for the Market Analysis and Evaluation Branch (MAE) under the Assistant Secretary for Conservation and Solar Application. Regulatory and tax policies at the federal, state and local level have a critical impact on the economic competitiveness and, consequently, the rate of commercialization of solar energy. It is the purpose of this task to provide detailed information which can be employed in the process of selecting appropriate regulatory and tax policies affecting the use of solar energy.

A particular focus of these studies is the economics of solar heating, hot water and air conditioning systems (HHWAC) employing as the backup energy supply, electricity or gas supplied by regulated utilities. The degree to which rate structures reflect the cost of providing backup power and the impact of rate structure philosophy upon the relative economics of solar HHW systems are investigated in detail. Other tasks include: investigation of methods of increasing the overall economic efficiency of combined utility/solar systems; estimation of externalities (resource use and environmental) and the total economic cost to society associated with solar and conventional HHWAC systems; improving the analytical techniques for studying the economics of utility/solar combinations; and communicating the results of these studies to interested parties in the federal and state governments and in the utilities.

Title: Regulatory Issues Associated With Cogenerating and Small Power Production Facilities

FY 79: New

Principal Investigator: H. Davitian

FY 80: \$35,000

Sponsor: Economic Regulatory Administration/Power Supply and Reliability

In this program, Brookhaven National Laboratory (BNL) will study regulatory issues associated with cogenerating and small power production facilities for the Economic Regulatory Administration (ERA). The information developed in these studies will help in determining appropriate federal and state policies in the area of rates and incentives for such facilities. A specific focus of the research will be the computation of the short run and the long run value of electricity delivered to the grid by such devices and the estimation of changes in the pattern of fuel use and in the net private cost of power generation associated with using such devices.

Title: Analysis of Architectural and Engineering Systems

FY 79: \$60,000

Principal Investigator: S. Guterman

FY 80: \$125,000

Sponsor: Conservation & Solar Application/Architectural and Engineering Systems

This project provides economic, environmental and regulatory analyses in support of Architectural and Engineering Systems (AES) activities. One of the major areas of activity is development and implementation of New Building Energy Performance Standards (BEPS). Once fully implemented, BEPS will require all new commercial and residential buildings to be designed to consume energy at a rate equal to or less than specific energy goals. AES, with assistance from many research organizations, has completed much analysis in the development of these regulations; other analyses are still under way, along with longer range studies for development of updated standards. Brookhaven National Laboratory (BNL) assists in the development of the standards both as an independent group reviewing the analysis and conclusion, and as coordinator of the various economic, regulatory and environmental analyses for AES.

Title: Analysis of Buildings and Community Systems

FY 79: \$83,000

Principal Investigator: P. Kleeman

FY 80: \$167,000

Sponsor: Conservation & Solar Application/Buildings and Community Systems

The purposes of this program are to expand or develop energy conservation policy assessment models and to assess a range of energy policy alternatives of interest to the Division of Buildings and Community Systems (BCS) of the Office of Conservation and Solar Applications. Two existing energy policy analysis models used in this program are the Brookhaven Building Energy Conservation Optimization Model (BECOM) and the Brookhaven Energy System Optimization Model (BESOM). BECOM is a detailed model of residential and commercial buildings energy consumption and conservation. BESOM is a comprehensive national energy system model which includes energy supply, conversion, and end-use demand components. BECOM and BESOM together can be used to assess impacts of energy policies on energy consumption in buildings and on the national economy.

Tasks undertaken with the help of these models include: (1) cost-benefit analysis of specific conservation options; (2) determination of design objectives for new end-use devices; (3) analysis of social and economic consequences of energy conservation policy, (4) estimation of markets for various conservation technologies, and (5) evaluation of pricing, incentive, and regulation policies on energy consumption.

Title: Special Purpose Vehicle Project

FY 79: \$100,000

Principal Investigator: J. Wagner

FY 80: \$95,000

Sponsor: Conservation & Solar Application/Office of Transportation Programs

This project is designed to assist the Office of Transportation Programs (OTP) in analyzing policies that affect transportation energy consumption. Currently the project consists of two studies: the Highway Fleets Study and the Transportation Budget Study.

The Highway Fleets Study has three basic objectives: (1) development of a statistical profile of fleet vehicles, and identification of factors affecting the penetration rates of new vehicle types; (2) development of a systematic framework for estimating the rate at which new technologies can penetrate the fleet vehicle market; (3) generation of a formal set of scenarios to illustrate the relationships between technological options, the requirements of fleet vehicles, and technological penetration rates.

The Transportation Budget Study is designed to develop a method for estimating the equity and energy consumption impacts of long-term policy options and economic trends affecting passenger transportation. Objectives which have been identified include: (1) analysis of consumer expenditure and household characteristic data to estimate linkages between household characteristics and money spent on various modes; (2) analysis of time budget data to estimate time expenditures per mode by different household types; (3) estimation of the future number of households, by type; (4) development of an algorithm to convert projected levels of income and leisure into amounts of time, money, and energy expended on different modes.

Title: Assessment of Conservation Options for Industry

FY 79: \$100,000

Principal Investigator: D. Pilati

FY 80: \$75,000

Sponsor: Conservation & Solar Application/Office of Industrial Programs

Under this project, several detailed process optimization models of the energy intensive industries are being developed for use in the evaluation of the potential market penetration of new energy conserving process technologies, the impacts of proposed industrial energy conservation fiscal policies, and the impact of industrial conservation on the consumption and mix of fossil fuels. These models incorporate risk-adjusted discount rates that represent private sector aversion to investing uncertain technologies. The BNL industry process models will be transferred to Idaho National Engineering Laboratory for further analyses.

Title: Industry Process Models for Energy Use Analysis

FY 79: \$75,000

Principal Investigator: D. Pilati

FY 80: \$50,000

Sponsor: Energy Information Administration/Office of Energy Use Analysis

Under this project, several detailed process optimization models of the energy intensive industries are being developed for use in the evaluation of the potential market penetration of new energy conserving process technologies, the impacts of proposed industrial energy conservation fiscal policies, and the impact of industrial conservation on the consumption and mix of fossil fuels. These models incorporate risk-adjusted discount rates that represent private sector aversion to investing uncertain technologies. The BNL industry process models will be transferred to the Energy Information Administration for further analyses.

Title: Economic Policy and Planning Program to Assess the Potential for Geothermal District Heating

FY 79: \$150,000

Principal Investigator: A. Reisman

FY 80: \$120,000

Sponsor: Resource Applications/Utility
and Industrial Applications

Under this program a set of systems models to evaluate the economic potential for district heating, using geothermal heat energy as the heat source, are being developed. Heating demands are described on a small area basis (census tract or minor civil division) for the entire country, thereby permitting the costs of pipe transmission and distribution systems to be realistically estimated. The demand model includes residential and commercial, heating and air conditioning demands, with projections to future years as an option. Economic comparison factors include costs of alternative fuels, heating equipment, and retrofit. The service model designs and costs a subtransmission and distribution network on the basis of demand densities, using specific data on installation and operating costs as well as detailed weather data. The well development model and data base designs and costs a transmission line, wells, and heat exchange equipment using data on resource characteristics and location. This comprehensive approach permits evaluation of geothermal district heating in any given U.S. market. The capability of determining the most economical size of a system, to evaluate alternative strategies for meeting peak demands, and to determine the optimal phasing of system development will be incorporated in the system. Institutional and regulatory constraints are considered so that their consequences for system economics may be included.

EAD PUBLICATIONS

Journal Articles and Conference Proceedings:

D. A. Pilati, W. Marcuse, and F. T. Sparrow, "Process Modeling of the Energy-intensive Industries: Results To-date," XXIV Intl. TMS Meeting, Honolulu, Hawaii, June 1979.

D. A. Pilati and F. T. Sparrow, "The Brookhaven Process Optimization Models," Joint Natl. Meeting, TMS/ORSA, New Orleans, Louisiana, April-May 1979, to be published in Energy.

Reports:

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- BNL 50989 R. J. Goettle IV, P. J. Groncki, E. A. Hudson, and J. Lukachinski, "A Comprehensive Long-range Energy-economy Projection," May 1979.
- BNL 51056 P. J. Groncki and W. Marcuse, "The Brookhaven Integrated Energy-economy Modeling System and Its Use in Conservation Policy Analysis," July 1979.
- BNL 26452 J. Lukachinski, P. J. Groncki, R. G. Tessmer Jr., R. J. Goettle IV, and E. A. Hudson, "An Integrated Methodology for Assessing Energy-economy Interactions," July 1979.
- BNL 51105 H. Davitian, P. J. Groncki, P. Kleeman, J. Lukachinski, R. J. Goettle IV, and E. A. Hudson, "A Strategic Cost-benefit Analysis of Energy Policies: Overview," October 1979.
- BNL 51127 H. Davitian, P. J. Groncki, P. Kleeman, J. Lukachinski, R. J. Goettle IV, and E. A. Hudson, "A Strategic Cost-benefit Analysis of Energy Policies: Detailed Projections," October 1979.
- BNL 51128 H. Davitian, P. J. Groncki, P. Kleeman, J. Lukachinski, R. J. Goettle IV, and E. A. Hudson, "A Strategic Cost-benefit Analysis of Energy Policies: Comparative Assessment," October 1979.
- BNL 51140 D. Jorgenson, T. Stoker, and L. Lau, "Inter-group Welfare Comparisons Using Aggregate Consumption Data," August 1979.

II. BIOMEDICAL AND ENVIRONMENTAL
ASSESSMENT DIVISION

Title: Assessment of Health and Environmental Effects of Energy Systems

FY 79: \$315,000

Principal Investigator(s):

L. D. Hamilton, S. C. Morris

FY 80: \$451,000

Sponsor: Environment/Office of Health
and Environmental Research

This program aims at developing a systematic overview of biomedical and environmental costs of energy production and use. All forms of energy are being considered. Starting with a compilation of residuals from the energy system, the various pathways to man are traced. This task entails definition of transport mechanisms including chemical conversions and various links through the biosphere to man. An evaluation is then made of effects. The initial focus is on biomedical and environmental effects on animals, crops, other vegetation, and land. This evaluation relies on available information, epidemiological data, field and laboratory studies, and basic biomedical research designed to elucidate molecular and cellular mechanisms underlying biological responses to various residuals. With the institution in 1979 of the Health and Environmental Effects Assessment Program (HEEAP) in DOE's Office of Health and Environmental Research, this program takes on a substantially new role. It provides overall technological program guidance and has the responsibility of integrating technology specific assessments into an annual overall assessment of the health and environmental effects of the national energy plan.

Title: Environmental Risk Assessment

FY 79: \$360,000
(\$260,000 within BEAD)

Principal Investigator(s):
L.D. Hamilton and S.C. Morris

FY 80: \$235,000
(\$135,000 within BEAD)

Sponsor: Environment/Office of
Technology Impacts Environ-
mental Impacts Division

This program will provide the Department of Energy (DOE) with analyses of relationships among technical, environmental, health, economic, and societal factors as they affect environmental regulation, energy and environmental R&D policy, or commercialization of newly-developed energy systems. The program entails longer-term policy analyses to diagnose incipient energy/environmental problems and short-term studies to meet policy-making needs in DOE. The objective of these analyses is to identify potential conflicts between energy development and environmental/energy use policies.

During FY 1979 work was done in BEAD on air pollution health effects, energy transport health effects, endangered species, and coal-electric solid wastes. The program also included development of energy-environment inter-technology trade-off methods, extension of projection capability (done by the Economic Analysis Division) and air quality modeling (done by the Atmospheric Sciences Division). In FY 1980, work on energy solid waste generation and impacts, and air quality modeling (Atmospheric Sciences Division) will be continued.

Title: Air Pollution Impacts on Vegetation

FY 79: New

Principal Investigator: P. D. Moskowitz

FY 80: \$85,000

Sponsor: USEPA Corvallis Environmental
Research Laboratory

This program aims to develop an assessment of the loss associated with air pollutant damage to agricultural crops. Work includes updating 1973 Stanford Research Institute estimates of crop loss and participating in a large EPA field study to develop new data and models for estimating crop loss. This program relates directly to other BEAD activities aimed at developing systematic overviews of the health and environmental costs of energy production and use.

Title: Endangered Species Listings

FY 79: \$10,000

Principal Investigator: J. Nagy

FY 80: \$10,000

Sponsor: US Fish and Wildlife Service
Office of Endangered Species

This project will provide Fish and Wildlife Service with technical support in listing endangered species distribution in the U.S. by county.

BEAD PUBLICATIONS

Journal Articles and Conference Proceedings and Books:

S. R. Bozzo, K. M. Novak, F. Galdos, F. Hakoopian and L. D. Hamilton, "Mortality, Migration, Income and Air Pollution: A Comparative Study," Social Science and Medicine: Medical Geography 13D, No. 2, 95-109, (1979).

S. Silberstein, "Outdoor Sources of Indoor Air Pollution," Energy and Buildings 2, 55-64 (1979).

M. K. Goldstein, S. R. Bozzo, R. Malone, F. Galdos, W. Sevian, and D. Guellner, "Health Effects from the Nuclear Fuel Cycle and Other Sources in Perspective," Environmental Management 2, 447-460 (1979).

S. C. Morris, P. D. Moskowitz, W. A. Sevian, S. Silberstein, and L. D. Hamilton, "Coal Conversion Technologies: Some Health and Environmental Effects," Science 206, 654-662 (1979).

S. J. Finch and S. C. Morris, "Consistency of Reported Effects of Air Pollution on Mortality," in J. R. Pfafflin and E. N. Ziegler, eds., Advances in Environmental Science and Engineering, 2, Gordon and Breach, London, 1979, pp. 106-117.

Reports:

BNL 26140	M. D. Rowe, "Human Exposure to Sulfates from Coal Fired Power Plants," April 1979.
BNL 26188	E. Kaplan and H. C. Thode, Jr., "Interrelationships Between Man, Energy, and Water Quality: A New Methodology for Integrative Analysis," May 1979.
BNL 51041	S. C. Morris, K. M. Novak and C. E. Calif, eds., "Use of County Level Data in Health, Energy, Demographic, Environmental and Economic Analysis," June 1979.
BNL 51043	S. C. Morris, K. M. Novak and L. D. Hamilton, "Health Effects of Coal in the National Energy Plan," April 1979.
BNL 51068	E. Kaplan and H. C. Thode, Jr., "New Techniques for Analyzing Relationships Between Energy and Water Quality," September 1979.

IV. TECHNOLOGY ASSESSMENT GROUP

Title: EEMIS - Support for Energy Emergency Management Information Systems Program

FY 79: \$705,000

Principal Investigator: M. Beller

FY 80: \$295,000

Sponsor: Energy Information Administration/EEMIS Project Office

The objective of this program is to provide analytical support to the Energy Emergency Management Information System (EEMIS) Project Office in the Energy Information Administration (EIA). This support will provide data, analyses, and other assistance needed by the EEMIS staff as they prepare or respond to energy emergencies and problems. Brookhaven National Laboratory (BNL) personnel have played an active role in structuring the EEMIS data system, and are familiar with the data available from EIA data bases. Additionally, BNL staff is familiar with and has access to many other data sources which are of value for energy analysis. BNL will be prepared to assist the EEMIS staff on short notice to address specific problems as they arise. These problems may involve:

- Analysis of regional fuel shortages
- Interfuel substitution possibilities
- Fuel savings achievable from mandatory conservation measures

In anticipation of energy problems, BNL staff will search out both data and contacts which may be of value in analyzing anticipated areas of the energy system where emergencies may arise. Specific emphasis will be placed on the selection of key "flag" indicators to provide monitoring capability in the energy system to anticipate the potential onset of emergencies. In particular, a potential gasoline shortage in the Spring of 1980 is under study.

Title: Energy/Utility Analysis for the Office of Coal Utilization

FY 79: New

Principal Investigator: J. Lamontagne

FY 80: \$200,000

Sponsor: Fossil Energy/Office of Coal
Utilization

This program will provide analytical support to the Department of Energy's Office of Coal Utilization (OCU). Support activities will focus on refining and applying an integrated systems assessment procedure for OCU. Brookhaven National Laboratory will interact with and provide support to OCU, Argonne National Laboratory, and other OCU contractors in overall program development. Areas of primary BNL responsibility will include:

- support to ANL in energy systems evaluation;
- support to OCU in utility market penetration analysis;
- support to OCU and ANL in model evaluation.

Title: Energy Case Studies

FY 79: \$142,000

Principal Investigator: J. Lamontagne

FY 80: \$183,000

Sponsor: Fossil Energy/Office of Plans
and Technical Assessments

This program provides data and analytical support to DOE-FE's (Fossil Energy) Office of Plans and Technical Assessments. This involves the assembly, qualification, updating, and application of data bases and analytical tools describing technical, environmental, and economic characteristics of FE technology and resources.

Title: Energy Storage Systems Analysis

FY 79: \$100,000

Principal Investigator: R. Leigh

FY 80: \$100,000

Sponsor: Conservation & Solar Application/
Division of Energy Storage

This program focuses on systems and impact analyses of various energy storage systems, especially in solar energy applications. Devices examined include thermal, mechanical and electro-chemical storage; applications include decentralized solar total energy systems, passive systems for solar heating and electrical storage for grid-connected solar energy systems. The range of analysis extends from examinations of engineering compatibility between storage and solar technologies to estimations of national energy impacts resulting from widespread implementation of these technologies.

Title: Technology Characterization Program

FY 79: \$225,000

Principal Investigator: A. Reisman

Sponsor: Energy Research/Office of
Program Analysis

The objective of this program is to develop a uniform format for characterizing the economic and environmental parameters associated with various technologies, resources, and energy-related applications. The format insures uniform definitions so that data can be used for analyses, assessments, and economic modeling across various disciplines and organizations with consistent baseline assumptions.

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M. Beller, A. Doernberg, A. Hermelee, and K.C. Hoffman, "Impacts of New Energy Technologies as Measured against Reference Energy Systems," Energy 4, 891-909 (1979).

M. Beller, "The Applications of Energy Systems Analysis to Policy and Technology Studies," August 1979, Energy Systems Analysis International Conference - Dublin, Ireland, Oct. 9-11, 1979.

A. Hermelee, "Reference Energy Systems as Applied to Regional Energy Policy," 14th Intersociety Energy Conversion Engineering Conference, Boston, Massachusetts, (paper No. 799383) August 5-10, 1979.

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BNL 26545 J. D'Acierno, A. Hermelee, J. Lamontagne, and M. Beller, "Analysis of New England Winter Fuel Shortage," September 1979.

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BNL 26984 R. Pouder and L. Friend, "Finance Strategies for Coal Gasification Plants - Government Policy Options," November 1979.

BNL 26985 J. Lamontagne and L. Friend, "Incorporating the Mobil M-gasoline Process into the Materials-Process-Product Model: Value and Feasibility," November 1979.

BNL 26986 J. Lamontagne, "Synthetic Fuels Planning: Energy Supply Modeling and the MPPM," December 1979.

^aAbstract

- BNL 26988 M. Beller, "Methodology for Assessing the Full Costs of Technology," November 1979, submitted to International Journal of Energy Research.
- BNL 50949 N. Bhagat, M. Beller, A. Hermelee, J. Wagner, and J. Lamontagne, "Evaluation of Technological Data in the DFI and PIES Models," April 1979.
- BNL 50962 A. Hermelee, "Regional Reference Energy Systems: Electric Utility Applications," January 1979.
- BNL 50982 H. Davitian, N. Bhagat, and R. Pouder, "The Potential of Crop Residues as a Fuel for Power Generation" (in press).
- BNL 50987 M. Reckard, "Decentralized Energy: Technology Assessment and Systems Description," June 1979.
- BNL 51012 R. Leigh, "Review of Recent Research on Energy Storage in Residential Solar Total Energy Systems," May 1979.
- BNL 51050 H. Davitian and H. Serry, "Carry-over Grain Stocks as an Emergency Fuel," August 1979.
- BNL 51076 J. D'Acierno, and A. Hermelee, "Physical Aspects of the U.S. Oil and Gas Systems," November 1979 (in press).
- BNL 51077 J. D'Acierno, A. Hermelee, M. Beller, J. Rabinowitz, and N. Bhagat, "The U.S. Oil and Gas System Representation in the EEMIS Data Structure," November 1979 (in press).
- BNL 51079 R. Pouder, L. Friend, T. Albanese, and J. Lamontagne, "Validation of the Material-Process-Product Model (Coal SNG)," (in preparation).
- BNL 51086 J. D'Acierno, A. Hermelee, C.P. Fredrickson, K. Van Valkenburg, "Methodology for Coding the Energy Emergency Management Information System," November 1979.
- BNL 51091 K. Croteau, A.S. Kydes, and D. Maier, "EEMIS Data Structure Correspondence with Conceptual Database Design," July 1979 (in press).
- BNL 51093 J. D'Acierno and A. Hermelee, "The Use of the Reference Energy System and EEMIS to Analyze Some Cause-Effect Relationships," November 1979 (in press).
- BNL 51109 J. D'Acierno and A. Hermelee, "Compatibility of EIA Energy Data Bases with EEMIS Requirements," December 1979.

V. ENERGY DATA AND MODELS GROUP

Title: Long-Range Energy Model Analysis and Support

FY 79: \$279,000

Principal Investigator: L. L. Juang

FY 80: \$90,000

Sponsor: Energy Information Adminis-
tration/Office of Applied
Analysis

Under this project for the Energy Information Administration (EIA), three main tasks will be performed. The first is model documentation to conform to EIA standards and to describe the current version of the EIA's Long-term Energy Analysis Program (LEAP). The second task is to provide data support for the 1979 Annual Report to Congress (ARC 79) consisting of modification of the present resource preprocessors to incorporate enhancements that are being made to EIA supply models, and using these preprocessors to generate oil, gas, and coal supply curves. The third task is to develop and implement logic in LEAP to handle four improvements in the resource submodels: better representation of end effects (terminal value calculation), financial logic, direct modeling of by-products, and elimination of the translation equations. These improvements will be documented in conformance with EIA standards. A fourth task to be undertaken as time and resources permit, is to incorporate other enhancements in model logic as necessary for ARC 80.

Title: International Model and Data Assistance Activity - General Systems Studies

FY 79: \$ 60,000

Principal Investigator(s):

A. S. Kydes, J. Rabinowitz

FY 80: \$ 66,000

Sponsor: International Affairs/Market Analysis

The International Model and Data Assistance Program of BNL enables DOE to further its policy of establishing cooperative research relationships with international energy system analysis groups. The program's primary purpose is to assist these groups in their energy systems analysis by providing BNL models and data bases when requested, and giving preliminary advice and consultation in model use and interpretation. A secondary objective is the exchange of energy technology and systems information which may enhance BNL's approach to energy systems analysis capabilities. This assistance will also include, when appropriate, discussions with personnel sent to BNL by their home country sponsor. A user's guide will be developed for the transportable FORTRAN versions of Brookhaven Energy System Optimization Model (BESOM) and Energy System Network Simulator (ESNS). Although the program will give emphasis to data and models available at NCAES, under special circumstances approved by the Office of International Affairs, assistance may also be given on other models. An information system has been initiated and maintained to record all requests submitted under this program.

Title: Long-Range Forecasting Methodology for Oil and Gas Supply

FY 79: \$ 5,000

Principal Investigator: L. L. Juang

FY 80: \$47,000

Sponsor: Energy Information Adminis-
tration/Office of Applied
Analysis

The purpose of this project is to provide the Oil and Gas Analysis (OGA) Division with a long-range forecasting capability to project oil and gas supply through the year 2025. This methodology shall be compatible with the LEAP model.

Phase I of the study will provide a review of the literature and analysis of the major determinants of supply in the long-term, and a plan for development of a model complete with data specification and data availability. If the results of Phase I are acceptable to OGA, Phase II will fund the implementation of the model, including data development and full documentation of the system.

Title: Modeling and Forecasting - Energy Data Base Program

FY 79: New

Principal Investigator: A. Reisman

FY 80: \$75,000

Sponsor: Energy Information Adminis-
tration/Information
Validation

The data and analysis functions of the Energy Information Administration (EIA) in the Department of Energy will require access to a wide variety of data sources including information relating to the technological, economic, and environmental aspects of energy production and use. Brookhaven National Laboratory (BNL) has been engaged in the survey, analysis, and acquisition of pertinent data, and has gained relevant experience in making these data accessible to both in-house and outside users.

The Energy Data Base, developed at BNL, contains data on over 800 energy supply processes and over 200 energy utilization processes. With each process is associated a vector of environmental emissions, social impacts, and costs; A "hardness" number gives a subjective evaluation of how good each datum is. The Energy Data Base has provided data inputs for a variety of models requiring technical detail. In addition, users can extract individual data elements, or investigate the effects associated with a single supply trajectory, e.g., gas from coal; interactive software has been developed that permits easy access to such information.

Under this program it is proposed to update and extend the Energy Data Base, and to continue providing user access to the data. Work will be undertaken to verify and validate relevant data and to improve the usefulness of these data by filling in gaps in process characterization and by providing, whenever possible, ranges of values for each coefficients. A study will also be done of the utility of the Energy Data Base format as the framework for an Energy Information System.

Title: Model Assessment Laboratory

FY 79: New

Principal Investigator: A. S. Kydes

FY 80: \$70,000

Sponsor: Energy Information Administration/Applied Analysis

This project is intended to develop model simplification and assessment procedures for the Energy Information Administration (EIA). The EIA has established many large scale mathematical and statistical procedures for projecting and analyzing energy production, consumption, prices, and associated impacts. It is EIA policy that these systems, based on complex mathematical, technological, and statistical techniques, be subjected to extensive, continuing reviews and simplification aimed at improving their applicability. Simpler models are easier to run and analyze, will be developed for use as companion models when detailed analysis is unnecessary and costly.

The National Center for Analysis of Energy Systems at BNL will establish a continuing program in support of the general model simplification and assessment activities of EIA. The test of the results of this effort will be their application to specific analysis systems selected by EIA.

The goals of this research are to develop rigorous analytical methods for simplifying complex energy forecasting tools of the EIA and clarifying the circumstances under which simplified systems may be used, and to assess the plausibility of models used by the EIA.

EDM PUBLICATIONS

Reports:

- BNL 26423 K. Croteau, A. S. Kydes, and P. Meier, "EEMIS Data Sector Correspondence with Conceptual Design," July 1979.
- BNL 26456 A. S. Kydes and J. Rabinowitz, "The Time Stepped Energy System Optimization Model (TESOM) Overview and Special Features," August 1979.
- BNL 26882-R E. A. Cherniavsky, "Multiobjective Energy Analysis." Prepared for the NATO Advanced Research Institute On the Applications of Systems Science to National Energy Policy Planning, Brookhaven National Laboratory, November 12-16, 1979.
- BNL 27302 A. S. Kydes, "Methods of Mathematical Programming to Program Planning and R&D Strategies," December 1979.
- BNL 50940 A. S. Kydes, "A Demand Elasticity Representation - Methodology and Calibration," July 1979.
- BNL 50949 N. Bhagat, M. Beller, A. Hermelee, J. Wagner, and J. Lamontagne, "Evaluation of Technological Data in the DFI and PIES Models," April 1979.
- BNL 50999 R. Condap and A. S. Kydes, "Modeling Market Penetration with Emphasis on the DFI Energy-Economy System," April 1979.
- BNL 51009 Y. Draper, A. S. Kydes and S. Finch, "Rim Analysis, Statistical Techniques Applied to the Evaluation of the National Energy System by Multiple Criteria," December 1979.
- BNL 51064 A. Gerasoulis and A. S. Kydes, "A Probabilistic Interpretation to Market Shares," December 1979.
- E. A. Cherniavsky, and L. L. Juang, "Resource Submodels of the Long-range Energy Analysis Program: Documentation." Report to the Division of Long-range Analysis, Energy Information Administration, Department of Energy, October 1979.
- J. E. Falk, G. P. McCormick, and R. M. Soland. School of Engineering and Applied Science, the George Washington University. "Methodology of the LEAP model." Final report to Brookhaven National Laboratory, March 1979.
- A. S. Kydes and J. D. Pearson, editors, "A Comparative Assessment of Five Long-Run Energy Projections," December 1979. Report prepared for the Division of Long Range Analysis, Energy Information Administration, U.S. Department of Energy, Washington, D.C. (in press).

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FUTURE PLANS FOR 1980

The activities of the National Center for Analysis of Energy Systems are, for the most part, continuing programs. The emphasis is shifting, however, as national concerns evolve and as the analytical arts mature. Whereas the need several years ago was for methods to analyze the general relationships among the energy, economic and environmental systems, increasingly the need is for more detailed analyses of specific policies and programs. This shift in emphasis is evident in the specific future plans for the National Center, listed below by Division and Group.

Regional Studies Division

- Complete an evaluation for the Nuclear Regulatory Commission of methodologies used in siting nuclear power plants.
- Assess solar energy impacts on selected environmental and health parameters.
- Analyze the President's Second National Energy Plan with respect to world oil price impacts on environmental, socioeconomic, and institutional aspects of the Northeast.
- Complete a study of energy conservation in the pulp and paper industry.
- Complete a study of selected environmental aspects of district heating.
- Continue application of New York State Energy Information Analytical System in support of the State's master planning effort.
- Complete an analysis of selected socioeconomic consequences of long-term electric supply disruptions.
- Continue efforts in support of electricity demand curtailment planning by states.
- Develop analytic methods for energy-economic analysis in developing countries and techniques for estimating the use of noncommercial fuels.

- Plan and implement Phase III of the IEA Energy Systems Analysis Program including analysis of conservation technologies, new technologies and ranking methods, environmental impacts, and the consequences of major shocks to existing energy systems.

Economic Analysis Division

- Assess prospects for market penetration of specific conservation and solar technologies.
- Apply the integrated BNL/DJA model framework for assessment of the system-wide energy, economic, and environmental impacts of alternative conservation and solar energy policies.
- Construct a more complete representation of the coal market within TESOM to reflect regional differences in coal prices and quality, and regional constraints on availability.
- Complete and make operational location-specific geothermal district heating evaluation model.
- Estimate long-run incremental values of power delivered to selected electric utilities from solar and cogeneration devices, and the long-run cost of producing electric backup to facilities using such devices.
- Develop pseudo-data versions of the steel, paper, and aluminum industry process models for EPRI, and complete first-generation versions of process models for pork processing, dairy, glass, copper, and cement industries.
- Develop estimated limits to transport growth, based on consideration of household time and money budgets.
- Improve buildings energy consumption simulation model for use in policy assessment.
- Formulate policy assessment models for community energy systems and solid waste energy recovery systems.
- Assess appliance energy efficiency standards.

Biomedical and Environmental Assessment Division

- Continue support of the expanding DOE Health and Environmental Effects Assessment Program.
- Assess the health and environmental effects of photovoltaic energy systems.
- Begin a new program on health effects of energy-related pollutants.

Technology Assessment Group

- Analyze regional fuel shortages, interfuel substitution possibilities and fuel savings achievable in an energy emergency.
- Develop "lead indicators" of fuel shortages for use by the DOE Energy Emergency Management Information System.
- Refine and apply an integrated systems assessment procedure for synthetic fuels.
- Continue analyses of energy storage systems.

Energy Data and Models Group

- Provide model enhancement, validation and documentation support for EIA.
- Initiate model simplification effort for EIA.
- Develop improved oil and gas supply models compatible with EIA forecasting models.
- Incorporate improved market penetration process representations in BNL models.
- Transfer models and data to Yugoslavia, Israel, Brazil and Italy, as requested.