DOE/EIA-0293(89)
Distribution Category UC-98

DOE/EIA--0293(89)

DE89 012600

Directory of Energy Information Administration Models 1989

Energy Information Administration
Office of Statistical Standards
U.S. Department of Energy
Washington, DC 20585

This report was prepared by the Energy Information Administration, the independent statistical and analytical agency within the Department of Energy. The information contained herein should not be construed as advocating or necessarily reflecting any policy position of the Department of Energy or any other organization.

Preface

This directory revises and updates the *Directory of Energy Information Administration Model Abstracts,* DOE/EIA-0293(88), Energy Information Administration (EIA), U.S. Department of Energy, September 1988. The major changes are the inclusion of the Transportation and Refining of International Petroleum (TRIP) Model and the Uranium Market Model (UMM-PC), and the deletion of the Evaluation of Uranium Resources and Economic Analysis (EUREKA) Model and of the International Uranium Resources and Economic Analysis (INT-EUREKA) Model.

Publication of this directory is supported by Public Law 93-275, Federal Energy Administration Act of 1974, Section 57(B)(1) (as amended by Public Law 94-385), Energy Conservation and Production Act, which states in part,

> *...that adequate documentation for all statistical and forecast reports prepared...is made available to the public at the time of publication of such reports.*

The Energy Information Administration has issued two orders that address the form and public availability of documentation. The orders are EI 5910.3C, "Guidelines and Procedures for Model Documentation," and EI 5910.4C, "Guidelines and Procedures for the Preparation of Model Archival Packages." This directory partially fulfills the requirements of Section 8c, of the documentation order, which states in part that:

> *(The) Office of Statistical Standards will annually publish an EIA listing of the collected abstracts and the appendices.*

This directory contains descriptions about each basic and auxiliary model, including the title, acronym, purpose, and type, followed by more detailed information on characteristics, uses, and requirements. For developing models, limited information is provided. Sources for additional information are identified. Included in this directory are 40 EIA models active as of March 1, 1989, as well as the PC-AEO Forecasting Model Overview and the three Subsystems for the Short-Term Integrated Forecasting System (STIFS) Model. Models that run on personal computers are identified by "PC" as part of the acronym.

The main body of this directory is an alphabetical listing of all basic and auxiliary EIA models. Appendix A identifies major EIA modeling systems and the models within these systems, and Appendix B identifies EIA models by type (basic or auxiliary). Appendix C lists developing models and contact persons for those models.

- A basic model is one designated by the Administrator as being sufficiently important to require sustained support and public scrutiny.
- An auxiliary model is one designated by the Administrator as being used only occasionally in analysis, and therefore requires minimal levels of documentation.
- A developing model is one designated by the Administrator as being under development and yet of sufficient interest to require a level of documentation for a basic model at a future date.

EIA also leases models developed by proprietary software vendors. Documentation for these "proprietary" models is the responsibility of the companies from which they are leased. EIA has recently leased models from Chase Econometrics, Inc., Data Resources, Inc. (DRI), the Oak Ridge National Laboratory (ORNL), and Wharton Econometric Forecasting Associates (WEFA). Leased models are not abstracted here.

Contents

Models of the Energy Information Administration

Coal Price and Supply Model (COAL-PC)

Abstract: COAL-PC takes an input forecast of the demand for coal and estimates the supply and its price. The model is based principally on equations capturing trends in recent years.

Type: Basic

Last Model Update: September 1988.

Part of Another Model? Part of the PC-*Annual Energy Outlook* system.

Model Interfaces: PC-AEO; PC Demand (Residential, Commercial, Industrial) Models; PC Electricity Generation Model

Sponsor:

Office:	Coal, Nuclear, Electric and Alternate Fuels
Division:	Coal
Branch:	Data Analysis and Forecasting, EI-522
Model Contact:	B. D. Hong
Telephone:	586-6532

Documentation: Energy Information Administration, *Model Documentation for the Coal Price and Supply Model for the Annual Energy Outlook* 198 9 (Washington, DC, January 1989).

Archive Media and Installation Manual(s): Archived on floppy disk.

Purpose: The purpose of the Coal Price and Supply Model (COAL-PC) is to forecast coal production, minemouth price, storage adjustments, and end-use prices for the Energy Information Administration's *Annual Energy Outlook* (AEO).

Energy System Described by Model: COAL-PC computes production needed to meet sectoral demands and exports. It also computes minemouth prices and sectoral delivered prices.

Coverage:

- **Geographic:** Production and minemouth prices to seven coal regions (Northern Appalachia, Southern Appalachia, Interior, Texas-Louisiana, North Dakota, Montana-Wyoming, and West)
- **Time Unit/Frequency:** Annual, 1985 through 2000
- **Product(s):** Coal
- **Economic Sector(s):** Residential, commercial, industrial, and utility.

Modeling Features:

- **Model Structure:** COAL-PC calculates production, minemouth prices, and delivered prices in a sequential procedure:
  - Production by coal producing region is computed to meet a set of given demand by sector and by Census region.
  - Average minemouth prices by coal producing region are then calculated based on production, labor productivity, and the world oil prices.
  - Delivered prices by sector and region are calculated based on minemouth prices plus transportation markups which are forecast on the basis of a transportation cost escalation index.
- **Modeling Technique:** COAL-PC uses a sharing algorithm which calculates regional coal production to meet regional demand, based upon historical trend. It also uses regional transportation markups to estimate delivered prices.
- **Special Features:** None.

Non-DOE Input Sources:
None.

DOE Data Input Sources:
Forms and Publications:

- Energy Information Administration, *Coal Production* (DOE/EIA-0118), *Coal Distribution* (DOE/EIA-0125), *Quarterly Coal Report* (DOE/EIA-0121), and the *Electric Power Annual* (DOE/EIA-0348), (Washington, DC).
  - Coal demand
  - Prices
  - Net exports
  - Production.

General Output Descriptions: Forecasts and reports on coal demand, supply, and prices.

Computing Environment:

- **Hardware Used:** Compaq 386 Personal Computer, DOS 3.1
- **Language Used:** Lotus 1-2-3, Version 2.01
- **Core Requirement:** 640K
- **Estimated Cost to Run:** Stand-alone version, under 5 seconds; integrating version varies
- **Special Features:** None.

Independent Reviews Conducted: T. Denny Ellerman, Independent Expert Review, Charles River Associates Incorporated, May 1988.

Status of Evaluation Efforts by Sponsor: None.

Coal Supply and Transportation Model (CSTM)

Abstract: CSTM projects distribution patterns of coal supply and intermodal movements of coal. Both rail and water movements are represented covering all major U.S. rail lines and barge or collier routes. Rail shipments are differentiated by sector and various adjustments are possible for coal cleaning, use of compliance coal, etc. A complete set of reports are produced showing detailed shipments, production and transportation routes. Information on steam and metallurgical coal exports is also available.

Type: Basic

Last Model Update: October 1988.

Part of Another Model? Intermediate Future Forecasting System (IFFS)

Model Interfaces: The Intermediate Future Forecasting System (IFFS), the Resource Allocation and Mine Costing (RAMC) Model, the International Coal Trade Model (ICTM), and the National Coal Model (NCM).

Sponsor:

Office:	Coal, Nuclear, Electric and Alternate Fuels
Division:	Coal
Branch:	Data Analysis and Forecasting, EI-522
Model Contact:	James R. Littleton, Jr.
Telephone:	586-5938

Documentation:

- Energy Information Administration, *Coal Supply and Transportation Model: Executive Summary*, DOE/EIA-0401 (Exec) (Washington, DC, August 1983)
- Energy Information Administration, *Coal Supply and Transportation Model: Model Description* and Data Documentation, DOE/EIA-0401 (Washington, DC, August 1983)
- Energy Information Administration, *Coal Supply and Transportation Model: Model Description*, DOE/EIA-M022 (Washington, DC, June 1987).

Archive Media and Installation Manual(s): Archive tape CSTM383 replicates computer runs for analysis report entitled, *Railroad Deregulation: Impact on Coal.*

Archive tape CSTM84 replicates computer runs for report entitled, *Coal Slurry Pipelines: Impact on Coal Markets*, using stand-alone version of CSTM. This is also consistent with the current documentation. The use of the CSTM as a module of the Intermediate Future Forecasting System (IFFS) is archived with the entire IFFS system for the 1986 *Annual Energy Outlook.*

The use of CSTM as a module of IFFS for the *Annual Outlook for U.S. Electric Power 1989*, and *Annual Outlook for U.S. Coal 1989* is archived on a forthcoming archive tape IFFS89.

Archive tape CSTMX86 replicates computer runs for analysis report entitled, *Outlook for U.S. Coal Imports.* This is an extended version of the model.

Purpose: CSTM is used to forecast coal production levels and coal transportation flows.

Energy System Described by Model: Simulates production and transportation of coal to meet a given set of demands for coal in the various consuming sectors.

Coverage:

- **Geographic:** CSTM uses 32 coal producing regions, corresponding to States or substate regions, and 48 demand regions, including 44 domestic demand regions and 4 overseas demand regions in Northern Europe, Southern Europe, Canada, and the Orient. The CSTM transportation network contains over 300 nodes and 735 links.
- **Time Unit/Frequency:** A CSTM run represents a single forecast year. The CSTM can be run for any forecast year for which input data are available. When used as a stand-alone model, it is generally run for 1990, 1995, and 2000.
- **Product(s):** CSTM represents up to 30 different types of coal, defined by up to 5 Btu and 6 sulfur ranges, mined by underground and surface methods.
- **Economic Sector(s):** Electric utility, industrial, metallurgical, residential/commercial and export, with various subsectors.

Modeling Features:

- **Model Structure:** CSTM uses a three-step procedure, as follows:
  - Costing Computations. Minemouth prices for each coal supply region and type of coal are computed at the prevailing production levels. Transportation rates are computed at the prevailing transportation volumes. Transportation and coal supply volumes are initially set at zero.
  - Least-Cost Participant Calculation. A shortest-path type of algorithm determines the least-cost route, using prevailing transportation rates, from each supply region to each demand region. The summation of the link rates for each route produces the unit-train rate for the route. Trainload, multicar, and single-car rates, as required by the various demand sectors, are calculated by escalating these unit-train rates. All coal types that can handle a demand are considered in terms of prevailing minemouth prices per ton. Each minemouth price is summed with the related transportation rate and, if appropriate, with scrubber cost. Each total price per ton is converted to price per million Btu. The least-cost coal type and route is selected. A new coal type and route for the demand is established if the least-cost coal type and route is cheaper than any current coal type and route.
  - Participation-Shifting Calculation. For each demand, the lowest-cost coal type and route and the highest-cost active coal type and route are identified. Delivered costs are shifted toward equilibrium by transferring a fraction of the demand from the high-cost coal type and route to the low-cost coal type and route. The fraction transferred is determined by a set of heuristic rules (see below). The largest shift-ratio across all jobs is retained.
- **Modeling Technique:** A computationally efficient method for identifying the shortest path through the network is used to identify least-cost routes. A series of heuristic rules is used to shift participation from high-cost to low-cost routes. These rules move a fixed percentage the first time and then base the size of each succeeding shift on the results of the immediately preceding shift until costs converge.
- **Special Features:** CSTM is designed to couple a high level of detail in the coal transportation network with an efficient algorithm for achieving an equilibrium solution to a nonlinear transhipment problem. Both supply prices and transportation prices are represented as functions of volume (either production level or volume of coal across a transportation link.)

Non-DOE Input Sources:

Developed from discussions with knowledgeable industry personnel

- Fees for loading, unloading, and transshipment

Rand-McNally Handy Railroad Atlas

- Detailed identification of main line rail network links and nodes

U.S. Army Corps of Engineers National Waterways Study

- Base rate for waterway links.

DOE Data Input Sources:
Forms and Publications:

FERC-423, "Monthly Report of Cost and Quality of Fuels for Electric Power Plants."

- Contract coal supply region for demand jobs.

Models and Other:

National Coal Model Nonutility Demand Inputs

- Coal demand required for demand job

International Coal Trade Model

- Base rates for ocean collier shipments.

National Coal Model Input Tables

- Scrubber cost factor for scrubber type and sulfur level
- Acceptable coal types

National Coal Model Definitions

- Sector names

- Coal supply region index for region/coal type combinations
- Coal demand regions
- Demand sectors for demand jobs.

Resource Allocation and Mine Costing Model

- Coal type sulfur level
- Btu content for coal produced in a given region
- Quantity beginning point for coal supply steps
- Slope of coal supply curve steps
- Intercept of coal supply curve steps
- Coal type index

Relationships Between Various Types of Rail Transportation Rates for Coal, Memorandum from J. Watkins to M. Hutzler, August 1983.

- Rail rate multiplier for demand sectors.

General Output Descriptions: The CSTM produces output reports on coal production, coal transportation, and coal demand. Coal projections are provided for the forecast year represented by the data. Thus, both short- and mid-term analyses can be performed using this model.

Computing Environment:

- **Hardware Used:** IBM 3084QX
- **Language Used:** FORTRAN
- **Core Requirement:** 2000K
- **Estimated Cost to Run:** Approximately 90 CPU seconds for a single year using the CSTM standalone version
- **Special Features:** None.

Independent Reviews Conducted:

- Coal Supply and Transportation Module of the Revised National Coal Model: Presented by William Orchard-Hays to the American Statistical Association Committee on Energy Statistics, October 1982.
- Implementation of a Coal Supply Model in the Intermediate Future Forecasting System: Presented by Robert M. Schnapp to the American Statistical Association Committee on Energy Statistics, October 1983.

Status of Evaluation Efforts by Sponsor: Continuing in-house review, enhancement, and documentation.

Commercial Sector Energy Model (CSEM-PC)

Abstract: The Commercial Sector Energy Model - PC is used as the commercial module in the PC-AEO (spreadsheet) model that ultimately generates commercial energy demand forecasts for EIA's *Annual Energy Outlook* (AEO).

Type: Basic

Last Model Update: January 1989

Part of Another Model? Part of the PC-*Annual Energy Outlook* system.

Model Interfaces: Input data are fed in from MAIN; Output data are submitted to MAIN

Sponsor:

Office:	Energy Markets and End Use
Division:	Energy Analysis and Forecasting
Branch:	Demand Analysis and Forecasting Branch, EI-621
Model Contact:	Barry Cohen
Telephone:	586-5359

Documentation: Energy Information Administration, *Model Documentation for the PC-AEO Forecasting Model for the Annual Energy Outlook* (Washington, DC, March 1989.)

Archive Media and Installation Manual(s): Archived on floppy disk.

Purpose: Annual consumption forecasts are produced through year 2000 for the three major commercial fuels, electricity, natural gas, and distillate, in each of the four U.S. Census regions: Northeast, Midwest, South, and West. Forecasts for the four minor fuels (residual fuel, liquefied petroleum gas, coal, and motor gasoline) are produced by the model.

Energy System Described by Model: Consumption forecasts are generated for electricity, natural gas, and distillate. In addition, residual fuel, liquefied natural gas, coal, and motor gasoline are projected.

Coverage:

- **Geographic:** Northeast, Midwest, South, West--Census Regions
- **Time Unit/Frequency:** Annual, 1985 through 2000

- **Product(s):** Consumption forecasts are generated for electricity, natural gas, and distillate. In addition, residual fuel, liquefied natural gas, coal, and motor gasoline are projected.
- **Economic Sector(s):** Non-residential, non-industrial, and government/public buildings.

Modeling Features:

- **Model Structure:** Recursive by fuel and Census region
- **Modeling Technique:** Least squares regression with correction for autocorrelation
- **Special Features:** None.

Non-DOE Input Sources:

- U.S. Department of Commerce, Bureau of the Census
  - New floorspace
  - Population data
- U.S. Department of Commerce, Bureau of Economic Analysis
  - Disposable personal income data.

DOE Data Input Sources:
Forms and Publications:

- Energy Information Administration, *Non-Residential Buildings Energy Consumption Survey: Building Characteristics*, DOE/EIA-0278, (Washington, DC).
  - New/surviving floorspace shares of major fuels
  - Initial (1986) new/total floorspace levels
  - Total floorspace for all major fuels
  - Initial (1986) values and parameters for energy use rates
- Energy Information Administration, *State Energy Data Report*, DOE/EIA-0214, (Washington, DC).
  - Short-term price elasticities
  - Energy price data.

General Output Descriptions: The consumption forecasts by region are calibrated to the State Energy Data System (SEDS) levels reported for the starting year of the forecast period (1985 through 2000).

Computing Environment:

- **Hardware Used:** IBM compatible personal computer (PC/AT)
- **Language Used:** Lotus 1-2-3, Version 2.01
- **Core Requirement:** 200 K
- **Estimated Cost to Run:** 60 minutes on an 80386 based PC
- **Special Features:** None.

Independent Reviews Conducted: The Commercial Sector Energy Model (CSEM) PC Spreadsheet Version, Prepared by Roberto S. Mariano, University of Pennsylvania, May 27, 1988.

Status of Evaluation Efforts by Sponsor: None.

Drilling Cost Estimates Model (DCEM)

Abstract: DCEM estimates current instantaneous domestic well drilling costs by area, well depth, and well type (oil, gas, dry, and composite). The model uses Joint Association Survey (JAS) data on drilling costs and other variables which represent actual components of drilling costs (or surrogates) to estimate costs for 2 years following the published JAS costs.

Type: Auxiliary

Last Model Update: April 1984.

Part of Another Model? No

Model Interfaces: None

Sponsor:

Office:	Oil and Gas
Division:	Reserves and Natural Gas
Branch:	Data Quality and Support, Dallas Field Office
Model Contact:	Velton T. Funk
Telephone:	(214) 767-2200

Documentation: Model documentation is available from the model contact.

Archive Media and Installation Manual(s): DCEM83 - for *Indexes and Estimates of Domestic Well Drilling Costs* 1982 and 1983, DOE/EIA-0347, September 1983.

Purpose: DCEM estimates current domestic well drilling costs for a Dallas Field Office annual publication, *Indexes and Estimates of Domestic Well Drilling Costs.*

Energy System Described by Model: Crude oil, natural gas, and dry hole drilling costs.

Coverage:

- **Geographic:** Lower-48 States
- **Time Unit/Frequency:** Annual
- **Product(s):** Oil and natural gas wells
- **Economic Sector(s):** Oil and gas operating, service and supply companies, financial institutions, government and related industries.

Modeling Features:

- **Model Structure:** Two separate steps are run for each depth and well type by area to: (1) select the equation with the highest R-square and (2) fit the data to the selected equations to give estimates of costs 2 years after the last available drilling costs.
- **Modeling Technique:** Least squares regression of nonlinear equations.
- **Special Features:** DCEM incorporates the engineering and economic factors assumed to influence well drilling costs. Instantaneous drilling costs, comparative tables, and plots for each type of well are published as an integral part of each annual report.

Non-DOE Input Sources:
Hughes Tool Company Weekly Rig Count

- Rig-use factor

American Petroleum Institute

- Wildcat ratio
- Major-operator adjustment factor
- Hole production factor

The Oil Daily

- Fuel index

Bureau of Labor Statistics

- Tubular index
- Labor index

Independent Petroleum Association of America

- Mud index
- Hydrocarbon-value index

Salomon Brothers, Inc.

- Major operator-adjustment factor.

DOE Data Input Sources:
Forms and Publications:

- Energy Information Administration, *Monthly Energy Review*, DOE/EIA-0035, (Washington, DC).
  - Hydrocarbon-value index

Models and Other:

- None.

General Output Descriptions: DCEM produces estimated well drilling and completion costs and indexes for 13 onshore geographical areas of the United States. Included are estimates for composite (all types) wells, oil wells, gas wells, and dry holes. Results are published by the Energy Information Administration.

Computing Environment:

- **Hardware Used:** IBM 3084QX
- **Language Used:** Statistical Analysis System (SAS)
- **Core Requirement:** 1200K
- **Estimated Cost to Run:** 30-40 CPU seconds for each of 14 areas and 4 well types
- **Special Features:** None.

Independent Reviews Conducted:

- Independent Expert Review conducted by George M. Lady, July 1983
- Independent Expert Review conducted by Bryan W. Brown, August 1984.

Status of Evaluation Efforts by Sponsor: Under revision.

Electric Utility Model - Capacity (UTILCAP-PC)

Abstract: UTILCAP-PC is a capacity planning model used to estimate generating capacity additions beyond the level of additions already planned or under construction. UTILCAP-PC determines the quantity of new capacity by plant type, based on user-provided new-plant-type options. Costs of construction are calculated and passed to the electricity pricing component, UTILFIN-PC.

Type: Basic

Last Model Update: January 1989

Part of Another Model? Yes, UTILCAP-PC is the capacity planning module of the PC- *Annual Energy Outlook* modeling system. UTILCAP-PC may be used together with the electricity generation module, UTILGEN-PC, and the electricity pricing module, UTILFIN-PC, or it may also be used as a stand-alone model.

Model Interfaces: Built-in macro routines for input and output to the integrated PC-AEO model worksheet.

Sponsor:

Office:	Coal, Nuclear, Electric and Alternate Fuels
Division:	Electric Power
Branch:	Data Analysis and Forecasting, EI-542
Model Contact:	Jeff Jones
Telephone:	586-1603

Documentation: Energy Information Administration, *Model Documentation Report for PC-AEO Forecasting Model for the Annual Energy Outlook 1987.*

Archive Media and Installation Manual(s): Archived on floppy disk.

Purpose: UTILCAP-PC estimates generating capacity additions beyond the level currently planned or under construction and determines costs associated with the construction of new plants.

Energy System Described by Model: UTILCAP-PC represents the capacity expansion requirements of the domestic electric utility sector.

Coverage:

- **Geographic:** National and the four Census regions
- **Time Unit/Frequency:** Annual, 1985 - 2000
- **Product(s):** Electricity
- **Economic Sector(s):** Electric utilities.

Modeling Features:

- **Model Structure:** Economic
- **Modeling Technique:** Deterministic
- **Special Features:** Implemented in Lotus 1-2-3. It can be used independently or in the integrated PC-AEO model.

Non-DOE Input Sources:

- Electric Power Research Institute, Technical Assessment Guide, (Palo Alto, CA, 1986)
  - Construction costs for new plants by plant type.

DOE Data Input Sources:

Forms and Publications:

- EIA-860, "Annual Electric Generator Report"
  - Existing generating capacity, scheduled capacity additions, and scheduled capacity retirements.

Models and Other:

- PC- *Annual Energy Outlook* models
  - Electricity demand
- Electricity Market Model
  - Reserve margins
  - Load factors
  - Construction expenditure profiles
  - Peak/nonpeak capacity ratios.

General Output Descriptions: UTILCAP-PC projects generating capacity additions by plant type and Census region.

Computing Environment:

- **Hardware Used:** IBM compatible personal computer (PC/AT)
- **Language Used:** LOTUS 1-2-3, Version 2.1
- **Core Requirement:** 512K to run standalone
- **Estimated Cost to Run:** Recalculation time between 10 and 30 seconds
- **Special Features:** Designed to be run either as a stand-alone worksheet or as a callable worksheet component of the integrated PC- *Annual Energy Outlook* Model.

Independent Reviews Conducted: Martin L. Baughman, Independent Expert Reviewer.

Status of Evaluation Efforts by Sponsor: None.

Electric Utility Model - Financial/Pricing (UTILFIN-PC)

Abstract: UTILFIN-PC is a regulatory accounting model that calculates electric utility revenue requirements and electricity prices for investor-owned utilities using rate-of-return regulation and for government-owned utilities using debt service coverage criteria. The model determines electric revenue by first calculating a rate base and allowed operating and fuel expenses. UTILFIN-PC alters overall financing levels in response to capital requirements. It then tallies summary financial statements for analysis. Inputs to UTILFIN-PC include capital, operating and fuel costs

of generation, capacity expansion plans (usually from UTILCAP-PC and UTILGEN-PC), the initial financial position of electric utilities and electricity consumption (usually from the residential, commercial, industrial and transportation demand modules of PC-AEO).

Type: Basic

Last Model Update: January 1989

Part of Another Model? Yes, designed to be used as the electricity pricing module of the PC-*Annual Energy Outlook* system. It may also be used as a stand-alone model.

Model Interfaces: Built-in macro routines for input and output to the integrated PC-AEO model worksheet. Model is structured parallel to the National Utility Financial Statements Model

Sponsor:

Office:	Coal, Nuclear, Electric and Alternate Fuels
Division:	Electric Power
Branch:	Data Analysis and Forecasting, EI-542
Model Contact:	John Conti
Telephone:	586-9856

Documentation: Energy Information Administration, *Model Documentation for the Electric Utility Financial Submodel for the PC-AEO 1987* (UTILFIN-PC) February 1988.

Archive Media and Installation Manual(s): Archived on floppy disk.

Purpose: UTILFIN-PC estimates the price of electricity by consuming sector based on rate-of-return regulation and debt service coverage criteria to meet capital, fuel, and operating costs of electricity generation.

Energy System Described by Model: UTILFIN-PC represents the financial/pricing aspects of the domestic electric utility sector for both public and private utilities.

Coverage:

- **Geographic:** National and calibrated to four Census regions
- **Time Unit/Frequency:** Annual, 1985 - 2000
- **Product(s):** Electricity
- **Economic Sector(s):** Private and public electric utilities.

Modeling Features:

- **Model Structure:** Finance and accounting
- **Modeling Technique:** Deterministic
- **Special Features:** It can be used independently or in the integrated PC AEO model.

Non-DOE Input Sources:
None.

DOE Data Input Sources:
Forms and Publications:

- FERC-1, "Annual Report of Major Electric Utilities, Licensees, and Others," and EIA-412, "Annual Report of Publicly Owned Electric Utilities"
  - Base year data on utility plant in service, construction work in progress, and taxes
- Energy Information Administration, *Electric Power Annual*, DOE/EIA-0348 (Washington, DC)
  - Base year (1985, 1986) data on generation, fuel consumption, and fuel costs by plant type and Census region.

Models and Other:

- PC- *Annual Energy Outlook* models
  - Electricity demand
  - Regional fuel expense
  - Regional operations and maintenance expenses
  - Plant additions
  - Generating plant construction-work-in-progress
  - Utility AA bond rate
  - GNP implicit price deflator
- Other EIA Models:
  - Sectoral price markups by Census region
  - Tax rates: State, local, and gross receipts
  - Deferred income taxes and investment tax credit amortization.

General Output Descriptions: Projects electricity prices by consuming sector marked up to Census region. Also provides pro forma financial statements for private and public utility aggregates.

Computing Environment:

- **Hardware Used:** IBM compatible personal computer (PC/AT)
- **Language Used:** LOTUS 1-2-3, Version 2.1
- **Core Requirement:** 512K to run standalone
- **Estimated Cost to Run:** Recalculation time between 10 and 30 seconds
- **Special Features:** Designed to be run either as a stand-alone worksheet or as a callable worksheet component of the integrated PC Energy Model.

Independent Reviews Conducted: Martin L. Baughman, Independent Expert Reviewer.

Status of Evaluation Efforts by Sponsor: None.

Electric Utility Model - Generating (UTILGEN-PC)

Abstract: UTILGEN-PC is a generation and fuel use model that allocates available generating capacity to meet electricity demand and estimates the energy use by plant type. UTILGEN-PC also determines the generation mix, energy use by fuel, fuel expense, and operations and maintenance (O&M) costs. Fuel and O&M costs are passed to the electricity pricing component, UTILFIN-PC.

Type: Basic

Last Model Update: January 1989

Part of Another Model? Yes, UTILGEN-PC is the electricity generation and fuel consumption module of the PC-AEO modeling system. UTILGEN-PC may be used together with the capacity planning module, UTILCAP-PC, and the electricity pricing module, UTILFIN-PC, or it may also be used as a stand-alone model.

Model Interfaces: Built-in macro routines for input and output to the integrated PC-AEO model worksheet.

Sponsor:

Office: Coal, Nuclear, Electric and Alternate Fuels

Division: Electric Power

Branch: Data Analysis and Forecasting, EI-542

Model Contact: Jeff Jones

Telephone: 586-1603

Documentation: Energy Information Administration, *Model Documentation Report for PC-AEO Forecasting Model for the Annual Energy Outlook 1987.*

Archive Media and Installation Manual(s): Archived on floppy disk.

Purpose: UTILGEN-PC allocates generating capacity to meet electricity demand and determines the energy use by plant type and fuel, fuel expense, and operating and maintenance cost.

Energy System Described by Model: UTILGEN-PC represents the electricity production and fuel consumption of the domestic electric utility sector.

Coverage:

- **Geographic:** National and the four Census regions
- **Time Unit/Frequency:** Annual, 1985 - 2000
- **Product(s):** Electricity
- **Economic Sector(s):** Electric utilities.

Modeling Features:

- **Model Structure:** Economic
- **Modeling Technique:** Deterministic
- **Special Features:** Implemented in Lotus 1-2-3. It can be used independently or in the integrated PC-AEO model.

Non-DOE Input Sources:

- Electric Power Research Institute, Technical Assessment Guide, (Palo Alto, CA, 1986)
  - Heat rates and operating and maintenance costs by plant type.

DOE Data Input Sources:
Forms and Publications:

- Energy Information Administration, *Electric Power Annual*, DOE/EIA-0348 (Washington, DC)
  - Base Year (1985, 1986) data on generation, fuel consumption, and fuel costs by plant type and Census region.

Models and Other:

- PC- *Annual Energy Outlook* models
  - Electricity demand
  - Fuel prices

- Electricity Market Model
  - Utilization rates for nuclear, hydroelectric, and combustion turbine plants
  - Minimum and maximum utilization rates for combined cycle plants
  - Transmission/distribution loss factors
  - Net imports and purchases from small power producers and cogenerators.

General Output Descriptions: UTILGEN-PC projects electricity generation and fuel consumption by plant type and Census region.

Computing Environment:

- **Hardware Used:** IBM compatible personal computer (PC/AT)
- **Language Used:** LOTUS 1-2-3, Version 2.1
- **Core Requirement:** 512K to run standalone
- **Estimated Cost to Run:** Recalculation time between 10 and 30 seconds
- **Special Features:** Designed to be run either as a stand-alone worksheet or as a callable worksheet component of the integrated PC- *Annual Energy Outlook* Model.

Independent Reviews Conducted: Martin L. Baughman, Independent Expert Reviewer.

Status of Evaluation Efforts by Sponsor: None.

Electricity Market Model (EMM)

Abstract: EMM is used by the Energy Information Administration as an analytical system for projecting the future state of the electricity market. This model is a major component of the Intermediate Future Forecasting System (IFFS). This representation of the electricity market accounts for the economic factors of supply and demand, the economic competition of fuels, and Government policies and regulations that deviate from purely economic behavior.

Type: Basic

Last Model Update: December 1988.

Part of Another Model? Intermediate Future Forecasting System (IFFS)

Model Interfaces: EMM is one of the primary components of IFFS from which it derives estimates of projected fuel prices, electricity demands, inflation rates, and interest rates. In addition, capital costs for new plants are estimated by the Oak Ridge National Laboratory's CONCEPT Model.

Sponsor:

Office:	Coal, Nuclear, Electric and Alternate Fuels
Division:	Electric Power
Branch:	Data Analysis and Forecasting, EI-542
Model Contact:	Jeff Jones
Telephone:	586-1603

Documentation: Energy Information Administration, *Model Documentation: Electricity Market Module*, DOE/EIA-MOO1 (Washington, DC, December 1984). Updated documentation is forthcoming.

Archive Media and Installation Manual(s): The use of EMM as a module of IFFS for the *Oil and Gas Annual Fuels Outlook 1989*, the *Annual Outlook for U.S. Electric Power 1989*, and *Annual Outlook for U.S. Coal 1989* is archived on a forthcoming archive tape IFFS89.

Purpose: EMM's objective is to simulate electric utility behavior in order to produce a forecast of electricity prices, fuel consumption patterns and expansion plans consistent with electricity demand forecasts.

Energy System Described by Model: EMM is a process model representing the domestic electricity market. EMM represents the conversion of fossil fuels, nuclear power, hydropower and other renewable energy sources into electricity. EMM translates the fixed and variable costs of production into electricity prices by simulating electric utility regulatory practices for both privately and publicly owned utilities. In addition, EMM formulates capacity expansion plans to provide adequate capacity throughout the forecast horizon.

Coverage:

- **Geographic:** 10 Federal Regions
- **Time Unit/Frequency:** Annually through 2010
- **Product(s):** Electricity prices and demands, fuel consumption for coal, natural gas, distillate oil, low sulfur residual oil, high sulfur residual oil, nuclear power fossil fuel equivalent, and hydropower/other fossil fuel equivalent.
- **Economic Sector(s):** Private and public electric utilities.

Modeling Features:

- **Model Structure:** EMM is a process model simulating the decisionmaking behavior of electric utilities in choosing the appropriate mix of capacity to construct for future years, in allocating current plants to satisfy generation requirements, and in determining electricity prices consistent with demand estimates.
- **Modeling Technique:** EMM is modular in its relation to the Intermediate Future Forecasting System and in the relationship among the components which define the model. In addition, EMM is largely data-driven in that the core software (those routines which implement the methodology) is blind to both region and forecast year.
- **Special Features:** The primary design feature of the EMM is its modularity. The model is composed of four loosely linked components: planning, dispatch, pricing and demand. Any of these components may be replaced by a new representation with only minimal direct interface required.

  The modularity allows EMM and the Natioanl Utility Financial Statement Model to use the same software. The common subroutines are data driven and serve both functions equally well and allow for maintenance and development of only one set of software.

Non-DOE Input Sources:

Edison Electric Institute, 1982 hourly load data

- Base year load curve coefficients by season
- Seasonal shares of electricity demand
- Coefficients for the annual load duration curve

Concept-5 User's Manual, Oak Ridge National Laboratory, 1979

- Current year original capital costs
- Capital cost associated with each type of new unit
- Actual capacity costs in current year (real dollars)
- Overnight plant costs per unit of capacity for new plants
- Construction profile for each plant type
- Length of the construction period for each type of new unit

Regionalized Capital and Operating and Maintenance (O&M) Cost Estimates for Emission Control Equipment Required for New Fossil Steam Power Plants, J.A. Reyes Associates, 1982.

- O&M costs for emission control equipment
- Heat rate penalties for emission control equipment
- O&M costs for new fossil steam capacity
- Heat rates for new fossil steam capacity

U.S. Long-term Review, Data Resources Inc., 1984.

- Historical GNP deflators
- Historical GNP price deflators.

DOE Data Input Sources:

Forms and Publications:

- EIA-254, "Semiannual Report on Status of Reactor Construction"
  - Book value of cancelled nuclear plants
  - Nuclear cancellation costs
  - Length of the construction period for each new unit
- EIA-759, "Monthly Power Plant Report"
  - Generation and fuel consumption for existing capacity
  - Maximum fuel shares for existing capacity
  - Seasonal generation for existing hydro capacity
- FERC-423, "Monthly Report of Cost and Quality of Fuels for Electric Plants"
  - Btu and sulfur contents for existing capacity
  - Residual type code
  - Coal shares by plant, coal type, and NCM region
  - Residual shares by plant and residual type
- IE-411, "Coordinated Regional Bulk Power Supply Program Report"
  - Base load adjustment for interregional transfers
  - Fuel cost adjustment for purchased power
  - Adjustment to revenues for bulk power sales
- FERC-1, "Annual Report of Major Electric Utilities, Licensees, and Others," and Form EIA-412, "Annual Report of Publicly Owned Electric Utilities"
  - Utility plant in service aggregated by type
  - Construction work in progress
  - Accumulated provisions for depreciation, amortization, and depletion
  - Total capitalization by type
  - Taxes (Federal, State, general, other)
  - Embedded cost of capital (debt and preferred)
  - Electric Revenues
  - Deferred taxes (income and investment tax credits)
- Energy Information Administration, State *Energy Price and Expenditure Report* 1984 (DOE/EIA-0376), (Washington, DC, 1984)
  - Base year sectoral price markups

- Economic Regulatory Administration, *Electricity Transactions Across International Borders*, DOE/RG-0068, 0069, (Washington, DC, 1986, 1987)
  - Canadian transfers, historical and projected
- Energy Information Administration, *Data Notebook Generating Technology Assessment*, DE-AC01-79EI10480, (Washington, DC, 1980).
  - Current year original capital costs for hydroelectric plants
  - Equipment reliabilities
  - Fixed O&M cost for gas turbines, combined cycle, and hydroelectric plants
  - Forced outage rates for existing and new capacity
  - Heat rates for new capacity
  - Capital costs associated with each type of new unit
  - Planned maintenance rates for existing and new capacity
  - Variable O&M rate for gas turbines, combined cycle, and hydroelectric plants

Models and Other:

- None.

General Output Descriptions: EMM provides information on electricity demand, supply, and financial information for the 10 Federal regions as well as for the entire United States. The data are used for analysis by the Department of Energy and other analysts and are published in the *Annual Outlook for U.S. Electric Power 1988*.

Computing Environment:

- **Hardware Used:** IBM 3084QX
- **Language Used:** Fortran 77
- **Core Requirement:** 2048K
- **Estimated Cost to Run:** 5 CPU minutes for years 1985 through 2000
- **Special Features:** EMM may be run as part of IFFS or as a stand-alone module. In addition, SAS is used in processing.

Independent Reviews Conducted: Ed Hillsman of Oak Ridge National Laboratory (ORNL) conducted a review of EMM in 1984-85.

Status of Evaluation Efforts by Sponsor: EMM is currently being evaluated by the Oak Ridge National Laboratory.

Energy Disaggregated Input-Output Model (EDIO)

Abstract: EDIO describes the supply interdependencies among the various producing sectors of the economy. The EDIO model incorporates a new sectoring format that explicitly identifies 15 energy sectors as compared to the standard 5 in other input-output models. EDIO was developed in conjunction with the Bureau of Labor Statistics.

Type: Auxiliary

Last Model Update: February 1984.

Part of Another Model? No.

Model Interfaces: Input of macroeconomic final demands from macro models.

Sponsor:

Office:	Energy Markets and End Use
Division:	Economics and Statistics
Branch:	Macro and Financial Information, EI-641
Model Contact:	Ronald Earley
Telephone:	586-1398

Documentation:

- *Model Applications Guide; Methodology Guide; Systems and Database Guide*, Consad Research Corp., 1981
- *EDIO Model System Specifications*, The Orkand Corp., 1984.

Archive Media and Installation Manual(s): *Annual Report to Congress* (ARC) 1978 version archived.

Purpose: EDIO addresses output and employment implications of alternative energy scenarios. It also identifies energy flows to industrial sectors.

Energy System Described by Model: 15 explicitly identified products plus 100 nonenergy sectors.

Coverage:

- **Geographic:** National, by economic sector
- **Time Unit/Frequency:** Coefficients 1977 based, annual forecasts based on alternative macro final demand specifications
- **Product(s):** 15 explicitly identified energy products

- **Economic Sector(s):** 115 industrial sectors.

Modeling Features:

- **Model Structure:** Input/output (I/O) model
- **Modeling Technique:** Standard demand driven I/O inverse matrix procedures
- **Special Features:** The energy sector detail (15) is significantly greater than previously existing input-output models (5).

Non-DOE Input Sources:

Farm Production Expenditures, Department of Agriculture, 1977/1980.

- Expenditures for fuels
- Consumption of fuels

Agricultural Statistics, Department of Agriculture, 1981.

- Price data for fuels

Bureau of Labor Statistics, U.S. Department of Labor.

- Energy use coefficients

Census of Mineral Industries, Fuels and Electric Energy Consumed, Bureau of the Census, U.S. Department of Commerce.

- Cost and quantity data for coal, distillate fuel, residual fuel, natural gas, gasoline, other fuels

1977 Census of Construction Industries, Bureau of the Census, U.S. Department of Commerce.

- Energy use data in the construction industry for electricity, natural gas, gasoline, diesel fuel, lubricants, and other fuels

Value of New Construction Put in Place in the United States, 1964-1980, Bureau of the Census, U.S. Department of Commerce.

- Value of new construction in current dollars and in 1977 constant dollars

Residential Alterations and Repairs, Bureau of the Census, U.S. Department of Commerce, 1977 and 1980.

- The amounts of residential maintenance performed in 1977 and 1980

Highway Statistics, Federal Highway Administration, 1977 and 1980.

- The amounts of highway maintenance performed in 1977 and 1980
- Automobile fuel consumption
- On-highway fuel use by trucks

Census of Manufacturers, Fuels and Electric Energy Consumed, Bureau of the Census, U.S. Department of Commerce, 1977.

- Consumption of distillate fuel oil, residual fuel oil, coal, coke and breeze, natural gas, electric energy, and LPG in the manufacturing sector

1980 *Annual Survey of Manufacturers, Fuels and Electric Energy Consumed*, Bureau of the Census, U.S. Department of Commerce, 1980.

- Consumption of distillate fuel oil, residual fuel oil, coal, coke and breeze, natural gas, electric energy, and LPG in the manufacturing sector

Statistical Yearbook of the Electric Utility Industry, Edison Electric Institute, 1980.

- Consumption of electricity by utilities
- Sales of electricity in the commercial sector

Gas Facts, American Gas Association, 1980.

- Consumption of natural gas by utilities
- Sales of natural gas in the commercial sector

Survey of Current Business, July 1982.

- Dollar values for electricity, natural gas, and other fuels for 1977 and 1980

DOE Data Input Sources:

Forms and Publications:

- Energy Information Administration, Office of Oil and Gas
  - Imports of petroleum products, 1977 and 1980
  - Distillate fuel use in personal consumption sector, commercial sector, government sector, utility sector
  - Exports of petroleum products, 1977 and 1980
- Energy Information Administration, *Monthly Energy Review*, DOE/EIA-0035, (Washington, DC).
  - Fuel use by each sector

Models and Other:

- None.

General Output Descriptions: Output for 115 sectors.

Computing Environment:

- **Hardware Used:** IBM 3084QX
- **Language Used:** PL/1
- **Core Requirement:** 900K
- **Estimated Cost to Run:** 17.5 CPU seconds for all subprograms
- **Special Features:** None.

Independent Reviews Conducted: Energy Disaggregated Input-Output (EDIO) Model, James A. Edmonds, October 15, 1981, Independent Expert Reviewer.

Status of Evaluation Efforts by Sponsor: None.

Gas Analysis Modeling System (GAMS)

Abstract: The Gas Analysis Modeling System (GAMS) covers all aspects of the natural gas market, from producers through pipeline companies and distributors, to the consumer. GAMS encompasses regional drilling activity levels subject to the availability of rigs and other equipment and the corresponding reserve additions; spot market activity, natural gas contract pricing and take-or-pay provisions for production purchases; cost-of-service pricing by pipeline companies and distributors; regional markets, with sectoral detail; projected demand for each sector; and transmission and distribution of natural gas. Forecasts are typically generated through the year 2000, however, the model can be run through the year 2010. The model is used to forecast gas market activity (supply/demand balance), to analyze the natural gas industry, including the effects of current regulations (such as Federal Energy Regulatory Commission Order 451 and Order 500), and for policy alternatives.

Type: Basic

Last Model Update: December 1988.

Part of Another Model? No, but may be run with Intermediate Future Forecasting System (IFFS).

Model Interfaces: IFFS, and PROLOG

Sponsor:

Office:	Oil and Gas
Division:	Reserves and Natural Gas
Branch:	Analysis and Forecasting, EI-442
Model Contact:	Barbara Mariner-Volpe
Telephone:	586-5878

Documentation: Energy Information Administration, *Model Documentation of the Gas Analysis Modeling System*, DOE/EIA-0450 (Washington, DC, August 1984).

- Volume 1 - Model Overview
- Volume 2 - Model Methodology
  - Part I: GAMS Overview
  - Part II: Control, Pricing, and Methodology
  - Part III: MARKET Methodology
  - Part IV: BID/AWARD Methodology
- Volume 3 - Software and Data Documentation, and User's Guide.

Archive Media and Installation Manual(s):

- GAMS82(AO) - Archived for the *Annual Energy Outlook* 1982.
- GAMS82(P4) - Archived for the "Part IV Study."
- GAMS83 - Archived for the *Annual Energy Outlook* 1983.
- GAMS84 - Archived for the *Annual Energy Outlook* 1984.
- GAMS85 - Archived for the *Annual Energy Outlook* 1985.
- GAMS86 - Archived for the *Annual Energy Outlook* 1986.
- GAMS88 - Archived for the *Annual Outlook for Oil and Gas 1988*, the *Annual Outlook for U.S. Electric Power 1988*, and the *Annual Outlook for U.S. Coal 1988* .
- GAMS89 - Archived for the *Annual Outlook for Oil and Gas 1989*, the *Annual Outlook for U.S. Electric Power 1989*, the *Annual Outlook for U.S. Coal 1989* , and *Electricity Generation from Natural Gas: Prospects and Implications for the United States.*

Purpose: GAMS is used by the Analysis and Forecasting Branch in the Office of Oil and Gas as an analytic aid to support preparation of annual medium term (10 to 15 years) regional projections of reserves, production of natural gas, and of consumption by end-use sector, so as to illustrate the potential effects of alternative policies, regulations, and economic environments on domestic gas market balances. The annual projections and associated analyses appear in the Annual Outlook for Oil and Gas, in prior publications of the *Annual Energy Outlook* (DOE/EIA-0383) of the the Energy Information Administration, and other special analyses.

Energy System Described by Model: GAMS is a modular, multiregional, time-stepped (annual), partial equilibrium model of domestic natural gas markets. Annual gas reserve changes are stratified by wellhead price categories defined by The Natural Gas Policy Act (NGPA). Production from reserves are resolved at the level of groups of major pipelines. Annual demand is resolved at the regional level for end-use sectors. Key determinants of market balance are prices of gas and alternate fuels, exploratory/developmental drilling ac-

tivity, macro-economic growth, regulations and market conditions.

Coverage:

- **Geographic:** National, demand region, State level, and pipeline systems
- **Time Unit/Frequency:** Annually through 2010
- **Product(s):** Natural gas
- **Economic Sector(s):** Residential, commercial, industrial, and electric utility.

Modeling Features:

- **Model Structure:** Modular; containing six major components
  - CONTROL - system initialization and report generation
  - PRICE - annual update of contract prices of gas by category and pipeline system - MARKET - annual demand and supply balancing
  - PROLOG - annual reserve additions and production potential
- **Modeling Technique:** GAMS is a modular system of mathematical equations linking gas discovery, production, production rates, consumption, and stock change to geological, engineering, economic, and institutional determinants.
- **Special Features:** GAMS:
- Can be used to analyze different policy scenarios o Can run stand-alone or in conjunction with IFFS.

GAMS incorporates the primary economic, geological, engineering, and institutional factors that are assumed to determine feasible levels of annual gas production and domestic market balances. Unique among annual gas market models, it incorporates:

- Calibration of historical market distribution data in the simulation, enabling refinement and benchmarking of projections with updated data
- State/sector detail by articulated tracing of transmission/distribution to State market sectors to accumulate user demands
- Explicit representation of characteristic provisions of wellhead contracts.

The variables included in the GAMS' information base that may be affected by future policy, regulatory, or economic conditions and that in turn affect annual domestic gas market balances are:

- Domestic gas wellhead prices and contract terms
- Oil burning capabilities and domestic prices of residual fuel oil delivered to end-use sectors
- World crude oil prices
- Import deliverability
- Availability of Alaskan gas
- Domestic tax, interest, and inflation rates

The effects of various alternative gas policies and regulations can be analyzed in terms of their effects on market balances.

Non-DOE Input Sources:
Summary of Rate Schedules of Natural Gas Pipelines

- tariffs posted by interstate pipelines (semi-annually)

Gas Facts

- State consumption and sales prices
- transmission loss factors
- load factor estimates

Handy-Whitman Index of Public Utility Construction Costs

- price indices for replacement and construction of distribution facilities

Survey of Current Business, Bureau of Labor Statistics, U.S. Department of Labor.

- GNP deflator
- AA utility bond interest rates

DOE Data Input Sources:
Forms and Publications:

- EIA-23, "Annual Survey of Domestic Oil and Gas Reserves"
  - annual estimate of gas reserves by type and State.
- FERC-50, "Alternate Fuel Demand Due to Natural Gas Curtailments"
  - monthly sales to end-use customers
  - number of customers in each sector
  - annual (heating year) purchases from suppliers.
- EIA-176, "Annual Report of Natural and Supplemental Gas Supply and Disposition"
  - annual natural gas sources of supply and consumption.
- EIA-758, "Natural Gas Producer/Pipeline Contract Report"
  - distribution of contract clauses for existing contracts.
- FERC-2, "Annual Report of Major Natural Gas Companies"
  - annual sales by pipeline (volume and price).

- FERC-15, "Interstate Pipeline's Annual Report of Gas Supply"
  - annual status of reserves
  - commitments to pipeline companies
  - annual gas production, storage, interstate movements, and consumption.
- FERC-121, "Application for Determination of Maximum Lawful Price under the Natural Gas Policy Act of 1978"
  - tariff components.
- FERC-123, "Initial Report of First Sale of Natural Gas Under Section 105, Natural Gas Policy Act, Existing Interstate Contract."
  - contract data

Models and Other:

- EIA-REGSHARE 81
  - State annual population projections.

General Output Descriptions: GAMS reports three broad aspects of the natural gas market on an historical and forecast basis:

- annual status of reserves and production by NGPA category
- annual pipeline system wellhead purchases and prices by NGPA categories and intersystem transfers
- annual consumption and prices by sector and region

The annual reports include the following:

- total gas production and consumption
- throughput by pipeline systems for controlled and decontrolled gas
- ceiling prices of NGPA categories of gas
- take-or-pay defaults by pipeline systems
- intersystem transfers of gas and prices
- imports and prices by pipeline system
- average price and value of consumption by region, by region/market sector, and by market sector ('region' denotes Census region and DOE region).

Computing Environment:

- **Hardware Used:** IBM 3084QX
- **Language Used:** FORTRAN, COBOL
- **Core Requirement:** 6000K
- **Estimated Cost to Run:** Fifteen year forecast, 8 minutes.
- **Special Features:** None.

Independent Reviews Conducted: *Assessment of Natural Gas Market Models*, Charles River Associates, (Boston, Massachusetts, April 1984).

Status of Evaluation Efforts by Sponsor: None.

Household Model of Energy (HOME3-PC)

Abstract: HOME3-PC forecasts energy use in the residential sector annually through the year 2000. It is an econometric model with some structural detail concerning housing characteristics, fuel shares and energy consumption per house. HOME3-PC forecasts consumption of energy for six fuels in four Census regions. It is sensitive to the major demographic and economic determinants of residential sector energy use. HOME3-PC is the residential component of the PC *Annual Energy Outlook* modeling system.

Type: Basic

Last Model Update: January 1989

Part of Another Model? Yes, part of the PC- *Annual Energy Outlook* system.

Model Interfaces: Prices, population, interest rate and income from the PC- *Annual Energy Outlook* system Input data: Data sources: Output data:

Sponsor:

Office:	Energy Markets and End Use
Division:	Energy Analysis and Forecasting
Branch:	Demand Analysis and Forecasting Branch, EI-621
Model Contact:	Barry Cohen
Telephone:	586-5359

Documentation: Energy Information Administration, *Model Documentation for the PC-AEO Forecasting Model for the Annual Energy Outlook* , (Washington, DC, March 1988).

Archive Media and Installation Manual(s): Archived on floppy disk.

Purpose: To provide residential sector energy forecasts for the *Annual Energy Outlook* and various other studies.

Energy System Described by Model: Residential sector energy use.

Coverage:

- **Geographic:** Four Census regions
- **Time Unit/Frequency:** Annual, 1985 through 2000
- **Product(s):** Electricity, natural gas, distillate, kerosene, liquid gas and coal
- **Economic Sector(s):** Residential.

Modeling Features:

- **Model Structure:** Energy use based on the number of customers (houses), fuel shares, and energy use per customer.
- **Modeling Technique:** Econometric
- **Special Features:** None.

Non-DOE Input Sources:

- *Characteristics of New Housing*, U.S. Department of Commerce
  - New housing construction by Census region
  - Housing type
  - Fuels used for space heating and for air conditioning in
  - New housing sizes
- *Annual Housing Survey*, Bureau of the Census, U.S. Department of Commerce
  - Data on housing stock
  - Fuels used for space heating and air conditioning.

DOE Data Input Sources:
Forms and Publications:

- Form EIA-457, "Residential Energy Consumption Survey"
  - Consumption per electricity customer
  - Consumption per natural gas customer
  - Consumption per distillate customer
- Energy Information Administration, *State Energy Data Report*, DOE/EIA-0214, (Washington, DC)
  - Annual State level consumption data for a wide variety of fuels and sectors
- Energy Information Administration, State Energy Price and Expenditure System (Washington, DC)
  - Annual State level price data for a wide variety of fuels and sectors.

General Output Descriptions: Energy consumption for six residential sector fuels by four Census regions.

Computing Environment:

- **Hardware Used:** IBM compatible personal computer (PC/AT)
- **Language Used:** Uses operating system MS-DOS and coded in Lotus 1-2-3, Version 2.01
- **Core Requirement:** Model uses approximately 300K
- **Estimated Cost to Run:** On a Compaq 386 machine, approximately 20 seconds.
- **Special Features:** None.

Independent Reviews Conducted: Independent Expert Review of the Household Model of Energy, Version 3, Prepared by Bryan W. Brown, Rice University, May 29, 1988.

Status of Evaluation Efforts by Sponsor: None.

Industrial Energy Model (IEM-PC)

Abstract: The industrial model spreadsheet is based on manufacturing energy consumption as characterized by the *Annual Survey of Manufactures* series up to 1981 and the Manufacturing Energy Consumption Survey for 1985 now conducted triennially by EIA. For manufacturing, the model characterizes total energy and its shares to fuels as a function of relative prices and manufacturing growth in each of eight two-digit aggregations. Additional equations describe key nonmanufacturing trends.

Type: Basic

Last Model Update: October 1988.

Part of Another Model? Part of the PC-AEO system.

Model Interfaces: Inputs are read from MAIN, and outputs are written to MAIN. Input data: Data sources: Output data:

Sponsor:

Office:	Energy Markets and End Use
Division:	Energy Analysis and Forecasting
Branch:	Supply Analysis & Integration, EI-622
Model Contact:	John Holte
Telephone:	586-1471

Documentation: Energy Information Administration, *PC-AEO Forecasting Model for the Annual Energy Outlook 1989 (Washington, DC, 1/: Model Documentatio March 1989).*

Archive Media and Installation Manual(s): Archived on floppy disk with the PC-AEO system.

Purpose: The Industrial Sector Energy Model - PC is designed to project industrial energy demand at the national level by energy source and by year.

Energy System Described by Model: Industrial sector energy consumption consisting of the manufacturing sector, agriculture, construction and mining, feedstocks and other industrial consumption.

Coverage:

- **Geographic:** Four Census regions
- **Time Unit/Frequency:** Annual
- **Product(s):** Electricity, residual oil, distillate oil, natural gas, steam coal, metallurgical coal, kerosene, liquid petroleum gas, lubricants, motor gasoline, petroleum coke, special naphthas, still gas, asphalt, and hydropower.
- **Economic Sector(s):** Manufacturing, agriculture, mining, construction and other industrial.

Modeling Features:

- **Model Structure:** In the manufacturing sector, total consumption is estimated for each of eight two-digit sic code aggregations. The total is then shared to the fuels and electricity for each group. Outisde of the manufacturing sector, fuel consumption is estimated with a variety of econometric equations.
- **Modeling Technique:** Ordinary least squares with correction for autocorrelation
- **Special Features:** None.

Non-DOE Input Sources:

- U.S. Department of Commerce, *Complete National Energy Accounts*, computer tape OBA-NEA-07, Bureau of the Census, *Annual Survey of Manufactures*, 1958 through 1985.
  - Price and quantity data
  - Electricity consumption data
- American Iron & Steel Institute (AISI)
  - Estimates of metallurgical coal consumption
- American Gas Association
  - Estimates of manufacturing gas consumption
- Dun & Bradstreet
  - Estimates of residual and distillate fuel oil consumption
- Bureau of Labor Statistics
  - Data on output on the mining industries
- U.S. Department of Commerce, Bureau of the Census, *Census of the Construction Industry*
  - Estimates of energy expenditure by energy source.

DOE Data Input Sources:
Forms and Publications:

- Energy Information Administration, *State Energy Data Report*, DOE/EIA-0214; State *Energy Price and Expenditure Report*, DOE/EIA-0376; *Quarterly Coal Report*, DOE/EIA-0121 (Washington, DC)
  - Price data for various products
- Energy Information Administration, *Annual Energy Outlook*, DOE/EIA-0383 (Washington, DC)
  - Coal prices for 1985
- Energy Information Administration, *Monthly Energy Review*, DOE/EIA-0035 (Washington, DC)
  - Price data for natural gas and electricity
- Energy Information Administration, *Petroleum Marketing Annual*, DOE/EIA-0487 (Washington, DC)
  - Price data for distillate oil, LPG, residual oil, lubricants, and kerosene

Models and Other: None.

General Output Descriptions: Heat and power energy used by eight groupings of manufacturing SIC codes are projected for natural gas, purchased electricity, distllate LPG, residual oil, and steam coal. Agricultural, mining, and construction energy use along with feedstock consumption and consumption of other fuels are also forecasted.

Computing Environment:

- **Hardware Used:** IBM compatible personal computer (PC/AT)
- **Language Used:** Lotus 1-2-3, Version 2.01
- **Core Requirement:** 640K
- **Estimated Cost to Run:** 30 to 45 seconds
- **Special Features:** None.

Independent Reviews Conducted: A Review of the Industrial Sector Energy Model (ISEM-PC), G.S. Maddala, May 1988. Independent Expert Reviewer.

Status of Evaluation Efforts by Sponsor: None.

Intermediate Future Forecasting System (IFFS)

Abstract: IFFS represents U.S. energy supply, distribution, and consumption by fuel supply and consumption sector given a baseline forecast of consumption defined for the world crude oil price and a macroeconomic projection of economic growth. A detailed representation of electric utility planning and generation provides the demand for oil, coal, natural gas, hydropower, and nuclear and the prices of the generated electricity. An econometric representation of refinery pricing provides oil product prices. A coal supply and transportation model provides the delivery price of coal. IFFS is linked to the Gas Analysis Modeling System (GAMS) to compute the production and price of natural gas. The model solves for the market equilibrium for each fuel by balancing supply and demand to produce an energy balance in each forecast year. IFFS currently forecasts to the year 2010.

Type: Basic

Last Model Update: April 1988.

Part of Another Model? No, but can be linked with the Gas Analysis Modeling System (GAMS), so that GAMS can serve as the natural gas module in the Intermediate Future Forecasting System.

Model Interfaces: - Gas Analysis Modeling System (GAMS) - Production of Onshore Lower 48 Oil and Gas (PROLOG) Model - Oil Market Module (OMM) - Electricity Market Model (EMM) - Outer Continental Shelf Model (OCSM) - International Coal Trade Model (ICTM) - Coal Supply and Transportation Model (CSTM) - National Coal Model (NCM) - Resource Allocation and Mine Costing (RAMC) Model - National Utility Financial Statement (NUFS) Model - PC-AEO System - Oil Market Simulation (OMS) Model.

Sponsor:

Office:	Oil and Gas (OG); Coal, Nuclear, Electric and Alternate Fuels

Model Contacts:

Oil and Gas	Susan Shaw (OG) (586-4838)
Electricity	Jeff Jones (CNEAF) (586-1603)
Coal	Jim Littleton (CNEAF) (586-5938)

Documentation:

- Energy Information Administration, *Intermediate Future Forecasting System Executive Summary*, DOE/EIA-0430, (Washington, DC, October 1983)
- Energy Information Administration, *Documentation of the Integrating Module and Stock Module of the Intermediate Future Forecasting System*, DOE/EIA-M023 (Washington, DC, May 1987)
- See the documentation for each of the following modules listed separately in this report:
  - Coal Supply Transportation Module (CSTM)
  - Oil Market Module (OMM)
  - Electricity Market Module (EMM)

Archive Media and Installation Manual(s): IFFS83 - for the *Annual Energy Outlook* 1983

IFFS84 - for the *Annual Energy Outlook 1984*

IFFS85 - for the *Annual Energy Outlook 1985*

IFFS86 - for the *Annual Energy Outlook 1986*

IFFS88 - for the *Annual Outlook for Oil and Gas 1988*, the *Annual Outlook for U.S. Electric Power 1988*, and the *Annual Outlook for U.S. Coal 1988* .

IFFS89 - forthcoming for the *Annual Outlook for Oil and Gas 1989*, the *Annual Outlook for U.S. Electric Power 1989*, the *Annual Outlook for U.S. Coal 1989* , and *Electricity Generation from Natural Gas: Prospects and Implications for the United States.*

Purpose: The objective of the IFFS is to account for the many interactions of the different segments of the energy industries and to provide an internally consistent forecast of prices and quantities for which supply equals demand. This equilibrium solution accounts for the main economic factors affecting supply and demand, allows price competition of fuels, and accounts for Government policies and regulations that cause deviations from purely economic behavior.

Energy System Described by Model: IFFS is a partial equilibrium model of domestic energy supply and demand. IFFS represents the domestic production of oil, natural gas, coal, and the imports of crude oil, natural gas, and refined petroleum products. It also represents the two major energy conversion activities, the refining of crude oil into petroleum products and the conversion of fossil fuels, nuclear power, hydropower and other technologies into electricity. Consumption is represented by major end-use sectors.

Coverage:

- **Geographic:** United States. Different modules represent energy production or consumption at different levels of regional detail. The price and quantity interface between modules is at the 10 Federal region levels

- **Time Unit/Frequency:** Annual through 2010
- **Product(s):** Natural gas, electricity, coal, distillate oil, residual oil, automobile gasoline, jet fuel, aviation gasoline, liquefied petroleum gases, petrochemical feedstocks, kerosene, lubricants and waxes, petroleum coke, asphalt, special naphthas, and other petroleum products
- **Economic Sector(s):** Residential, commercial, industrial and transportation end-use consumption. Coal supply. Oil and gas production and natural gas markets when linked with the Gas Analysis Modeling System (GAMS). Electric utility capacity, expansion, and generation. Oil product pricing and refining.

Modeling Features:

- **Model Structure:** IFFS provides an equilibrium framework in which the economic forces of supply and demand can be simulated. Due to its modularity, IFFS allows each individual module to be represented in a different fashion if desired.
- **Modeling Technique:** The oil module is a series of econometric equations for oil product pricing. The coal module incorporates existing contracts, simulates the pricing of coal supplies from all existing mines and new mines, and combines the mine costing with cost of transportation to solve a least-cost-of-supply network algorithm.

  The electricity module simulates the decisionmaking behavior of utilities in choosing the projected least-cost capacity to construct for future years and the least-cost allocation of current plants for generation. The electric utilities, refineries and other modules simulate the way the industries make their decisions, rather than solving with some notion of optimal behavior. As such the model is predictive, not normative.

- **Special Features:** The primary design deature of IFFS is its modularity. That is, the model is organized by fuels--oil, natural gas, coal, and electricity--from production through demand. Any of these sectors can be replaced by a simple representation when detailed results are not required.

  The modularity also allows any single sector or group of sectors to be run independently as a debugging aid or for stand-alone analysis. Furthermore, the modularity also allows the flexibility for each sector to be represented in the way most appropriate, highlighting the particular issues important for the sector, including the regional structure most appropriate. Thus the oil module uses econometric techniques with PADD level data, the electricity module simulates the decisionmaking procedures of utilities on the Federal region level, and the coal module represents 44 supply regions and a detailed transportation network.

  The individual modules vary in the depth of their structural representation and, therefore, in their ability to address particular issues. The electric utility module explicitly considers capacity addition. The coal and electric utility modules can be used to consider the effects of a number of regulatory, policy, and legislative issues; other modules can address such issues to a lesser degree.

Non-DOE Input Sources:
All data sources are listed under appropriate modules of IFFS.

DOE Data Input Sources:
Forms and Publications:

All data sources are listed under appropriate modules of IFFS.

Models and Other:

- See list under model interfaces.

General Output Descriptions: The following data elements are generally used in published reports; however, more detailed information is likely to be available:

Total energy supply and disposition

Domestic production by fuel type

Imports and exports by fuel type

Electric utility fuel consumption

Electric utility generation

Electric utility capacity

Electricity disposition and prices

Petroleum supply, disposition, and prices

Natural gas supply, disposition, and prices

Coal supply, disposition, and prices.

Computing Environment:

- **Hardware Used:** IBM 3084QX
- **Language Used:** FORTRAN
- **Core Requirement:** 5000K
- **Estimated Cost to Run:** 15 minutes CPU for all modules, excluding GAMS.
- **Special Features:** Utilizing specialized software resident on the EIA computer, Intermediate Future Forecasting System can be directly linked to

the Gas Analysis Modeling System for dynamic computation of the prices for natural gas.

Independent Reviews Conducted:

- *Interim (sic) Future Forecasting System Model Documentation*, Hausman, Jerry A., February 1982, Independent Expert Reviewer
- U.S. Department of Commerce. National Bureau of Standards, Intermediate Future Forecasting System, Proceedings of a Symposium held at the Department of Energy, Washington, DC, August 19, 1982, NBS-670, (Washington, DC, December 1983).

Status of Evaluation Efforts by Sponsor: None.

International Coal Trade Model (ICTM)

Abstract: ICTM projects coal trade flows from 20 coal-exporting regions of the world to 9 demand regions for 3 types of coal: metallurgical, low-sulfur steam, and high-sulfur steam. The model consists of supply, demand, trade and transportation constraint components, the latter representing alternate routes of passage (Panama Canal, Suez Canal, direct ocean-going) and ship size (30,000 to 250,000 deadweight tons). The major coal producing countries (United States, Australia, South Africa, Canada, and Poland) are represented, as well as countries that could become major coal exporters (Colombia, Venezuela, and China).

Type: Basic

Last Model Update: December 1987.

Part of Another Model? Provides input to the National Coal Model (NCM), the Coal Supply and Transportation Model (CSTM), and the Intermediate Future Forecasting System (IFFS).

Model Interfaces: The Resource Allocation and Mine Costing (RAMC) model, the National Coal Model (NCM), the Coal Supply and Transportation Model (CSTM), and the Intermediate Future Forecasting System (IFFS).

Sponsor:

Office: Coal, Nuclear, Electric and Alternate Fuels

Division: Coal

Branch: Data Analysis and Forecasting, EI-522

Model Contact: Fred Mayes, Jr.

Telephone: 586-5253

Documentation:

- *International Coal Trade Model, Version 2 (ICTM-2) Users Guide*, DOE/EIA-M026, March 1987
- *International Coal Trade Model: Executive Summary*, DOE/EIA-0444, May 1984
- *Description of the International Coal Trade Model*, DOE/EI/11815-1, September 1982
- *Mathematical Structure of the International Coal Trade Model*, DOE/NBB-0025, September 1982.

Archive Media and Installation Manual(s):

- ICTM81 - *Annual Report to Congress 1981*
- ICTM82 - *Annual Energy Outlook 1982*
- ICTM82A - *Railroad Deregulation: Impact on Coal*
- ICTM82B - *Port Deepening and User Fees: Impact on U.S. Coal Exports*
- ICTM83 - *Annual Energy Outlook 1983*
- ICTM84 - *Annual Energy Outlook 1984*
- ICTM85 - *Annual Energy Outlook 1985*
- ICTM86 - *Annual Energy Outlook 1986*
- ICTM87 - *Annual Energy Outlook 1987* .

Purpose: The ICTM is a static equilibrium model used by EIA to represent the international coal market. The model is used to assess the consequences of events and issues relating to world coal trade and U.S. coal exports, and to forecast coal trade based on the various assumptions concerning world coal supply and demand. U.S. coal export projections developed by using the ICTM appear in EIA's *Annual Energy Outlook*. These and other forecasts are provided as a service to other components of the Department of Energy, the Federal Government, and non-Federal public and private institutions concerned with U.S. coal exports.

Energy System Described by Model: ICTM balances supply and demand in the international coal trade market. The ICTM is designed to compute the trade between coal exporters and coal importers, given supply and demand curves for each participant and other data that reflect final prices, such as transportation costs, constraints on routes, port capacities, coal preparation costs, and taxes.

Coverage:

- **Geographic:** The ICTM consists of nine coal-exporting regions, corresponding to countries or

subregions, and six coal-demand regions, representing an individual country or a group of countries.

- **Time Unit/Frequency:** For any forecast year, but generally run for 1990, 1995, and 2000
- **Product(s):** Metallurgical coal, low-sulfur steam coal, high-sulfur steam coal
- **Economic Sector(s):** Electric utilities, steelmaking and other industries.

Modeling Features:

- **Model Structure:** The ICTM consists of three major analytical components:
  - Supply Component. The ICTM models coal production activities based upon supply curves generated by formal mine-costing techniques or resource depletion formulas to represent minemouth costs. Inland transportation costs between the mines and ports are added to the minemouth costs of coal.
  - Demand Component. Export coal demand is divided between coal price-elastic demand markets, and coal price-inelastic demand markets. For the price elastic demand markets, coal demand is calculated as a function of observed prices and quantities and of the price elasticity of coal demand. Price-elastic demand markets encompass Organization for Economic Cooperation and Development (OECD) countries. Price-inelastic markets are classified as such primarily because there is insufficient information on these markets and because of their relatively minor participation in world coal trade.
  - Transportation Component. Ocean transportation costs are required for the computation of delivered costs and are computed for each supply-demand link. The ocean transportation costs used in the ICTM are generated by computing auxiliary model SEATRAN, which calculates the various long-run costs of shipping coal (i.e., capital costs, operating costs, fuel costs and loading and unloading costs) for each projection year by selecting the least-cost option from various possible vessel sizes and routes.
- **Modeling Technique:** Coal supply and demand are modeled in the ICTM using curves, or functions, that represent long-run producer and consumer behavior in response to price. Equilibrium is reached, in economic terms, when the total of producer and consumer surplus is maximized, (using a linear programming algorithm) which assures that in each projection year the amount of coal supplied will exactly equal the amount demanded.
- **Special Features:** The ICTM is a system of computer models, submodels, data bases, and model interfaces that constitute an integrated framework of analysis. The variables included in ICTM's data base are: minemouth costs, inland transportation costs, ocean transportation costs, contraints on production, trade, transportation, port capacities, and taxes or subsidies.

Non-DOE Input Sources:

Coal Supply Curves for Australia, Canada, and South Africa, ICF, Incorporated, Fall 1980.

- Number of steps in the supply schedule for a supply subregion
- Annual production level for a given step
- The minimum acceptable selling price (MASP) at the minemouth for a given step
- Assigned cumulative production capacity limit
- Inland transportation costs from each ICTM supply subregion to the designated port of exit

Trade and Business Journals

- Lower bound on trade between each supply region and its trading partners for a specific coal demand category
- Applicable tax (or subsidy) rate on each type of export coal

Projections of the Australian Department of Trade and Resources, New South Wales Joint Coal Board

- Projected production for domestic consumption of each specific coal type - Australia
- Upper bound on total coal exports from the supply region - Australia

Projections of Energy, Mines, and Resources, Canada

- Projected production for domestic consumption of each specific coal type - Canada
- Upper bound on total coal exports from the supply region - Canada

The World Bank/Trade and Business Journals

- Projected production for domestic consumption of each specific coal type - Other countries

Minerals Bureau, South Africa

- Upper bound on total coal exports from the supply region - South Africa

Country Projections

- Upper bound on total coal exports from the supply region - Other countries

U.S. Maritime Administration, Office of Ship Financing Guarantees, *Coal Supply Curves for Australia, Canada, and South Africa*, ICF, Inc., prepared for the Energy Information Administration, Fall, 1980.

- Assumed proportion of initial ship-purchase cost that is equity-financed
- Rate of interest on debt
- Assumed rate of inflation
- Nominal required rate of return
- Years over which ship debt is financed
- Assumed operating life of ship

U.S. Maritime Administration, Office of Shipbuilding Costs; *The Long Run Economics of Ocean Transportation of Coal*, Lee, H.M., Economic Assessment Service (IEA Coal Research), Report No. D1/78, London, England, December 1978; and *The Future Economics of Coal Transport*, Lee, H.M., Economic Assessment Service, (IEA Coal Research), Report No. D2/79, London, England, July 1980; and Marine Transport Costs and Coal Trade, Doyle, Guy C., (IEA Coal Research), August 1986.

- Deadweight tonnage of vessel
- Present value cost of vessel, in base-year dollars
- Scrap value of vessel, in base-year dollars
- Estimated number of operating days per year
- Vessel operating costs
- Vessel operating speed
- Average number of days vessel can expect to spend in port to load or unload
- Stores allowance for food, water, supplies, etc.
- Primary fuel consumption at sea
- Primary fuel consumption in port
- Diesel fuel consumption at sea, if not primary fuel
- Diesel fuel consumption in port, if not primary fuel
- Primary fuel type

Existing and Potential U.S. Coal Export Loading Terminals, U.S. Maritime Administration, Office of Ports and Intermodal Development, Published Quarterly, Washington, DC; Australian Coal Report; and Various Trade Journals.

- Port dues
- Maximum ship-size handling capacity

U.S. Code of Federal Regulations (35), Panama Canal Commission, Panama Canal Annual Report, Washington, DC; *Suez Canal Annual Report*; and *Maritime Shipping*, Organization for Economic Cooperation and Development, Paris, published yearly.

- Canal toll, fully laden
- Canal toll, in ballast
- Maximum allowable ship-size, fully laden
- Maximum allowable ship-size, in ballast

Distance Between Ports, U.S. Department of Defense, Defense Mapping Agency, Pub. 151, Washington, DC, 1976.

- Nautical miles between supply and demand regions via specified route

Supply and Demand for United States Coking Coals and Metallurgical Coke, Sheridan, E.T., U.S. Department of the Interior, Bureau of Mines, Washington, DC, 1976.

- Proportion of premium coking coal required in metallurgical coal mix.

DOE Data Input Sources:
Forms and Publications:

Energy Information Administration Definitions of Coal Types

- Coal-type codes
- Thermal content of coal

Energy Information Administration, *Annual Energy Review*, DOE/EIA-0384, (Washington, DC).

- World crude oil price

Models and Other:

- ICTM Base-Case Projections
  - Average world steam-coal price (delivered to Rotterdam, The Netherlands)
- Resource Allocation and Mine Costing Model (RAMC)
  - Number of steps in the supply schedule for a supply subregion
  - Code identifying whether the step is for existing capacity or new capacity
  - Annual production level for a given step
  - The minimum acceptable selling price (MASP) at the minemouth for a given step
  - Fraction of production in a step that is surface-mined
  - Assigned cumulative production capacity limit
  - Amount of dragline capacity required for new surface mine increments.
- Energy Information Administration Estimates
  - Assigned cumulative production capacity limit
  - Inland transportation costs from each ICTM supply subregion - United States
  - Vessel loading costs
  - Port dues
  - Vessel unloading costs
  - Reference import demand in year "xx"

- Reference coal price at which reference import demand was estimated
- Coefficient of elasticity for the import-demand equation
- The number of data pairs in the supply curve - Countries other than Australia, Canada, South Africa, and the United States
- Cumulative annual coal production point - Countries other than Australia, Canada, South Africa, and the United States
- Minimal acceptable selling price (MASP) associated with the cumulative annual coal production point - Countries other than Australia, Canada, South Africa, and the United States
- Applicable tax (or subsidy) rate on each type of export coal
- Upper bound on exports of individual coal types
- Projected production for domestic consumption of each specific coal type - Countries other than Australia, Canada, South Africa, and the United States
- Upper bound on total coal exports from the supply region - Countries other than Australia, Canada, South Africa, and the United States
- Incremental costs of deep cleaning and blending constituent coals to produce a metallurgical blend.

• National Coal Model (NCM)
- Inland transportation costs from each ICTM supply subregion to the designated port of exit (United States)
- Projected production for domestic consumption of each specific coal type (United States)
- Upper bound on total coal exports from the supply region (United States)

• SEATRAN Submodel
- Transportation throughput capacities for direct and canal routes
- Transportation costs between each ICTM supply region and the corresponding demand region via an ocean route

• OECD-Country Energy Demand Model
- Reference import demand in year "xx" (OECD countries)
- Reference coal price at which reference import demand was estimated (OECD countries)
- Coefficient of elasticity for the import-demand equation (OECD countries)

• SUPPLY Data-preprocessing Program - (Australia, Canada, South Africa, and the United States)
- The number of data pairs in the supply curve
- Cumulative annual coal production point
- Minimum acceptable selling price (MASP) associated with the cumulative annual coal production point.

General Output Descriptions: The output of the ICTM consists of detailed forecasts of key attributes of the international coal market in projected case years. The main outputs are reports on: coal exports and imports by region and coal type; coal trade from origin to destination, market shares, prices, and type of coal; and producer information on revenues, surplus, and rents.

Computing Environment:

- **Hardware Used:** IBM 3084QX
- **Language Used:** FORTRAN and MDMS30
- **Core Requirement:** 1000K
- **Estimated Cost to Run:** 30 CPU seconds
- **Special Features:** Non-linear extension of LP algorithm.

Independent Reviews Conducted: *International Coal Trade Model Documentation Review*, Edward Hillsman, November 1983, Independent Expert Reviewer.

Status of Evaluation Efforts by Sponsor: None.

International Nuclear Model (INM)

Abstract: INM simulates the commercial nuclear power industry with emphasis on the nuclear fuel cycle. The model projects nuclear fuel cycle requirements (including uranium and enrichment services, as well as spent fuel discharges) and electricity generation associated with a specific nuclear reactor deployment schedule.

Type: Basic

Last Model Update: NA

Part of Another Model? No

Model Interfaces: None

Sponsor:

Office: Coal, Nuclear, Electric and Altenate Fuels

Division: Nuclear and Alternate Fuels

Branch: Data Analysis and Forecasting, EI-532

Model Contact: Bob Moden

Telephone: 586-9369

Documentation:

- *International Nuclear Model: Overview*; Andress, David A., March 1985.
- *International Nuclear Model: Data Base Relationships*; Andress, David A., April 1985.
- *International Nuclear Model: Program Description*; Andress, David A., June 1985.

Archive Media and Installation Manual(s): INM85 - for the *World Nuclear Fuel Cycle Requirements 1985*

INM86 - for the *World Nuclear Fuel Cycle Requirements 1986*

INM87 - for the *World Nuclear Fuel Cycle Requirements 1987*

INM88 - for the *World Nuclear Fuel Cycle Requirements 1988.*

Purpose: INM provides fuel cycle forecasts for uranium and enrichment service requirements, spent fuel discharges and annual nuclear electricity generation projections.

Energy System Described by Model: Electricity generation by nuclear-powered units.

Coverage:

- **Geographic:** Any country or country group, (user specified, limited to data availability).
- **Time Unit/Frequency:** Specified by user, from 1 through 70 years, annually
- **Product(s):** Uranium, enrichment services, spent fuel discharges and electrical generation projections
- **Economic Sector(s):** Electric utility sector with emphasis on the nuclear fuel-cycle requirements.

Modeling Features:

- **Model Structure:** Dynamic model
- **Modeling Technique:** Optimizes present value of decision maker's costs
- **Special Features:** Regionalized with interregional transfer of fuel cycle services and flexible fuel management capabilities.

Non-DOE Input Sources:
Nuclear Assurance Corporation

- Fuel-trac data used to determine foreign reactor operating characteristics.

DOE Data Input Sources:
Forms and Publications:

- Form RW-859, "Nuclear Fuel Data Form"
  - Electric utility survey data used to set starting inventory levels of spent fuel
  - Survey data used to determine and update reactor operating characteristics

Models and Other:

- Energy Information Administration, *Commercial Nuclear Power Report*, DOE/EIA-0438, (Washington, DC).
  - Provides projected commercial operation data for reactors under construction.

General Output Descriptions: Electric generation, fuel cycle transactions.

Computing Environment:

- **Hardware Used:** IBM 3084QX
- **Language Used:** FORTRAN
- **Core Requirement:** 1200K
- **Estimated Cost to Run:** 60 CPU seconds for a full run; 15 CPU seconds for U.S. mid-case
- **Special Features:** None.

Independent Reviews Conducted: Andress, D.A. Comparative Analysis of NUFUEL, INM, and SCENARIOS. System Sciences, Inc., Technical Report to the Department of Energy, August 1984.

Hampton, N. et al. *Model Quality Audit of the International Nuclear Model* (INM), Washington Consulting Group, August 1988.

Status of Evaluation Efforts by Sponsor: On-going.

Levelized Nuclear Fuel Cycle Cost Model (LNFCC-PC)

Abstract: LNFCC-PC computes an electric utility's levelized nuclear fuel cost (mills per kilowatthour). The code computes quantities of fuel cycle services and levelized direct costs which include the carrying charges accounting for the time value of money. All fuel-cycle services from natural uranium purchased through waste disposal are covered.

Type: Auxiliary

Last Model Update: April 1986.

Part of Another Model? No

Model Interfaces: As required for particular application

Sponsor:

Office:	Coal, Nuclear, Electric and Alternate Fuels
Division:	Nuclear and Alternate Fuels
Branch:	Data Analysis and Forecasting, EI-532
Model Contact:	Laurence Sanders
Telephone:	586-1268

Documentation: Energy Information Administration, *Levelized Nuclear Fuel Cycle Cost Model User's Guide*, MDR/ES/81, (Washington, DC, June 1982).

Energy Information Administration, Levelized Nuclear Fuel Cycle Cost (LNFCC-PC) Lotus 1-2-3 Spreadsheet Documentation, Installation, and Operating Instructions, Laurence Sanders (Washington, DC, April 1986).

Archive Media and Installation Manual(s): LNFCC86 - *Annual Energy Outlook 1986* .

Purpose: LNFCC-PC computes nuclear fuel cost, given uranium prices, fuel processing prices, and tails assays.

Energy System Described by Model: LNFCC-PC covers the entire nuclear fuel cycle.

Coverage:

- **Geographic:** Constrained to light water reactors (LWRs) United States and foreign
- **Time Unit/Frequency:** As needed for annual reports
- **Product(s):** Nuclear fuel costs
- **Economic Sector(s):** Electric utilities.

Modeling Features:

- **Model Structure:** Equations described in model documentation
- **Modeling Technique:** Deterministic
- **Special Features:** Lotus 1-2-3 electronic spreadsheet.

Non-DOE Input Sources:
NUEXCO, Monthly Report on the Nuclear Fuel Market (Denver, CO) and NUFUEL, Monthly Market Report on the Nuclear Fuel Cycle (Hanau, Federal Republic of Germany).

- Conversion and fabrication prices

Data Resources, Inc., "Utility Cost of Finance for Debt, Preferred Equity, and Common Equity," and Standard and Poor's Compustat Services, Inc., The Compustat Tapes (Denver, CO), and subsequent releases

- Economic parameters (cost of capital).

DOE Data Input Sources:
Forms and Publications:

- Energy Information Administration, *World Nuclear Fuel Cycle Requirements*, DOE/EIA-0436, (Washington, DC, September 1988)
- Energy Information Administration, *Domestic Uranium Mining and Milling Industry 1987 Viability Assessment*, DOE/EIA-0477 (Washington, DC, December 1988).

Models and Other:

- International Nuclear Model (INM).

General Output Descriptions: LNFCC is used to estimate and interpret the cost of commercial nuclear reactor fuel.

Computing Environment:

- **Hardware Used:** IBM compatible personal computer (PC/AT)
- **Language Used:** Lotus 1-2-3
- **Core Requirement:** 640K
- **Estimated Cost to Run:** 30 - 40 CPU seconds
- **Special Features:** Interactive.

Independent Reviews Conducted: None.

Status of Evaluation Efforts by Sponsor: None.

Mini-Macroeconomic Personal Computer Model (MINMAC-PC)

Abstract: MINMAC-PCprovides forecasts of changes from a given "base case" of important macroeconomic variables utilized by the PC-AEO model for energy demand forecasts. Variables include real GNP, the

GNP deflator, real disposable income, the unemployment rate, housing starts, industrial output, the interest rate on corporate bonds, and the mortgage rate. Based on energy price changes internal to PC-AEO, MINMAC-PC calculates the economic feedback effects of the macroeconomic variables which in turn influence energy demand.

Type: Basic

Last Model Update: February 1988.

Part of Another Model? MINMAC-PC was designed to be used as the interactive macro-economic model of the PC-AEO model. MINMAC-PC may also be used in a stand-alone mode under a number of user controlled options.

Model Interfaces: Takes computed energy prices from PC-AEO and returns projected macroeconomic and industrial variables used to drive energy demands. Input data: Data sources: Output data:

Sponsor:

Office:	Energy Markets and End Use
Division:	Economics and Statistics
Branch:	Macro and Financial Information, EI-641
Model Contact:	Ronald Earley
Telephone:	586-1398

Documentation: Energy Information Administration, *Model Documentation for the Mini-Macroeconomic Personal Computer Model* (MINMAC-PC), February 1988.

Archive Media and Installation Manual(s): Archived on floppy disk.

Purpose: Addresses macroeconomic implications of alternative energy scenarios.

Energy System Described by Model: None.

Coverage:

- **Geographic:** National. Disposable income is disaggregated into four regions
- **Time Unit/Frequency:** Annual, 1988 through 2000
- **Product(s):** None
- **Economic Sector(s):** 39 macroeconomic variables (19 passed to PC-AEO) plus 12 industrial sectors.

Modeling Features:

- **Model Structure:** Linear approximation version of the Data Resources, Inc., Annual *Model of the U.S. Economy*.
- **Modeling Technique:** Estimated on simulation data, using ordinary least squares regression techniques.
- **Special Features:** Constructed in Lotus 1-2-3 with menu driven structure to allow user to specify alternative input assumptions.

Non-DOE Input Sources:

- Baseline forecast values of the following macroeconomic variables (partial list):
  - Real GNP
  - GNP price deflator
  - Real disposable income
  - Unemployment rate
  - Housing starts
  - Industrial output for 12 sectors
  - Interest rate on corporate bonds
  - Mortgage rate
  - Population for four regions
  - Wholesale price index for fuels and power
  - Price of foreign crude oil.

DOE Data Input Sources:
Forms and Publications:

- None

Models and Other:

- PC-AEO
  - Price of coal
  - Price of oil
  - Price of gas
  - Price of electricity
  - Foreign crude oil price.

General Output Descriptions: Total of 39 macroeconomic variables, with 19 macroeconomic variables passed to PC-AEO, plus industrial output for 12 sectors.

Computing Environment:

- **Hardware Used:** IBM compatible personal computer (PC/AT)
- **Language Used:** LOTUS 1-2-3
- **Core Requirement:** 281K
- **Estimated Cost to Run:** Less than 14 seconds

- **Special Features:** Makes use of Data Matrix Multiply features of LOTUS.

Independent Reviews Conducted: EIA Model Documentation Review. Oak Ridge National Laboratory, July 20, 1984. Independent Expert Review by Victor Zarnowitz, August 1988.

Status of Evaluation Efforts by Sponsor: Independent outside review in progress.

National Coal Model (NCM)

Abstract: NCM projects coal production by State; coal transportation flows; and fuel consumption by electric utilities based on specified levels of electricity consumption, existing and planned generating capacity, the economics of electricity generation, and nonutility demand for coal. The NCM is a highly disaggregated coal supply and utility model. Coal demands in each of 44 regions are met via a transportation network from existing and new mines in 31 supply regions. Flue gas desulfurization technology is internally represented and both sulfur dioxide and other emissions are reported.

Type: Basic

Last Model Update: February 1989.

Part of Another Model? National Utility Financial Statement (NUFS) Model can be used as an extension to NCM.

Model Interfaces: The NCM uses as input data supply curves produced by the RAMC model and transportation costs produced by a special transportation rate generator. Levels of electricity demand and nonutility coal demand used in the NCM are obtained from forecasts produced by the Intermediate Future Forecasting System (IFFS) for the *Annual Energy Outlook*.

Sponsor:

Office:	Coal, Nuclear, Electric and Alternate Fuels
Division:	Coal
Branch:	Data Analysis and Forecasting, EI-522
Model Contact:	Melinda A. Hobbs
Telephone:	586-5273

Documentation:

- Energy Information Administration, *National Coal Model: Executive Summary*, DOE/EIA-0325, (Washington, DC, April 1982).
- Energy Information Administration, *National Coal Model, Model Description and Formulation*, DOE/EIA-0428, (Washington, DC, September 1983).
- Energy Information Administration, *National Coal Model (Versions 6 and 7) Users Manual*, DOE/EIA-M027 (Washington, DC, March 1988.)
- Energy Information Administration, *National Coal Model (Versions 6 and 7) Software Manual*, DOE/EIA-M025 (Washington, DC, January 1988).

Previous Documentation

- Energy Information Administration, *National Coal Model Users Manual*, DOE/EIA-0427, (Washington, DC, September 1983).
- Energy Information Administration, *Documentation of Data Inputs to the National Coal Model*, Kilkeary, Scott Associates, DOE/EI-11857-1, (Washington, DC, April 1983).
- Energy Information Administration, *Mathematical Structure and Computer Implementation of the National Coal Model* (Version 4), DOE/EI-10128-2, (Washington, DC, January 1982).

Archive Media and Installation Manual(s): Computer runs used in the Analysis Report entitled, *Impacts of the Proposed Clean Air Act Amendments of 1982 on the Coal and Electric Utility Industries*, are archived on NCM4. This is also consistent with the existing NCM4 documentation.

NCM484 - *Acid Rain Study 1984*

NCM585 - for Version 5 of the model

NCM88 - for Versions 6 and 7 of the model.

Purpose: The NCM is designed to analyze the impact of changing market conditions on the quantity and quality of coal consumed. The representations embodied in the NCM emphasize the role of the electric utility industry as the principal consumer of coal and the impact of legislation concerned with sulfur oxides released from coal combustion on the quantity and character of coal consumed by electric utilities.

Energy System Described by Model: The NCM attempts to describe the regional distribution of coal production and the quantity and quality of coal required to satisfy regionally disaggregated demands for steam and metallurgical coal. Nonutility demands for steam

and metallurgical coal are exogenous to the model. The quantity and quality of coal demanded by electric utilities is determined by the dispatch of generating units within the NCM to meet exogenous regional demands for electricity. Regional production of coal is determined from long-run supply curves produced by the Resource Allocation and Mine Costing (RAMC) model from engineering based estimates of production costs.

Coverage:

- **Geographic:** The NCM consists of 31 supply regions and 44 demand regions within the continental United States.
- **Time Unit/Frequency:** Any year for which input data are available, generally, 1990, 1995, and 2000
- **Product(s):** Coal and electricity
- **Economic Sector(s):** Electric utility, coal production and transportation.

Modeling Features:

- **Model Structure:** Four modules including: Electricity and Nonutility Demand, Electricity Generation and Transmission, *Coal Production*, and Transportation
- **Modeling Technique:** The NCM is formulated as a (large) linear programming (LP) problem.
- **Special Features:** The NCM is specifically designed for the analysis of legislation (and regulation) concerned with sulfur dioxide emissions from electrical generating units. In addition, the effects of environmental, tax, and other policy affecting surface or underground mining of coal can be analyzed by the NCM in conjunction with the RAMC model.

Non-DOE Input Sources:

Coal and Electric Utilities Model Documentation, ICF Inc., May 1980.

- Coal types or coal blends that may be used to satisfy a given demand
- Capacity factors for existing hydroelectric generating units
- Capacity factors for new hydroelectric generating units
- Capacity factors for coal-fired, nuclear, combustion, and turbine generating units
- Efficiency of new electricity transmission between a pair of demand regions
- Capital cost of new transmission capacity
- Intraregional electricity transfer efficiency for a demand region
- Particulate emission rates for existing oil-fired steam generating units
- Sulfur dioxide emission rates for existing oil-fired steam generating units

Effects of Alternative New Source Performance Standards (NSPS) Coal-Fired Electric Utility Boilers on the Coal Markets and on Utility Capacity Expansion Plans, ICF, June 1978.

- Capital charge rate
- Particulate emission rates for existing coal-fired steam generating units

Clean Air Act of 1971 and 1977

- Binding sulfur dioxide emission ceiling in each demand region for coal-fired generating units nominally subject to the NSPS
- Binding sulfur dioxide emission ceiling in each demand region for coal-fired generating units nominally subject to the revised NSPS

Still Further Analyses of Alternative New Source Performance Standards for New Coal-Fired Powerplants, ICF, Inc., January 1979.

- Capital charge rate multipliers

Regionalized Capital, Operating and Maintenance Cost Estimates for Emission Control Equipment Required for New Fossil Steam Power Plants, PEI Associates, November 1985.

- Heat rate
- Incremental operating and maintenance cost by load for new and existing combined cycle power generating units
- Nuclear generating unit capacity
- Capital cost of nuclear capacity
- Incremental nuclear generating capacity, 1990 and 1995
- Incremental operation and maintenance cost of a flue gas desulfurization (FGD) system for existing coal-fired generating units equipped with FGD
- Energy penalty for operation of an FGD system by coal-fired generating units subject to the NSPS or a State Implementation Plan (SIP)
- Capital cost of an FGD system installed in a coal-fired generating unit subject to the NSPS or retrofit to an existing generating unit subject to a SIP
- Capacity penalty for operation of an FGD system by coal-fired generating units subject to the NSPS or a SIP
- Incremental operation and maintenance cost of an FGD system installed in a coal-fired generating unit subject to the NSPS or retrofit to an existing generating unit subject to a SIP

- Capacity penalty for operation of an FGD system installed in a coal-fired generating unit subject to the revised NSPS
- Energy penalty for operation of an FGD system installed in a coal-fired generating unit subject to the revised NSPS
- Base load operation, maintenance, and fuel costs for coal-fired generating units
- Incremental operation and maintenance cost of an FGD system installed in a coal-fired generating unit subject to the revised NSPS
- Capital cost of combined cycle capacity

Handy Railroad Atlas of the United States, Rand-McNally and Co., Chicago, 1982.

- Distance over transportation lines

Data Notebook Generating Technology Assessment, Teknekron Research, Inc., Teknekron Report No. R-035-DOE-80, September 1980.

- Capital cost of combustion turbine capacity

Update of Electric Utility Data for the National Coal Model and the Midterm Energy Forecasting System, Theodore Barry and Associates, November 1981.

- Efficiency of existing transmission between a pair of demand regions
- Upper bound on existing electricity transmissions between a pair of demand regions
- Lower bound on new electricity transmission between a pair of demand regions
- Upper bound on new electricity transmission between a pair of demand regions.

DOE Data Input Sources:
Forms and Publications:

- EIA-7, " *Coal Production* Report"
  - coal production
  - coal production from deep mines
  - coal production from surface mines
- EIA-759, "Monthly Power Plant Report"
  - coal consumption by utilities
  - natural gas consumption by utilities
  - fuel oil consumption by utilities
  - electricity generation
- EIA-826, "Electric Utility Company Monthly Statement"
  - electricity consumption
- FERC-423, "Monthly Report of Cost and Quality of Fuels for Electric Plants"
  - Average Btu content of coal produced adjusted for ash content
  - Lower bound on coal shipments from supply to demand regions
- EIA-860, "Annual Electric Generator Report" and EIA-767, "Steam-Electric Plant Operation and Design Report"
  - Binding sulfur dioxide emission ceiling for coal-fired generating units subject to SIP category 1
  - Binding sulfur dioxide emission ceiling for coal-fired generating units subject to SIP category 2
  - Binding sulfur dioxide emission ceiling for coal-fired generating units subject to SIP category 3
  - Nonnuclear generating unit capacity
  - Incremental NSPS generating capacity, 1990 and 1995
  - Incremental revised NSPS generating capacity, 1990 and 1995
  - Incremental combined cycle generating capacity, 1990 and 1995
  - 1980 fuel consumption by utilities
  - 1980 electricity generation
- 1986 *Annual Energy Outlook*, Energy Information Administration, (Washington, DC).
  - 1990, 1995, and 2000 metallurgical demand for coal
  - 1990, 1995, and 2000 demand for coal for use in existing industrial boilers
  - 1990, 1995, and 2000 demand for coal for use in new industrial boilers
  - Annual utility cost deflator
  - Percent of total generation in each load segment
  - natural gas price
  - residual fuel oil price
  - distillate fuel oil price
  - Residual fuel oil price, 1990, 1995, and 2000
  - Distillate fuel oil price, 1990, 1995, and 2000
  - Natural gas price, 1990, 1995, and 2000
  - Residential and commercial coal demand, 1990, 1995, and 2000
  - Electricity demand, 1990, 1995, and 2000

Models and Other:

- Energy Information Administration, Office of Coal, Nuclear, Electric and Alternate Fuels, Electric Power Division
  - Capital cost of converting an existing generating unit without FGD to burn low-sulfur subbituminous coal

- ICTM Model
  - Percent of export and metallurgical demand satisfied by metallurgical and steam coals
  - Export demand for coal, 1990, 1995 and 2000
- RAMC Model
  - Current annual production
  - Minimum acceptable selling price for production from new mines
  - Proportion of annual production from surface mines
- NFACIL2 Data Base, Coal, Nuclear, Electric and Alternate Fuels Division, U.S. Department of Energy
  - Baseload operating and maintenance costs for nuclear generating units
  - Nuclear generating unit capacity
  - Capital cost of nuclear capacity
  - Incremental nuclear generating capacity, 1990 and 1995
- CONCEPT5 Model in Conjunction with 1983 United Engineers, Inc. Data Base, Electric Power Division, U.S. Department of Energy
  - Capital cost of coal-fired generating unit capacity
  - Capital cost of an FGD system installed in a coal-fired generating unit subject to the revised NSPS
  - Regional capital cost adjustment factors.

General Output Descriptions: The output of the National Coal Model consists of detailed projections of key attributes of the coal and electric utilities for 1990, 1995, and 2000. The projections are presented in various reports.

Computing Environment:

- **Hardware Used:** IBM 3084QX
- **Language Used:** FORTRAN and Assembly Language implementing MDMS30 Language
- **Core Requirement:** 1200K
- **Estimated Cost to Run:** 10 CPU minutes
- **Special Features:** Modular design and special modeling structure for Version 5, 6, and 7.

Independent Reviews Conducted: National Coal Model Documentation review conducted by Richard Gordon, April 27, 1983.

Status of Evaluation Efforts by Sponsor: Continuing comparisons with results of CSTM, IFFS, and PC-AEO.

National Utility Financial Statement Model (NUFS)

Abstract: NUFS is a regulatory accounting model that projects electricity prices. The model first solves for revenue requirements by building up a rate base, calculating a return on the rate base, and adding the allowed expenses. Next, electric revenues (prices) are calculated based on assumptions regarding regulatory lag. With revenues determined, the model solves for internal cash flow and analyzes the need for external financing to meet necessary capital expenditures. Given these results, the model finally builds up the financial statements and calculates financial ratios.

NUFS is normally used in conjunction with the National Coal Model or the Intermediate Future Forecasting System. Inputs to NUFS include forecast capacity expansion plans, operating costs, regulatory environment, and financial data. The outputs include forecasts of income statements, balance sheets, sources and uses of funds, revenue requirements, average electricity prices, and other financial ratios.

Type: Basic

Last Model Update: April 1988.

Part of Another Model? Intermediate Future Forecasting System (IFFS) and the National Coal Model (NCM)

Model Interfaces: IFFS and NCM

Sponsor:

Office:	Coal, Nuclear, Electric and Alternate Fuels
Division:	Electric Power
Branch:	Data Analysis and Forecasting, EI-542
Model Contact:	John Conti
Telephone:	586-9856

Documentation:

- *Documentation of the National Utility Financial Statement (NUFS) Model*, ICF Incorporated, Prepared Under Contract No. DE-AC01-87EI-19801, April 1988.

Archive Media and Installation Manual(s):

- NUFS83 - for the report, *Impact of the Proposed Clean Air Act Amendments*
- NUFS84 - for the *Acid Rain Study 1984*

- NUFSSA84 - for the 1984 stand-alone version of the model
- NUFS85 for the analysis of proposed tax legislation during July 1985
- NUFSFP - for the *Investor-Owned Electric Utilities Study*
- NUFS86 - for the *Annual Energy Outlook 1986* .

Purpose: NUFS provides projection of financial reports, financial measures and electricity prices. It is used in the publication of the *Annual Energy Outlook*, Outlook for Electric Power and other utility financial reports.

Energy System Described by Model: Financial impacts of electric utilities' plans and operations.

Coverage:

- **Geographic:** National, regional, and disaggregation to a single utility
- **Time Unit/Frequency:** Annual, the forecast horizon can be of any length up to 50 years
- **Product(s):** NA
- **Economic Sector(s):** Private and public electric utilities.

Modeling Features:

- **Model Structure:** Finance and accounting
- **Modeling Technique:** Deterministic
- **Special Features:** NUFS may be run with changes in the financial side inputs and sensitivities, assuming all other parameters are constant. This allows for flexibility in analyzing a variety of policy issues and options. It can be interfaced with IFFS, NCM, or other electricity production costing models.

Non-DOE Input Sources:
If data from the FERC-1 are not used, the "Annual Report to Stockholders, Securities and Exchange Commission," Form 10K, or the utility COMPUSTAT data base can be used.

DOE Data Input Sources:
Forms and Publications:

- FERC-1, "Annual Report of Major Electric Utilities, Licensees, and Others," and EIA-412, "Annual Report of Publicly Owned Electric Utilities"
  - Utility plant in service aggregated by type
  - Construction work in progress
  - Accumulated provisions for depreciation, amortization, and depletion
  - Total capitalization by type
  - Taxes (Federal, State, general, other)
  - Embedded cost of capital (debt and preferred)
  - Electric revenues
  - Deferred Taxes (income and investment tax credits)

Models and Other:

- The following data are obtained from capacity expansion/production models such as the Intermediate Future Forecasting System (IFFS) or from the National Coal Model (NCM). These are user defined inputs obtained from different sources.
  - Length of construction period
  - Fraction of total project cost to be expended in each year of the construction period for each plant type
  - Plant type
  - Book life of plant
  - Tax life for depreciation
  - Straight line depreciation rate
  - Tax recovery class
  - Investment tax credit rate
  - Real escalation rate
  - In-service date
  - First year in service fraction
  - Capacity cost
  - Capacity
  - Book value of the plant
  - Construction work in progress allowed in rate base
  - Total generation for given forecast year
  - Total nuclear generation for given forecast year
  - Total taxes for given forecast year
  - Total fuel cost per unit of generation for given forecast year
  - Total nuclear fuel cost per unit of generation for given forecast year
  - Total nonfuel operation and maintenance costs per unit of generation for given forecast year.

General Output Descriptions: NUFS output are income statements, balance sheets, sources and uses of funds, construction expenditures, and reports which contain electricity price data.

Computing Environment:

- **Hardware Used:** IBM 3084QX
- **Language Used:** FORTRAN VS

- **Core Requirement:** Varies with application: Ranges from 512K for a single utility to 2012K when interfacing with IFFS data base in multiregional application.
- **Estimated Cost to Run:** Varies with application: Ranges from less than 5 CPU seconds for a single utility to up to 40 CPU seconds when interfacing with IFFS data base in multiregional application.
- **Special Features:** None.

Independent Reviews Conducted:

- A Validation Report: An Evaluation of the NUFS Model, Oak Ridge National Laboratory, December 1982.
- Review of National Utility Financial Statement (NUFS) Model Documentation, Cyrus Baghelai, Applied Management Sciences, Inc., November 1983.

Status of Evaluation Efforts by Sponsor: None.

Non-OPEC Oil Production Model (NOPEC-PC)

Abstract: NOPEC-PC is used by the Energy Information Administration (EIA) to forecast oil supplies in the free world. The NOPEC-PC model is a personal computer-based analytical tool for estimating foreign oil supply trends in the longer term. It is the principal tool used by EIA to support the international (non-U.S.) oil supply analysis that is presented in the EIA's *International Energy Outlook* (IEO). The analysis of domestic petroleum production in the IEO is provided by EIA's Office of Oil and Gas. It is intended to serve a wide audience of users with a technical background in the energy field. The supply estimation methodology used in the NOPEC-PC model incorporates a combination of judgmental expertise, geological evidence, and production economics. Historical data on proved reserves, reserve to production ratios, estimated undiscovered resources, and oil production are utilized to examine the plausibility of any alternative forecasts of future oil production.

Type: Basic

Last Model Update: January 1988.

Part of Another Model? No.

Model Interfaces: The Oil Market Simulation Model uses NOPEC-PC outputs as inputs.

Sponsor:

Office:	Energy Markets and End Use
Division:	International & Contingency Information
Branch:	Analysis, EI-632
Model Contact:	Phillip Tseng
Telephone:	586-1154

Documentation:

- Energy Information Administration, *Model Documentation of the World Oil Supply Model*, DOE/EI/19656-5, (Washington, DC, May 1985).

Archive Media and Installation Manual(s):

- WOS85 - microcomputer version used for *International Energy Outlook 1985* .

Purpose: The NOPEC-PC model is used to support the *International Energy Outlook* by analyzing and projecting free world oil supply trends in the longer term.

Energy System Described by Model: NOPEC-PC produces projections for crude oil production and supplies of natural gas liquids, other liquids, and refinery gains.

Coverage:

- **Geographic:** 26 countries/regions (United Kingdom, Congo, Canada, Norway, Egypt, Mexico, Other North Sea, Tunisia, Argentina, Other OECD Europe, Other Africa, Brazil, Oman, Australia/New Zealand, Columbia, Syria, Brunei, Peru, Other Middle East, India, Trinidad/Tobago, Angola, Malaysia, Other Latin America, Cameroon, Other Far East
- **Time Unit/Frequency:** Annual, from the year 1979 through 2000
- **Product(s):** Petroleum production projections to support the *International Energy Outlook*
- **Economic Sector(s):** Petroleum producers.

Modeling Features:

- **Model Structure:** Spreadsheet tabular format
- **Modeling Technique:** Deterministic
- **Special Features:** The NOPEC-PC consists of four parts. The first and most important part includes information on proved reserves, reserve/production ratios, new discoveries, revisions, undiscovered resources, and production. The second part of the model reports natural gas liquids, other liquids, and refinery gains. The third part provides a summary of the production of all liquids in all foreign non-OPEC countries/regions. The fourth

part aggregates the total liquids production estimates into the regions of the Oil Market Simulation Model.

Non-DOE Input Sources:
Petroconsultants, Inc., Worldwide Non-OPEC Crude Production to 1995, August 1987

- Proved oil reserves

Oil and Gas Journal, end of year issues

- Proved oil reserves

World Oil, various issues

- Proved oil reserves

U.S. Department of Interior, Distribution and Quantitative Assessment of World Crude-Oil Reserves and Resources, Open-File Report, 82-728 (Washington, DC)

- Undiscovered reserves December 1983.

DOE Data Input Sources:
Forms and Publications:

- Energy Information Administration, Foreign Energy Supply Assessment Program (FESAP), series reports, various issues
  - Proved oil reserves
- Energy Information Administration, International Energy Annual, DOE/EIA-0219, (Washington, DC, various issues)
  - Crude oil, natural gas liquids, and other liquids production
- Energy Information Administration, U.S. Crude Oil, Natural Gas, and Natural Gas Liquids, and Liquids Reserves, DOE/EIA-0216(84), (Washington, DC, 1986)
  - Proved oil reserves

Models and Other:

- None.

General Output Descriptions: The output of the NOPEC-PC consists of forecasts for production, reserves and undiscovered reserves for both crude oil and NGLs for the United States and foreign countries.

Computing Environment:

- **Hardware Used:** IBM compatible personal computer (PC/AT)
- **Language Used:** Lotus 1-2-3
- **Core Requirement:** 256K
- **Estimated Cost to Run:** Installation time charges for personal computer, if any. No time charge at EIA.
- **Special Features:** Dot-matrix printer that can display graphic output. System unit must have graphics adapter cord. Monochrome or color monitor.

Independent Reviews Conducted: None.

Status of Evaluation Efforts by Sponsor: None.

Oil and Gas Spreadsheet Model (OGS-PC)

Abstract: The Oil and Gas Spreadsheet (OGS-PC) is a submodel of the PC-AEO spreadsheet model, which forecasts energy supply and demand annually to the year 2000 for the entire United States. The OGS-PC reads world oil prices and end-use sector demand for natural gas in trillion Btu from other parts of the PC-AEO system, and computes prices for natural gas and domestic production quantities for crude oil and natural gas. This spreadsheet equilibrates natural gas supply and demand to calculate natural gas wellhead prices for 1988 through 2000, by using an interval bisection methodology. The spreadsheet is executed until supply equals demand for each consecutive year.

Type: Basic

Last Model Update: November 1988.

Part of Another Model? Part of the PC-*Annual Energy Outlook* System.

Model Interfaces: World oil prices from the Main submodel and end-use demand for gas from the demand and electric utility submodels of the PC-AEO system

Sponsor:

Office:	Office of Oil and Gas
Division:	Reserves and Natural Gas
Branch:	Analysis and Forecasting, EI-442
Model Contact:	Susan Shaw
Telephone:	586-4838

Documentation: Model Documentation Report of the Oil and Gas Spreadsheet (OGS-PC) for the *Annual Energy Outlook* 1989 HP1/, (Washington, DC,

Archive Media and Installation Manuals): Available as G8811161.WK1 on a floppy disk.

Purpose: Projects domestic crude oil and natural gas production and wellhead and end-use prices for natural gas for the *Annual Energy Outlook*.

Energy System Described by Model: Domestic crude oil and natural gas production and natural gas prices.

Coverage:

- **Geographic:** United States and Census region (Census region only for regional specific markups from a national wellhead price to end-use prices
- **Time Unit/Frequency:** Annual, through 2000
- **Product(s):** Dry natural gas and crude oil
- **Economic Sector(s):** Crude oil and natural gas production, and residential, commercial, industrial, and electric utility end-use sectors.

Modeling Features:

- **Model Structure:** Econometric equations for determining oil and gas drilling levels
- Modeling Techniques: Econometrics and Supply/Demand equilibration using an interval bisection methodology
- **Special Features:** None.

Non-DOE Input Sources:
American Petroleum Institute (API)

- Well completions by class and fuel type
- Data on drilling footage, total and per well, by class and fuel type.

DOE Data Input Sources:
Forms and Publications:

- Energy Information Administration, *Annual Energy Review 1987*, DOE/EIA-0384 (Washington, DC)
- Energy Information Administration, *Natural Gas Annual*,
- Energy Information Administration, U.S. Crude Oil, Natural Gas and Natural Gas Liquids Reserves Report

Models and Other:

- Energy Information Administration, *Well Completion Estimation Model (WELCOM) Methodology Description for the Well Completion Estimation Model*, DOE/EIA-M007, (Washington, DC)
  - Data on well completions by class and fuel type
  - Data on drilling footage, total and per well, by class and fuel type
- Energy Information Administration, *Short-Term Energy Outlook* (DOE/EIA-0202) Washington, DC
  - Forecasts published in the October 1988 issue for domestic production, gas imports, supplemental gas, transportation fuel, lease and plant fuel and unaccounted for gas for 1988 and 1989
- Intermediate Future Forecasting System/Gas Analysis Modeling System
  - Average wellhead prices
  - Average regional end-use prices.

General Output Descriptions: End-use and wellhead prices for natural gas, crude oil production, and natural gas production.

Computing Environment:

- **Hardware Used:** Compaq 386 with MS-DOS
- **Language Used:** Lotus 1-2-3
- **Core Requirement:** 1 Megabyte
- **Estimated Cost to Run:** 10 - 20 seconds
- **Special Features:** None.

Independent Reviews Conducted: Oil and Gas Spreadsheet Model for the PC-AEO, *Annual Energy Outlook 1989* : Presented by Susan H. Shaw to the American Statistical Association Committee on *Energy Statistics*, April 1989.

Status of Evaluation Efforts by Sponsor: Extensive internal review.

Oil Market Module (OMM)

Abstract: OMM is a component of the Intermediate Future Forecasting System (IFFS) which represents the domestic refining and pricing of petroleum products. OMM has econometric equations, estimated from a large detailed representation of refineries, which compute the refinery gate prices of petroleum products given projected consumption levels. End-use prices by region are computed by adding markups derived from analysis of historical data to the refinery gate prices. OMM also computes refinery fuel consumption.

Type: Basic

Last Model Update: December 1988.

Part of Another Model? Yes, IFFS.

Model Interfaces: OMM operates as a module of the Intermediate Future Forecasting System and also obtains data from the results of the following systems: Gas Analysis Modeling System (GAMS), Production of Onshore Lower 48 Oil and Gas (PROLOG) Model,

Oil Market Simulation Model (OMS), and the PC-AEO demand models.

Sponsor:

Office: Oil and Gas

Division: Reserves and Natural Gas

Branch: Analysis and Forecasting, EI-442

Model Contact: Susan Shaw

Telephone: 586-4838

Documentation: Energy Information Administration, *Model Documentation for the Oil Market Module of the Intermediate Future Forecasting System*, DOE/EIA-M015, (Washington, DC, April 1986).

Archive Media and Installation Manual(s): The use of OMM as a module of IFFS for the *Annual Outlook for Oil and Gas 1988*, the *Annual Outlook for U.S. Electric Power 1988*, and *Annual Outlook for U.S. Coal 1988* is archived on archive tape IFFS88.

OMM as a module of IFFS for the *Annual Outlook for Oil and Gas 1989*, the *Annual Outlook for U.S. Electric Power 1989*, the *Annual Outlook for U.S. Coal 1989* , and Electricity Generation from Natural Gas: Prospects and Implications for the United States is archived on a forthcoming archive tape, IFF89.

Purpose: OMM is a module within IFFS. The objective of IFFS is to account for the many interactions of the different segments of the domestic energy industry and to provide an internally consistent forecast of prices and quantities for which supply equals demand. This equilibrium solution accounts for the economic factors of supply and demand, the economic competition of fuels, and Government policies and regulations that may influence economic behavior.

The supporting role of OMM within IFFS is to model domestic crude oil refining, crude oil and petroleum product imports, and pricing of petroleum products.

Energy System Described by Model: OMM is an econometric model of domestic crude oil refining and petroleum product pricing. The scope of OMM excludes domestic production of crude oil and natural gas liquids (NGL). Consumption of petroleum products is also beyond the scope of OMM.

Coverage:

- **Geographic:** 10 Federal regions
- **Time Unit/Frequency:** Annual through 2010
- **Product(s):** Motor gasoline, aviation gasoline, distillate fuel, kerosene, jet fuel, liquefied petroleum gases (LPG), petrochemical feedstocks, lubricants, petroleum coke, asphalt, special naphthas, residual fuel, still gas, and miscellaneous products
- **Economic Sector(s):** Oil refinery sector.

Modeling Features:

- **Model Structure:** Equilibrium simulation
- **Modeling Technique:** Econometric
- **Special Features:** The pricing algorithms in OMM can be conveniently adjusted to test alternate hypotheses related to product prices.

Non-DOE Input Sources:
None.

DOE Data Input Sources:
Forms and Publications:

- FERC-423, "Monthly Reporting for Cost and Quality of Fuels at Electric Plants"
  - Electric utility fuel prices
- Energy Information Administration, *Petroleum Marketing Monthly*, DOE/EIA-0380, and State *Energy Price and Expenditures Report*, DOE/EIA-0376, (Washington, DC)
  - Retail price by region for gasoline, jet fuel, liquefied petroleum gases, and by region and sector for distillate, low-sulfur residual, and high-sulfur residual
  - Average low-sulfur residual retail price
  - Average high-sulfur residual retail price
- Energy Information Administration, *Petroleum Supply Annual*, DOE/EIA-0340, (Washington, DC)
  - Gross crude exports
  - Gross product exports
  - Average volumetric "refinery gain" (i.e., processing gain divided by total product supplied)
  - Proportion of demand which is satisfied by imports
  - Proportion of residual imports which are low-sulfur residual
  - Refinery distillation capacity
  - Refinery fuel consumption
  - Total refinery production
  - Proportion of natural gas liquids blended to each product.

Models and Other:

- The following data are obtained from interfaces with the other modules of the Intermediate Future Forecasting System (IFFS)

- Demand for petroleum product for end-use sector and utilities and natural gas liquids
- Crude oil production.

General Output Descriptions: OMMoutputs petroleum product prices, petroleum imports, and refinery production forecasts through the year 2010.

Computing Environment:

- **Hardware Used:** IBM 3084QX
- **Language Used:** FORTRAN 77
- **Core Requirement:** Core requirement for IFFS is 5000K
- **Estimated Cost to Run:** .5 CPU seconds per call, called approximately 35 times in a standard IFFS run
- **Special Features:** None.

Independent Reviews Conducted: U.S. Department of Commerce, National Bureau of Standards, Intermediate Future Forecasting System, Proceedings of a Symposium held at the Department of Energy, Washington, DC, August 19, 1982, NBS-670, (Washington, DC, December 1983).

Epple, Dennis. *An Evaluation of the Oil Market Module of the Intermediate Future Forecasting System*, June 1987.

Status of Evaluation Efforts by Sponsor: Ongoing.

Oil Market Module (Spreadsheet) (OMM-PC)

Abstract: The Oil Market Module (OMM-PC) spreadsheet of the personal computer model for the *Annual Energy Outlook* (PC-AEO) computes end use prices of seven petroleum product categories for five different consumption sectors and four different regions.

Type: Basic

Last Model Update: December 1988.

Part of Another Model? Part of the PC-*Annual Energy Outlook* system.

Model Interfaces: OMM-PC can operate as a standalone model, or as a module in the PC-AEO system.

Sponsor:

Office: Oil and Gas

Division: Petroleum Marketing

Branch: Publications and Analysis, EI-432

Model Contact: Aileen Bohn

Telephone: 586-9795

Documentation: Energy Information Administration, *Model Documentation for the PC-AEO Forecasting Model for the Annual Energy Outlook 1989*, (Washington, DC, January 1988).

Archive Media and Installation Manual(s): Archived on floppy disk.

Purpose: The Oil Market Module-PC calculates end use prices for seven petroleum product categories by region and sector, as well as an overall petroleum supply/demand balance. This module can be run as a part of the PC-AEO system, or in stand-alone mode. The projections from this module are published in the *Annual Energy Outlook*.

Energy System Described by Model: Domestic petroleum supply, refinery gate prices, and product end use prices.

Coverage:

- **Geographic:** All calculations are done on the national level except product prices, done for four regions and five consumption sectors. Product demands are supplied from the MAIN model by the five consumption sectors.
- **Time Unit/Frequency:** Annual through 2000.
- **Product(s):** Motor gasoline, distillate fuel oil, residual fuel oil, jet fuel, liquefied petroleum gases, petrochemical feedstocks, other petroleum products, and crude oil.
- **Economic Sector(s):** Oil refining and marketing sectors.

Modeling Features:

- **Model Structure:** Equilibrium simulation.
- **Modeling Technique:** Econometric and accounting.
- **Special Features:** Alternate hypotheses can be tested by adjusting the pricing algorithms or import requirements.

Non-DOE Input Sources:
None.

DOE Data Input Sources:
Forms and Publications:

- Energy Information Administration, *Petroleum Marketing Monthly*, DOE/EIA-0380, and State *Energy Price and Expenditures Report*, DOE/EIA-0376 (Washington, DC)
  - Retail prices by region for gasoline, jet fuel, and liquefied petroleum gases
  - Retail prices by sector and region for distillate fuel oil and residual fuel oil
- Energy Information Administration, *Petroleum Supply Annual*, DOE/EIA-0340 (Washington, DC)
  - Gross crude exports
  - Gross product exports
  - Refinery gain fraction (processing gain divided by crude and unfinished oil refinery inputs)
  - Individual petroleum product net imports
  - Proportion of natural gas liquids allocated to liquefied petroleum gases
  - Ratio of unfinished oil refinery inputs to total petroleum product supplied
  - Ratio of motor gasoline blending component refinery inputs to total petroleum product supplied
  - Strategic Petroleum Reserve fill rate
  - Crude oil stock withdrawals
  - Total petroleum product stock withdrawals
  - Other hydrocarbons and alcohol field production
  - Crude oil product supplied and crude losses

Models and Other:

- The following data are obtained from other modules of the PC-AEO system:
  - Crude oil production in Alaska
  - Crude oil production in the Lower 48 States
  - Dry natural gas production
  - World oil price (refinery acquisition cost of crude)
  - Petroleum product demands for five consumption sectors.

General Output Descriptions: End-use prices for motor gasoline, distillate fuel oil, residual fuel oil, liquefied petroleum gases (LPGs), jet fuel, other petroleum products, and petrochemical feedstocks. The five consumption sectors represent the residential, commercial, industrial, transportation, and electric utility sectors. The four regions correspond to the four Census regions.

Computing Environment:

- **Hardware Used:** IBM compatible personal computer (PC/AT)
- **Language Used:** Lotus 1-2-3
- **Core Requirement:** Approximately 170K
- **Estimated Cost to Run:** 15 seconds recalculation time on an 80386 based PC
- **Special Features:** None.

Independent Reviews Conducted: Leamer, Edward, "Independent Expert Review of Oil Production and Oil Price Spreadsheet Models of the EIA," May 1988.

Status of Evaluation Efforts by Sponsor: None.

Oil Market Simulation Model (OMS)

Abstract: OMS projects future world oil prices and world crude oil supplies and demands by region (the United States, Canada, Japan, OECD-Europe, OPEC, developing countries, and net Communist trade) on an annual basis through the year 2000. The OMS model is used as an adjunct to the Transportation and Refining of International Petroleum Model (formerly the Petroleum Allocation Model).

Type: Basic

Last Model Update: January 1988.

Part of Another Model? No.

Model Interfaces: None directly. Inputs from STIFS and IFFS. Outputs to TRIP.

Sponsor:

Office:	Energy Markets and End Use
Division:	International and Contingency Information
Branch:	Analysis, EI-632
Model Contact:	Erik Kreil
Telephone:	586-6573

Documentation: Energy Information Administration, *Oil Market Simulation Model Documentation Report*, DOE/EI/19656-2, (Washington, DC, May 1985).

Energy Information Administration, *Oil Market Simulation Model User's Guide*, DOE/EIA-M028 (Washington, DC, June 1988).

Archive Media and Installation Manual(s):

- OMS81 - *Annual Report to Congress 1981*
- OMS82 - *Annual Report to Congress 1982*
- OMS85 - *International Energy Outlook 1985*
- OMS86 - *International Energy Outlook 1986*
- OMS87 - *International Energy Outlook 1987*.

Purpose: The model forecasts annual world oil prices and regional supplies and demands through the year 2000. The model consists of regional oil supply and demand equations with oil demand determined as a function of both prices and income. The model can be used to simulate OPEC production, given a projection of world crude oil prices, or to estimate oil prices for any given level of OPEC production capacity.

Energy System Described by Model: The model describes world oil supply and demand on a regional basis annually from the present through the year 2000.

Coverage:

- **Geographic:** U.S., Canada, Japan, OECD-Europe, OPEC, and developing countries
- **Time Unit/Frequency:** From the present through the year 2000, annually
- **Product(s):** Crude oil and natural gas liquids
- **Economic Sector(s):** All oil consuming countries, regionalized as above.

Modeling Features:

- **Model Structure:** Dynamic, recursive
- **Modeling Technique:** Parametric representation of embodied aggregate supply and demand elasticities
- **Special Features:** Operational, both in interactive and batch mode.

Non-DOE Input Sources:
Central Intelligence Agency, Office of Economic Research

- Maximum sustainable OPEC production capacity estimate.

DOE Data Input Sources:
Forms and Publications:

- Energy Information Administration, *Annual Energy Review*, DOE/EIA-0384
  - World oil price
- Energy Information Administration, *Monthly Energy Review*, DOE/EIA-0035
  - Demand for OPEC oil

Models and Other:

- Department of Energy, Energy Information Administration unpublished data.
  - Maximum sustainable production capacity
- Short-Term Integrated Forecasting System (STIFS)
  - implied (1 year) short-term elasticities of crude oil demand with respect to price, holding all other demand determinants constant
- International Future Forecasting System (IFFS)
  - Domestic energy balances for low, mid, and high world oil price scenarios
  - Market balance sensitivities to income variation
  - Domestic oil supply/demand
  - Mid- and long-term price sensitivity indicators
  - Mid-to long-term income sensitivities of demand
- *World Oil* Supply Model (WOS)
  - International oil supply.

General Output Descriptions: OMS model users can specify the world oil price path over time. The model accepts the user-specified prices to compute the world regional demand and supply. Output of this includes OPEC production, free world production, free world consumption, net U.S. imports, OPEC revenues, and excess OPEC capacity.

The OPEC price reaction function can be used to evaluate oil prices. OMS model users specify the demand and supply path over time. The model accepts these to compute world price levels. Output is similar to that of a production run, except that price is included as well.

An OMS model user can also specify an OPEC output (production) path, and the model will search for a world oil price such that the model solution will converge to the user-specified quantity or levels. Output of this run is similar to that of a price run.

In a disruption run, OMS model users can specify a reduction in OPEC capacity to trigger the disruption algorithm, and the model will be solved for world oil price, world oil demand, and world oil supply.

Computing Environment:

- **Hardware Used:** Compaq 386 PC
- **Language Used:** Lotus 1-2-3, Version 2.0
- **Core Requirement:** 500K
- **Estimated Cost to Run:** 10 seconds

- **Special Features:** Fast turnaround.

Independent Reviews Conducted:

- *Oil Market Simulation Model Documentation Review Report*: John Kraft, Independent Expert Review, October 13, 1980
- *Oil Market Simulation Model Documentation Report*: William Gaynor, Independent Expert Review, February 15, 1983
- *Oil Market Simulation Model Documentation Report*: William M. Fitzgerald, Independent Expert Review, November 25, 1983
- *An Evaluation of the Oil Market Simulation Model*: Dennis Epple, Independent Expert Review, April 1986.

Status of Evaluation Efforts by Sponsor: None.

Outer Continental Shelf Oil and Gas Supply Model (OCSM)

Abstract: OCSM forecasts lower 48 States Outer Continental Shelf oil and gas supply in terms of exploration and discovery processes influenced by economic and geological factors. Forecasts may be for up to 30 years in 1-year increments. Supply curves generated by the model are used in the integrating models. The model uses simulation methods to determine the probable supply of oil and gas at different price levels.

Type: Basic

Last Model Update: July 1984.

Part of Another Model? GAMS and IFFS interface with OCSM.

Model Interfaces: IFFS and GAMS

Sponsor:

Office:	Oil and Gas
Division:	Reserves and Natural Gas
Branch:	Analysis and Forecasting, EI-442
Model Contact:	William Trapmann
Telephone:	586-6408

Documentation:

- Energy Information Administration, *Outer Continental Shelf (OCS) Oil and Gas Supply Model, Volume 1 - Model Summary and Methodology Description*, DOE/EIA-0372/1 (Washington, DC, December 1982).
- Energy Information Administration, *Outer Continental Shelf (OCS) Oil and Gas Supply Model, Volume 2 - Data Description* , DOE/EIA-0372/2 (Washington, DC, December 1982).
- Energy Information Administration, *Outer Continental Shelf (OCS) Oil & Gas Supply Model, Volume 3 - User's Guide and Guide to Model Applications*, DOE/EIA-0372/3 (Washington, DC, December 1982).

Archive Media and Installation Manual(s):

- OCSM81 - *Annual Report to Congress 1981* .
- OCSM82 - *Annual Report to Congress 1982* .
- OCSM84 - *Annual Report to Congress 1984* .
- OCSM85 - *Annual Report to Congress 1985* .

Purpose: OCSM forecasts offshore crude oil and natural gas production.

Energy System Described by Model: Oil and natural gas production.

Coverage:

- **Geographic:** Offshore lower 48 States
- **Time Unit/Frequency:** Annually for 30 years
- **Product(s):** Crude oil and natural gas
- **Economic Sector(s):** None.

Modeling Features:

- **Model Structure:** Process model conducting economic evaluation of drilling prospects over time within an iterative sampling procedure to represent alternative feasible realizations of the geology base
- **Modeling Technique:** Iterative sampling with process model
- **Special Features:** None.

Non-DOE Input Sources:
U.S. Geological Survey Seismic Maps

- Tract numbers
- Map number and horizon number
- Sales and prospect numbers
- Prospective productive pay
- Geological trends

- Portion of geological age relevant to target reservoir
- Trap type
- Total number of prospective horizons in prospect
- Vertical sequence of prospect horizons
- Number of lease blocks that must be leased for full prospect development

U.S. Geological Survey Evaluation Maps

- Current status of leasing and exploration

U.S. Geological Survey, Texas and Louisiana Large-Scale Leasing Map

- Leasing area
- Distance to nearest field (in miles)

U.S. Geological Survey Prepared Plat Maps

- Number of exploration/delineation holes in a specific prospect

U.S. Geological Survey Hazard Maps

- Hazard class

U.S. Geological Survey Evaluation Forms

- Dominant lithology of the prospective reservoir
- Probability of hydrocarbon occurrence
- Probability that prospect contains no hydrocarbons
- Number of platforms
- Percent of area under first platform
- Percent of area under platform numbers 2 to 8
- Average vertical depth
- Average drilled depth
- Gas compressibility factor
- Oil formation volume factor
- Gas in place
- Oil in place
- Gas recovery
- Oil recovery
- Oil volumetric fraction
- Producing gas oil ratio
- Gas yield
- Productive area
- Expected thickness of the hydrocarbon-bearing reservoir

Bureau of Land Management Bathymetric Maps

- Water depth

Offshore Magazine, published monthly

- Classification of drillships
- Number of drillships available
- Assignment of drillships to structures.

DOE Data Input Sources:
Forms and Publications:

- Cost and Indexes for Oilfield Equipment and Production Operations in the United States. W.D. Dietzman, et. al., U.S. Department of Energy, 1978
  - Costs of drilling from an exploratory rig
  - Platform costs
  - Ultimate recovery associated with field-size class
  - Oil and gas well surface equipment costs required at maximum production rate
  - Completion costs for subsea wells
  - Number of platform and development wells required
  - Timing of platform construction and development drilling
  - Production rates and operating costs
  - Production schedules for offshore nonassociated gas fields
  - Production schedules for offshore oil fields
  - Operating cost calculations
  - Transportation costs
  - Abandonment costs

Models and Other:

- Federal Energy Regulatory Commission
  - Pipeline construction costs.

General Output Descriptions: OCSM produces production forecasts for Outer Continental Shelf reservoirs.

Computing Environment:

- **Hardware Used:** IBM 3084QX
- **Language Used:** FORTRAN
- **Core Requirement:** 1200K
- **Estimated Cost to Run:** 1500 CPU seconds
- **Special Features:** None.

Independent Reviews Conducted:

- An Analysis of the Feasibility of Separating Exploration from Production in the OCS. May, 1975,

Office of Technology Assessment, No. 51-542-0, Washington, DC, Government Printing Office

- Outer Continental Shelf (OCS) Oil and Gas Model Documentation: Carl M. Harris; Independent Expert Review, August 1980
- Outer Continental Shelf (OCS) Oil and Gas Model Documentation: Gordon M. Kaufman; Independent Expert Review, November 1980
- OCSM Computer Routines to Perform Basin-Prospect Analogue Sampling and Calculate Pipeline District Threshold Volumes. Memorandum to the record, June 2, 1982, Richard Farmer, EIA, Petroleum Supply Division
- *Reducing the Variability in Monte-Carlo Interactions of OCSM*: Carl M. Harris & Associates, Independent Expert Review, June 1982
- *The Bayes Adjustment in OCSM*; Carl M. Harris, & Associates, Independent Expert Review, July 1982
- *The Problem of Dependence of Oil and Gas Resources in a Prospect*: Carl M. Harris, & Associates, Independent Expert Review, September 1982
- Computer Issues in the Implementation of OCSM Model Changes: Carl M. Harris, & Associates, Independent Expert Review, January 1983
- Outer Continental Shelf (OCS) Oil and Gas Model Documentation: R. G. Alsmiller, Jr.; Independent Expert Review, April 1983
- *Plan for Lessening the Effect of Run-Size Limitations in the OCSM Geology Model*; Carl M. Harris & Associates, Independent Expert Review, August 1983.

Status of Evaluation Efforts by Sponsor: Internal evaluation completed in the summer of 1984.

Personal Computer - *Annual Energy Outlook* Forecasting Model Overview (PC-AEO)

Abstract: PC-AEO represents U.S. energy supply distribution, and consumption by fuel supply and consumption sector. A baseline forecast of the world crude oil prices and a macroeconomic projection of economic growth drive four price-sensitive models for consumption of fuels by end-use sector. A detailed representation of electric utility planning and generation provides the demand for oil, coal, natural gas, hydropower, and nuclear and the price of the generated electricity. Econometric representations provide crude oil production and natural gas prices. An econometric representation of refinery pricing provides oil product prices. A coal supply and transportation model provides the delivered price of coal. The model solves for the market equilibrium for each fuel by balancing supply and demand to produce an energy balance in each forecast year, currently through the year 2000.

Type: Overview

Last Model Update: November 1988.

Part of Another Model? No, but can be linked with the Intermediate Future Forecasting (IFFS) and Gas Analysis Modeling System (GAMS) for special studies. The link is made via reduced form representations of PC-AEO demand models and supports analysis with detailed IFFS/GAMS supply models. Contains a forecast calibration routine originally designed to assure consistency with the *Short-Term Energy Outlook* .

Model Interfaces:

Sponsor:

Office:	Oil and Gas (OG) Coal, Nuclear, Electric and Alternate Fuels (CNEAF) Energy Markets and End Use (EMEU)

Model Contacts:

Model	
Integration	M. Lehr (EMEU) (586-1470)
Oil and Gas	S. Shaw (OG) (586-4838)
Coal	B. D. Hong (CNEAF) (586-6532)
Electricity	J. Jones (CNEAF) (586-1603)
Macroeconomic	R. Earley (EMEU) (586-1398)
Residential	B. Cohen (EMEU) (586-5349)
Commercial	B. Cohen (EMEU) (586-5349)
Industrial	J. Holte (EMEU) (586-1471)
Transportation	B. Cohen (EMEU) (586-5349)
General	R. Farmer (EMEU) (586-1458)

Documentation: Energy Information Administration, *PC-AEO Forecasting Model for the Annual Energy Outlook 1989, DOE/EIA-M036 (Washington, DC, March 1989).*

Archive Media and Installation Manual(s): Archived on floppy disk.

Purpose: The objective of the PC-AEO is to account for the many interactions of the different segments of the energy industries and to provide an internally consistent forecast of prices and quantities for which supply equals demand. This equilibrium solution accounts for the main economic factors affecting supply and demand, allows price competition of fuels, and accounts for Government policies and regulations that cause deviations from purely economic behavior.

Energy System Described by Model: PC-AEO is a partial equilibrium model of domestic energy supply and demand. PC-AEO represents the domestic production of oil, natural gas, and coal and the imports of crude oil, natural gas, and refined petroleum products. It also represents the two major energy conversion activities, the refining of crude oil into petroleum products and the conversion of fossil fuels, nuclear power, hydropower and other technologies into electricity. Consumption is represented by major end-use sectors. The macro-economic relationships of energy to the general economy are represented by the incorporation of feedback to some major economic variables.

Coverage:

- **Geographic:** The United States. Different modules represent energy production or consumption at different levels of regional detail. The price and quantity interface between modules is at the four Census region levels.
- **Time Unit/Frequency:** Annual through the year 2000
- **Product(s):** Natural gas, electricity, coal, distillate oil, residual oil, gasoline, jet fuel, liquefied petroleum gases, petrochemical feedstocks, kerosene, and other petroleum products.
- **Economic Sector(s):** Residential, commercial, industrial, and transportation end-use consumption; coal, oil, and gas supply; electric utility capacity, pricing, and generation.

Modeling Features:

- **Model Structure:** PC-AEO provides an equilibrium framework in which the economic forces of supply and demand can be simulated. Due to its modularity, PC-AEO allows each individual module to be represented in a different fashion if desired.
- **Modeling Technique:** Modeling techniques differ from one submodel to another and are described in detail in the PC-AEO model documentation. Econometric estimation is the most common approach.
- **Special Features:** The primary design features of PC-AEO are modularity, portability and transparency.

  Modularity results from organizing the PC-AEO into submodels for each fuel supply sector, energy conversion sector and end-use demand sector. PC-AEO's modular structure allows a sector to be represented in different degrees of detail for different studies, supports independent debugging and analysis, and allows different sectors to be represented with different modeling techniques.

  Implementing PC-AEO on a personal computer allows great portability. The model will run on IBM-compatible computers with Lotus 1-2-3, Version 2.01, a hard disk, and one megabyte of RAM. An AT compatible is recommended.

  Transparency is a by-product of writing the model in Lotus. Code and data are both present in the spreadsheet.

Non-DOE Input Sources:
All data sources are listed under appropriate modules of PC-AEO.

DOE Data Input Sources:
All data sources are listed under appropriate modules of PC-AEO.

General Output Descriptions: The following data elements are generally used in published reports; however, more detailed information is likely to be available:

- Domestic production by fuel type
- Imports (exports) by fuel type
- Consumption by fuel type
- Total energy supply and disposition
- End-use fuel consumption summary
- End-use fuel price summary
- National macroeconomic indicators
- Residential energy consumption
- Commercial energy consumption
- Industrial energy consumption
- Transportation energy consumption
- Electric utility fuel consumption
- Electricity disposition and prices
- Electricity generation
- Electricity capacity
- World oil price
- Petroleum supply, disposition, and prices
- Natural gas supply, disposition, and prices
- Coal supply, disposition, and prices.

Computing Environment:

- **Hardware Used:** IBM compatible personal computer (PC/AT)

- **Language Used:** Lotus 1-2-3, Version 2.01
- **Core Requirement:** 1 megabyte RAM
- **Estimated Cost to Run:** 40 minutes for all modules on Compaq 386/16
- **Special Features:** None.

Independent Reviews Conducted: Expert Review of Coal Price and Supply Model (COAL-PC), Ellerman, A. Denny, May 1988. Independent Expert Reviewer.

Independent Expert Review of Oil Production and Oil Price Spreadsheet Models (OMM-PC and OSM-PC), Leamer, Edward E., May 1988. Independent Expert Reviewer.

Independent Expert Review of the Gas Production (GAS-PC) Spreadsheet Model, PC-AEO System, Toman, Michael A., May 1988. Independent Expert Reviewer.

Independent Expert Review of the Commercial Sector Energy Model (CSEM-PC) Spreadsheet Version, Mariano, Robert S., May 1988. Independent Expert Reviewer.

Independent Expert Review of the Household Model of Energy, (HOME3-PC), Brown, Byron W., May 1988. Independent Expert Reviewer.

Independent Expert Review of the Industrial Sector Energy Model (ISEM-PC), Maddala, G.S., May 1988.

Independent Expert Review of Transportation Energy Demand Model (TED-PC), Leamer, Edward E., June 1988. Independent Expert Reviewer.

Status of Evaluation Efforts by Sponsor: None.

Petroleum Financial Analysis System (PETFAS-PC)

Abstract: PETFAS-PC (Petroleum Financial Analysis System) utilizes PC-AEO model results for oil and gas prices, domestic drilling levels and drilling cost relationships, as well as information from PC-AEO on oil and gas reserves and production to provide forecasts of investment and profits for the U.S. oil and gas production industry. Detailed income statement, capital account, balance sheet and tax information is provided for two main industry categories--major energy companies' domestic oil and gas segments and domestic independent producers.

Type: Basic

Last Model Update: February 1988.

Part of Another Model? Designed not as a principal model involved in iterative solution algorithm for PC-AEO, but as a post-solution report writer with some embedded behavioral characteristics relating to industry structure. Can operate in stand-alone mode with internal oil and gas supply equations or with AEO inputs supplemented by user options.

Model Interfaces: In AEO mode, uses inputs directly from the oil and gas and macro modules solutions from PC-AEO to forecast investment and income for the oil and gas sector.

Sponsor:

Office:	Energy Markets and End Use
Division:	Economics and Statistics
Branch:	Macro and Financial Information, EI-641
Model Contact:	Arthur Rypinski
Telephone:	586-8425

Documentation: Energy Information Administration, *Model Documentation for the Petroleum Financial Analysis Personal Computer Model*, (PETFAS), April 1988.

Archive Media and Installation Manual(s): Archived on floppy disk.

Purpose: Make explicit the implications for financial health/performance of the domestic oil and gas industry embedded in PC-AEO and other energy model results.

Energy System Described by Model: Domestic oil and gas production industry.

Coverage:

- **Geographic:** National
- **Time Unit/Frequency:** Annual
- **Product(s):** None
- **Economic Sector(s):** United States oil and gas production sector, for total United States, majors and independents.

Modeling Features:

- **Model Structure:** Recursive model. Calculates aggregate financial results for aggregate industry using inputs on real activity levels and prices from PC-AEO or elsewhere as exogenous. Solves in top-down fashion for industry sector results.

- **Modeling Technique:** Key behavioral relationships estimated using Ordinary Least Squares regressions on pooled time-series cross-section data base created from survey data at the corporate level.
- **Special Features:** Constructed in Lotus 1-2-3 with menu-driven structure to allow user to specify alternative input assumptions.

Non-DOE Input Sources:
Financial data on nonmajor sector compiled (by company) from Compustat, Inc., Annual Data Base. These data were used for estimation only.

DOE Data Input Sources:
Forms and Publications: None

Models and Other:

- PC- *Annual Energy Outlook* (AEO)
  - Real world oil price (imported refiner acquisition cost)
  - Real domestic wellhead gas price (average)
  - Gas footage drilled
  - Gas drilling/equipping cost per foot (% growth rates)
  - Oil footage drilled
  - Oil drilling/equipping cost per foot (% growth rates)
  - Domestic oil production
  - Domestic gas production
  - Domestic oil reserves added
  - Domestic gas reserves added
  - Domestic oil reserves
  - Domestic gas reserves
  - Corporate bond yield (new issues)
  - Wholesale price index.

General Output Descriptions: Detailed output for both industry sectors on revenue and expenses (including windfall profits tax), operating income, interest expense, pretax income, sources of tax deferral, income tax calculations, investment in fixed assets, changes in long-term debt and stockholders' equity. Results make possible comparisons over time and between sectors of cash flow, changes in financial condition, and effective tax rates.

Computing Environment:

- **Hardware Used:** IBM compatible personal computer
- **Language Used:** Lotus 1-2-3
- **Core Requirement:** 325K
- **Estimated Cost to Run:** 2 minutes, 36 seconds
- **Special Features:** Makes use of Data Matrix Multiply feature of Lotus.

Independent Reviews Conducted: Independent Expert Review in progress.

Status of Evaluation Efforts by Sponsor: EIA evaluation complete.

Production of Onshore Lower 48 Oil and Gas Model (PROLOG)

Abstract: PROLOG forecasts oil and natural gas production activities for six onshore regions of the Lower 48 States on an annual basis. The primary activities are exploratory and developmental drilling. Forecast values include the reserve additions from exploratory drilling, as well as production from all flowing wells. The PROLOG model employs a linear programming framework to determine the optimal drilling levels that maximize the present value of profits stemming from the drilling projects.

Type: Basic

Last Model Update: December 1988.

Part of Another Model? PROLOG is used as a standalone model and component of the Gas Analysis Modeling System (GAMS) and the Intermediate Future Forecasting System (IFFS).

Model Interfaces: Gas Analysis Modeling System (GAMS)

Sponsor:

Office:	Oil and Gas
Division:	Reserves and Natural Gas
Branch:	Analysis and Forecasting, EI-442
Model Contact:	Susan Shaw
Telephone:	586-4838

Documentation:

- Energy Information Administration, Model Methodology and Data Description of the Production of Onshore Lower 48 Oil and Gas Model, DOE/EIA-M034 (Washington, DC, September 1988)

- Energy Information Administration, *Software Description and User's Guide for the Production of Onshore Lower 48 Oil and Gas Model*, DOE/EIA-M020 (Washington, DC, April 1987).

Archive Media and Installation Manual(s):

- PROLOG82 - *Annual Energy Outlook 1982*
- PROLOG83 - *Annual Energy Outlook 1983*
- PROLOG84 - *Annual Energy Outlook 1984*
- PROLOG85 - *Annual Energy Outlook 1985*
- PROLOG86 - *Annual Energy Outlook 1986* .
- PROLOG88 - *Annual Outlook for Oil and Gas 1988*, the *Annual Outlook for U.S. Electric Power 1988*, and the *Annual Outlook for U.S. Coal 1988*
- PROLOG89 - Archived for the *Annual Outlook for Oil and Gas 1989*, the *Annual Outlook for U.S. Electric Power 1989*, the *Annual Outlook for U.S. Coal 1989*, and *Electricity Generation from Natural Gas: Prospects and Implications for the United States.*

Purpose: PROLOG forecasts oil and natural gas production.

Energy System Described by Model: Oil and natural gas production.

Coverage:

- **Geographic:** Onshore, Lower 48 States
- **Time Unit/Frequency:** Annual, 1985 through 2010
- **Product(s):** Oil and natural gas
- **Economic Sector(s):** None.

Modeling Features:

- **Model Structure:** Linear programming structure
- **Modeling Technique:** Constrained optimization
- **Special Features:** None.

Non-DOE Input Sources:
State Tax Guide, Statute Summaries, by Taxes, by State, 1987, Commerce Clearing House, Inc., 1987, and Oil Property Evaluations, R.S. Thompson and J.D. Wright, 1983,

- State corporate income tax rates
- State severance (production taxes)

Miller's Oil and Gas Federal Income Taxation, Commerce Clearing House, Inc.

- State ad valorem taxes

Crude Oil Windfall Profit Tax Act of 1980, (Public Law 96-223).

- Windfall profit tax

Internal Revenue Service Regulations

- Federal corporate tax rate

Production Data for Lower 48 Oil and Gas Model: Interim Report, Grey Federal, Inc.

- Hydrocarbon production schedule for the evaluation of reserves added

29th Annual Rotary Rig Census, Reed Rock Bit Company.

- Number of wells drilled by one rig

Natural Gas Policy Act of 1978, (Public Law 95-621).

- Gas price forecast for NGPA sections 103, 104, 105, 106A, and 106B

Hughes Rotary Rig Census, Hughes Tool Company, 1985.

- Average number of rotary drilling rigs in service in 1985

1986 Joint Association Survey on Drilling Costs, American Petroleum Institute.

- Parameters for drilling curves

American Petroleum Institute Well Record Drilling Tapes for 1979 through 1988

- Average well depth
- 1985 through 1986 drilling footage
- Drilling ratios
- Successful gas footage
- Total gas footage
- Dry footage
- Finding rate parameters for oil, gas, and deep gas
- Success rates for developmental and exploratory oil and gas drilling

Dwight's Energydata.

- Average first year production per well

Annual Survey of Oil and Gas, U.S. Department of Commerce, Burau of the Census, MA-13K(82)-1.

- Lease acquisition costs
- Lease equipment costs
- Production facilities
- Operating costs

American Petroleum Institutes, 1985 Survey on Oil and Gas Expenditures

- Geological and geophysical costs.

Estimates of Undiscovered Recoverable Conventional Resources of Oil and Gas in the United States, Geological Survey Circular 860, U.S. Department of the Interior, 1981.

DOE Data Input Sources:
Forms and Publications:

- FERC-15, "Interstate Pipeline's Annual Report of Gas Supply"
  - Interstate gas reserves
- FERC-121, "Application for Determination of Maximum Lawful Price Under the Natural Gas Policy Act of 1978"
  - Average production per well
  - Average depth
  - Average first year production per well
- Energy Information Administration, *U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves*, DOE/EIA-0216, (Washington, DC)
  - reserves and production
  - co-product ratios
- Energy Information Administration, *The Current State of the Natural Gas Market*, DOE/EIA-0313, (Washington, DC)
  - Factors for rolling over NGPA sections 104 and 105 wells to Sections 106A and 106B
  - Factors for weighting prices of associated dissolved gas from old oil
- Energy Information Administration, *Natural Gas Annual*, DOE/EIA-0131, (Washington, DC)
  - Well counts
- Energy Information Administration, *Costs and Indexes for Domestic Oil and Gas Field Equipment and Production Operations*, DOE/EIA-0185, (Washington, DC, 1986)
  - Lease equipment costs
  - Operating costs

Models and Other:

- Potential Supply of Natural Gas in the United States, Potential Gas Committee, April 1987
  - Undiscovered recoverable resource base broken out by depth.

General Output Descriptions: PROLOG produces oil and natural gas forecasts annually through 2010. Output data are used as input to the Gas Analysis Modeling System (GAMS), and to the Intermediate Future Forecasting System (IFFS).

Computing Environment:

- **Hardware Used:** IBM 3084QX
- **Language Used:** FORTRAN, COBOL
- **Core Requirement:** 2000K
- **Estimated Cost to Run:** 150 CPU seconds
- **Special Features:** None.

Independent Reviews Conducted: *Assessment of Natural Gas Market Models*, Charles River Associates, April 1984.

Production of Onshore Lower 48 Oil and Gas Model, presentation by William Trapmann to the International Association for Mathematics and Computers in Simulation Conference, held at the Brookhaven National Laboratory, Upton, NY, August 1984.

An Analysis of Forecast Uncertainty, presentation by William Trapmann to the Operations Research Society of America/The Institute of Management Sciences, November 1985.

Status of Evaluation Efforts by Sponsor: Ongoing..

Refinery Evaluation Modeling System (REMS)

Abstract: REMS consists of two models. The regional Refinery Yield Model (RYM) produces a detailed representation of refinery processes and product production. The Oil Refining and Distribution Model (ORAD) simulates the industry's interregional producing, refining, and distribution network throughout the United States.

RYM can run over 130 different foreign and domestic crude types which are represented as linear combinations of 37 principal crudes, as defined by their assays. RYM refineries produce over 35 petroleum products using 21 detailed refinery process units. ORAD represents an aggregated bundle of domestic and foreign crudes available from the RYM, an aggregated bundle of petroleum products, and transportation modes and links for crude oil and petroleum products among regions.

RYM and ORAD are static linear programming simulations.

Type: Basic

Last Model Update: October 1986.

Part of Another Model? No.

Model Interfaces: REMS is a domestic model and as such it requires certain assumptions. REMS requires

data on the costs and availability of different crudes available both domestically and in the world market. A basis for determining these costs and quantities can be obtained by running the Oil Market Simulation (OMS) model and the Petroleum Allocation model (PAL) in conjunction with the Intermediate Future Forecasting System (if the period under study is a full year) or the Short Term Integrated Forecasting System (STIFS) (if the focus is on seasons, quarters or months). REMS also requires initial entries for petroleum products demand and prices, because, as currently configured, REMS is not an equilibrating model for supply and demand. Either STIFS or Intermediate Future Forecasting System must supply these. REMS can also be used to calibrate the refinery representations within Intermediate Future Forecasting System, STIFS and PAL. REMS refinery operating vectors can be used to update the refinery yields relating to the running of various crudes available both domestically and from foreign sources.

Sponsor:

Office:	Oil and Gas
Division:	Petroleum Supply Division
Branch:	Economic Analysis and Modeling, EI-425
Model Contact:	David Welsh
Telephone:	586-9271

Documentation:

- *Refinery Evaluation Modeling System (REMS) Model Documentation*, (released in July 1984 and available through the model contact)
- Energy Information Administration, *Refinery Evaluation Modeling System (REMS) Database Documentation*, DOE/EIA-M011, (Washington, DC, August 1985).

Archive Media and Installation Manual(s): REMS83 - for the report *Refinery Evaluation Modeling System 1983 Validation Results*

REMS86 - for the report *Refinery Evaluation Modeling System 1986 Validation Results.*

Purpose: REMS simulates the operations of refineries within the United States, including the purchases and transportation of crude oils and other raw materials to refineries, the processing of these raw materials into petroleum products, and the distribution of petroleum products to meet regional demands. The model chooses the set of these petroleum industry activities which maximizes the gross margin at the refinery level within the industry. Gross margin is defined as the difference between product revenues and the cost of crude oil and raw materials, refinery operations, and the transportation of raw materials to refineries and products to market.

REMS determines the potential impact on refinery operations of changes in any one or combination of several variables, including demands for petroleum product slates, crude and feedstock quality, costs and prices, refinery process unit capacities, foreign and domestic crude availability and costs, petroleum transportation mode availability, capacity, and government energy policies and regulations. REMS can also be used to assist short term and longer term integrating energy models (e.g. the Short Term Integrated Forecasting System, the Petroleum Allocation Model and the Intermediate Future Forecasting System of EIA) in the preparation of forecasts. This can be accomplished by driving REMS with prices and volumes of product demands and available crudes taken from these models and then executing REMS to determine optimal refinery processing and petroleum distribution patterns. REMS can also be used to update and calibrate the simpler refinery representations within these models.

Energy System Described by Model: REMS includes a regional representation for crude producing activities, natural gas plant operations, transportation modes for raw materials and petroleum products (pipelines, water vessels, and trucks/railroads), refinery distillation and downstream processes, and petroleum product demands. REMS consists of two components, regional Refinery Yield Model (RYM), and the Oil Refining and Distribution Model (ORAD). RYM contains a detailed representation of refinery processes and product production. The refineries can run over 130 different foreign and domestic crude types, which are represented as a linear combination of about 37 principal crudes, as defined by their assays. RYMs refineries produce over 35 petroleum products using 21 separate, detailed refinery process units. ORAD simulates the industry's interregional producing, refining, and distribution network throughout the United States. It represents an aggregated bundle of domestic and foreign crudes available to the RYM (one domestic crude from each producing region and approximately 22 foreign crudes), as an array of 22 petroleum products, and transportation modes and links for crude oil and petroleum products among regions.

Coverage:

- **Geographic:** Nine districts based on Bureau of Mines (BOM) refinery district aggregations which relate directly to Petroleum Administration for Defense Districts (PADD), plus separate districts for refineries in Puerto Rico and the Virgin Islands, other non-U.S. Caribbean refineries, foreign producers of crude, and two Strategic Petroleum Reserve producing sites.
- **Time Unit/Frequency:** The 1985 data base contains annual data. However, because the units used within the model are in terms of rates (thou-

sands of barrels per day is the most prevalent), the static version of the model can be exercised over any single period of time. The data base, of course, would have to be revised.

- **Product(s):** The RYM represents the running of over 130 different crude types in refineries, and the production of over 35 different refinery products using 21 separate, detailed refinery processes. In the ORAD module, refineries consume 9 domestic and 22 foreign crudes, and produce 22 petroleum products.
- **Economic Sector(s):** None.

Modeling Features:

- **Model Structure:** REMS is a static linear programming model which obtains an optimal solution using a two-step process. REMS is divided into a regional RYM module and the ORAD module. Each are static linear programming modules containing three basic programs--a preprocessor and matrix generator, a program which calls MPS-III to solve the linear programming problem, and a report writer. There is a regional RYM for each refinery district within the model. The same OMNI programming code is used to run each of the RYM. However, each of the regions has slightly different refinery process unit configurations, thereby better representing differences in actual regional refinery capabilities. One ORAD module simulates the entire industry interregional producing, refining, and distribution network within the United States.

  REMS is not a price equilibrium model as it is now constructed. The model can be used to allocate shortfalls to demand regions, given the availability of crudes and prices and the prices and quantities of products demand. The model can, however, be used to reach an equilibrium supply-demand solution if the increments of crude supplies and petroleum products demand are priced at levels approximating step-function supply and demand curves, respectively.

  A noteworthy feature of REMS is that it is data-driven. Major changes in the level of aggregation of crudes, refinery processes, petroleum products, etc., can be simulated with no changes to the programming code, simply by altering data input tables.

- **Modeling Technique:** Static linear programming model.
- **Special Features:** An important feature REMS is that it produces major petroleum products (motor gasolines, jet fuels, kerosene, and fuel oils) to specification. This feature allows an excellent representation of the flexibility in processing actually available to refiners. Input tables within the RYM define specifications such as volatility, octane rating, Reid vapor pressure, and distillation cut points. Nonlinearities in blending are taken into account by providing "bonuses" in specifications for certain blends. The RYM then produces products to equal or exceed the minimum required specifications. Other products are blended to recipe.

  Another special feature is the two-step optimization process obtained through the use of the RYM-ORAD combination of linear programming. This two-step optimization is based on the Theory of Decomposition of linear programming solutions. Simply stated, RYM defines extreme points of a surface of optimal and feasible solutions which maximize gross margins for refiners within a single region, ORAD determines the specific solution as a linear combination of these extreme points, after taking into account the interregional economics involved. This two-step process allows for greater efficiency in running REMS because the time-consuming RYM does not have to be rerun for each scenario unless the optimal surface defined by the RYM is expected to be exceeded.

Non-DOE Input Sources:

"Guide to World Export Crudes," *Oil and Gas Journal*, 1983

- ATM and vacuum crude unit-hydroconversion yield fractions from full crude assays for crude oils for:
  - capacity factor
  - fuel and utility consumption
  - variable costs
  - fixed refinery losses coefficient
  - coefficient for adjustment to plant fuel
- Crude blending recipe coefficients for specific crude types.

Sobotka & Company, Inc., Proprietary data sources

- Crude blending recipe coefficients for specific crude types
- Intermediate process streams input and yields, losses, capacity factor for the process plant, electricity and steam consumption, and variable costs for propylene polymerization operating mode
- Refinery intermediate process streams, capacity factor, purchased natural gas, electricity, steam, consumption and variable operating costs, research octane number of the reformate yield, and use of the reformer over severity levels by feed type for reformer operating modes
- Refinery intermediate process streams, capacity factor, purchased natural gas, electricity, steam, consumption and variable operating costs, and sulfur plant coefficient for fluid catalytic cracker operating modes

- Refinery intermediate process streams, capacity factor, purchased natural gas, electricity, steam, consumption and variable operating costs, and sulfur plant feed coefficient and severity of hydrocracker operating mode for hydrocracker operating mode
- Refinery intermediate process streams, capacity factor, purchased natural gas, electricity, steam, consumption and variable operating costs, for alkylation unit operating modes
- Refinery intermediate process streams, capacity factor, purchased natural gas, electricity, steam, consumption and variable operating costs, for aromatics recovery plant operating modes
- Refinery intermediate process streams, capacity factor, purchased natural gas, electricity, steam, consumption and variable operating costs, for butane isomerization operating modes
- Refinery intermediate process streams, capacity factor, purchased natural gas, electricity, steam, consumption and variable operating costs, sulfur, and sulfur plant feed coefficient for sulfur production and hydrogen sulfide recovery operating modes.

"Hydrocarbon Processing," *Refinery Handbook*, 1982.

- Refinery intermediate process streams, capacity factor, purchased natural gas, electricity, steam, consumption and variable operating costs for delayed coker operating modes
- Flexicoking feedstream yields for the operating modes available to the fluid coker.

"Coking Process Reflects Trends," *Oil and Gas Journal*, April 19, 1983

- Refinery intermediate process streams, capacity factor, purchased natural gas, electricity, steam, consumption and variable operating costs, for delayed coker operating modes

The Impact of SOx Emissions Control on the Petroleum Refining Industry, Arthur D. Little, 1975.

- Refinery intermediate process streams, capacity factor, purchased natural gas, electricity, steam, consumption and variable operating costs, for delayed coker operating modes
- Refinery intermediate process streams, capacity factor, purchased natural gas, electricity, steam, consumption and variable operating costs, for FCC gasoline fractionation
- Refinery intermediate process streams, capacity factor, purchased natural gas, electricity, steam, consumption and variable operating costs, for alkylation unit operating modes
- Refinery intermediate process streams, capacity factor, purchased natural gas, electricity, steam, consumption and variable operating costs, for lube and wax unit operating modes.

"Dual Gasification Coking Process Option for Synthetic Gas Production," *Oil and Gas Journal*, May 17, 1982.

- Refinery intermediate process streams, capacity factor, purchased natural gas, electricity, steam, consumption and variable operating costs, for the operating modes available to the fluid coker

Hydrocrack Heavier Feeds, Gulf Publishing Co., 1969

- Refinery intermediate process streams, capacity factor, purchased natural gas, electricity, steam, consumption and variable operating costs, sulfur plant feed coefficient, and severity of hydrocracker operating mode for hydrocracker operating mode

"Changes Keep HF Alkylation Up-to-Date," *Oil and Gas Journal*, February 11, 1974.

- Refinery intermediate process streams, capacity factor, purchased natural gas, electricity, steam, consumption and variable operating costs, for alkylation unit operating modes

Nelson Indices

- Conversions of costs to 1982 dollars

"Penex Unit Peps Up ST Gasoline," *Oil and Gas Journal*, October 1970.

- Refinery intermediate process streams, capacity factor, purchased natural gas, electricity, steam, consumption and variable operating costs, for pentane/hexane isomerization unit operating modes

Assessment of Atmospheric Emissions from Petroleum Refining, Radian Corporation, 1980.

- Refinery intermediate process streams, capacity factor, purchased natural gas, electricity, steam, consumption and variable operating costs, sulfur and sulfur plant feed coefficient for sulfur production and hydrogen sulfide recovery operating modes

Oil and Gas Journal, June 1, 1981

- Cost of tetraethyl lead purchased by refineries
- Capacity and capacity utilization bounds for refineries by BOM district and refinery.

Shell Oil Company

- Unit cost, minimum volume to be consumed, maximum volume available, and fixed quantity to be consumed for various crude or other raw material

Crude Oil Price Bulletins, Chevron Oil Company, 1983

- Unit cost, minimum volume to be consumed, maximum volume available, and fixed quantity to be consumed for various crude or other raw material

Platt's Oil Price Handbook, 1983.

- Unit cost, minimum volume to be consumed, maximum volume available, and fixed quantity to be consumed for various crude or other raw material

Platt's Oilgram, January 2, 1985

- Revenues per unit or prices at refinery rate (wholesale) for:
  - leaded motor gasoline
  - premium unleaded gasoline
  - unleaded motor gasoline
  - aviation gasoline
  - naphtha to PC (less than 400 degrees)
  - special naphtha
  - aromatics
  - distillate fuel
  - residual fuel oil
  - lubes and waxes
  - asphalt and road oil
  - coke marketable low sulfur
  - coke marketable high sulfur
  - sulfur
  - still gas for OT uses
  - still gas for petrochemical
  - ethane
  - propane fuel
  - isobutane
  - normal butane.
- Maximum or upper bound on production for:
  - leaded motor gasoline
  - premium unleaded gasoline
  - unleaded motor gasoline
  - aviation gasoline
  - naphtha to PC (less than 400 degrees)
  - special naphtha
  - aromatics
  - distillate fuel
  - residual fuel oil
  - lubes and waxes
  - asphalt and road oil
  - coke marketable low sulfur
  - coke marketable high sulfur
  - sulfur
  - still gas for OT uses
  - still gas for petrochemical
  - ethane
  - propane fuel
  - isobutane
  - normal butane.
- Minimum or lower bound on production for:
  - leaded motor gasoline
  - premium unleaded gasoline
  - unleaded motor gasoline
  - aviation gasoline
  - naphtha to PC (less than 400 degrees)
  - special naphtha
  - aromatics
  - distillate fuel
  - residual fuel oil
  - lubes and waxes
  - asphalt and road oil
  - coke marketable low sulfur
  - coke marketable high sulfur
  - sulfur
  - still gas for OT uses
  - still gas for petrochemical
  - ethane
  - propane fuel
  - isobutane
  - normal butane.

Bureau of Mines Refining Districts

- Geographic districts employed

Oil and Gas Journal, July 15, 1985

- Gas plant capacity constraints by model districts

Pipeline Rates on Crude Petroleum Oil, Marcova, Inc., 1983.

- Individual pipeline links, originating district, destination district, rate used in model, and actual rates for crude oil pipelines
- Individual pipeline links, originating district, destination district, rate used in model, and actual rates for products and gas liquids

Petroleum Storage and Transportation Capabilities - Petroleum Pipeline, Volume III, National Petroleum Council, December 1979.

- Crude oil pipeline capacities by pipeline links, originating district, destination district, and basis for capacity estimate
- Products pipeline capacities by pipeline links, originating district, destination district, and basis for capacity estimate
- Combination crude and products pipeline capacities by pipeline, originating district, destination district, and basis for capacity estimate
- Combination crude and LPG pipeline capacities by pipeline links, originating district, destination district, and basis for capacity estimate.

American Tanker Rate Schedule.

- Water transportation costs by crude or product type, originating district, and destination district

Producer Price Indices, 1982. U.S. Department of Labor.

- Producer price indices for rail and truck transportation costs.

DOE Data Input Sources:
Forms and Publications:

Form EIA-814, "Monthly Imports Report."

- Crude quality averages
- Refined product imports by product and district.

Form EIA-820, "Annual Refinery Report."

- Crude oil
- Distillate fuel oil
- Residual fuel oil
- Liquified petroleum gas
- Natural gas
- Still gas
- Marketable coke
- Catalyst coke
- Coal
- Purchased electricity
- Purchased steam
- Hydrogen
- Other fuels.

Energy Information Administration, *Cost and Quality of Fuels for Electric Utility Plants*, DOE/EIA-0191, (Washington, DC).

- Residual fuel oil sulfur content

Energy Information Administration, *Weekly Petroleum Status Report*, DOE/EIA-0208, (Washington, DC).

- Unit cost, minimum volume to be consumed, maximum volume available, and fixed quantity to be consumed for various crude or other raw material

U.S. Department of Energy, Bartlesville Energy Technology Center, *Motor Gasolines*, DOE/BETC/PPS-82/3,83/11.

- Research octane for each type of gasoline
- Motor octane for each type of gasoline
- Road octane for each type of gasoline
- Vapor pressure for each type of gasoline
- Degrees Fahrenheit at percentage boiled off (50, 70, and 90 percent) for each type of gasoline.

Energy Information Administration, *Monthly Energy Review*, DOE/EIA-0035, (Washington, DC., Monthly).

- Cost of natural gas, electricity, and steam purchased by refineries
- Unit cost, minimum volume to be consumed, maximum volume available, and fixed quantity to be consumed for various crude or other raw material.

Energy Information Administration, *Petroleum Supply Annual*, DOE/EIA-0340, (Washington, DC, annually).

- Refined product production for each BOM district and Total U.S. for:
  - gasoline (leaded)
  - gasoline (premium unleaded)
  - gasoline (regular unleaded)
  - gasoline (unleaded total)
  - aviation gas
  - naphtha to PC (less than 400 degrees)
  - special naphtha
  - aromatics
  - jet fuel B
  - jet fuel A
  - kerosene
  - distillate fuel
  - residual fuel
  - lubes and waxes
  - asphalt and road oil
  - coke marketable
  - coke catalyst
  - sulfur
  - still gas

- ethane
- propylene
- propane fuel
- isobutane
- butylene
- butane
- petroleum coke
- total refined product production

- Domestic crude oil refinery input for various crude oil types by BOM district
- Foreign crude oil refinery input for various crude oil types by BOM district
- Refinery input of NGL and unfinished oil by BOM district
- Capacity and capacity utilization bounds for refineries by BOM district and refinery.

Energy Information Administration, *Petroleum Marketing Monthly*, DOE/EIA-0380, (Washington, DC, monthly).

- Revenues per unit or prices at refinery rate (wholesale) for:
  - gasoline (leaded)
  - gasoline (premium unleaded)
  - gasoline (regular unleaded)
  - gasoline (unleaded total)
  - aviation gas
  - naphtha to PC (less than 400 degrees)
  - special naphtha
  - aromatics
  - jet fuel B
  - jet fuel A
  - kerosene
  - distillate fuel
  - residual fuel
  - lubes and waxes
  - asphalt and road oil
  - coke marketable
  - coke catalyst
  - sulfur
  - still gas
  - ethane
  - propylene
  - propane fuel
  - isobutane
  - butylene
  - butane
  - petroleum coke
  - total refined product production.
- Maximum or upper bound production for:
  - gasoline (leaded)
  - gasoline (premium unleaded)
  - gasoline (regular unleaded)
  - gasoline (unleaded total)
  - aviation gas
  - naphtha to PC (less than 400 degrees)
  - special naphtha
  - aromatics
  - jet fuel B
  - jet fuel A
  - kerosene
  - distillate fuel
  - residual fuel
  - lubes and waxes
  - asphalt and roal oil
  - coke marketable
  - coke catalyst
  - sulfur
  - still gas
  - ethane
  - propylene
  - propane fuel
  - isobutane
  - butylene
  - butane
  - petroleum coke
  - total refined product production.
- Minimum or lower bound on production for:
  - gasoline (leaded)
  - gasoline (premium unleaded)
  - gasoline (regular unleaded)
  - gasoline (unleaded total)
  - aviation gas
  - naphtha to PC (less than 400 degrees)
  - special naphtha
  - aromatics
  - jet fuel B

- jet fuel A
- kerosene
- distillate fuel
- residual fuel
- lubes and waxes
- asphalt and roal oil
- coke marketable
- coke catalyst
- sulfur
- still gas
- ethane
- propylene
- propane fuel
- isobutane
- butylene
- butane
- petroleum coke
- total refined product production

- Regular to premium gasoline grade production ratio
- Regular to unleaded gasoline grade production ratio
- Fixed or equivalency production for:
  - aromatics
  - sulfur
  - isobutane
  - normal butane.

Models and Other:

Integrated Petroleum Supply Reporting System, Energy Information Administration.

- Natural gas liquids imports by product and district
- NGL and refined product exports by product and district

Demand Analysis System (DAS), Energy Information Administration,

- Price elasticities.

General Output Descriptions: Both the RYM and the ORAD modules produce a series of output reports. RYM reports include: several economic summaries (raw materials costs and volumes, products costs and volumes, and process unit costs and utilization), accounting summaries products produced and revenues gained, and raw materials consumed and associated costs by refinery district), a summary of cutpoint adjustments and miscellaneous transfers, summaries of distillate blending activities (distillate and fuel oil specifications obtained), recipe products summary, material balance summaries by district, raw material production, summaries, petrochemical feedstocks and LPG composition report, a processing constraints summary for refineries and gas plants, distribution constraints summaries, cost summaries, an inventory utilization report, a summary of imports, and distribution summaries by transportation mode.

Computing Environment:

- **Hardware Used:** IBM 3084QX
- **Language Used:** OMNI, MPS-III
- **Core Requirement:** 800K bytes of memory
- **Estimated Cost to Run:** RYM: 31 CPU seconds; ORAD: 26-40 CPU seconds
- **Special Features:** None.

Independent Reviews Conducted: None.

Status of Evaluation Efforts by Sponsor: 1982 REMS verification tests by Decision Analysis Corporation and Sobotka & Company, Inc. (Available from the model manager.)

Reserves and Deliverability Analysis FORTRAN Louisiana (RDAF)

Abstract: The model allows rapid calculation of future gas deliverability. The pressure decline equation and the back-pressure equation are used in combination in the program. All pressures utilized in the calculations are bottom-hole pressures, which may be either calculated or measured. Bottom-hole static and flowing pressure calculations are accomplished by use of numerical means.

Type: Auxiliary

Last Model Update: December 1986.

Part of Another Model? No.

Model Interfaces: RDAFLA85 computations are based upon back-pressure tests, reservoir data, and initial gas in place. The first item is obtained from *Dwight's Energydata*, Inc., tapes. The initial gas in place is based on data in Form EIA-23.

Sponsor:

Office: Oil and Gas

Division: Reserves and Natural Gas

Branch: Data Quality and Support, Dallas Field Office

Model Contact: James N. Hicks

Telephone: 214 767-2200

Documentation: Formal documentation of RDAFLA is available in the Energy Information Administration's *Computerized Deliverability Calculations for Non-Associated Gas Reservoirs* by J.N. Hicks, published in 1978. This publication is available from the National Technical Information Service, Department of Commerce, 5285 Port Royal Road, Springfield, VA 22161.

Archive Media and Installation Manual(s): An archive tape of RDAFLA containing machine-readable copies of the model, sample job control language, sample data, and sample output along with instructions for operation is also available from the National Technical Information Service.

Purpose: RDAFLA is used by the Energy Information Administration to calculate gas-well gas deliverability and flow capacity. These calculations are done for reservoirs or fields and then aggregated for the State of Louisiana. RDAFLA can be used by those in government, industry, and the academic community to assess the long-range supply of natural gas fields. This model, prior to the most recent modification, was used to calculate the deliverability and flow capacity for large gas fields in four States, as well as in the Federal Offshore Areas of Louisiana and Texas. This resulted in four EIA publications.

Energy System Described by Model: RDAFLA is an auxiliary model that predicts the natural gas deliverability and flow capacity. Proposed takes are given to the model at the field level to produce 20-year deliverability schedules for each field. The main input parameters are initial gas in place and back-pressure test data.

Coverage:

- **Geographic:** Restricted to gas fields in Louisiana.
- **Time Unit/Frequency:** The model produces a deliverability schedule for 20 years (1987 through 2006) into the future, on a field basis.
- **Product(s):** Natural gas
- **Economic Sector(s):** Gas fields in Louisiana.

Modeling Features:

- **Model Structure:** The program consists of mathematical equations linking initial gas in place, cumulative gas production, reservoir pressures, flow rates, and other characteristics to deliverability flow rate and deliverability life. The model consists of two basic equations. The first is the pressure decline equation, which is used to describe the behavior of the static reservoir pressure as a function of cumulative production. The second, which is the back-pressure equation for the representative well in the reservoir, is used to calculate the rate of gas production for the representative well.
- **Modeling Technique:** The static and flowing bottom-hole pressures were calculated by two techniques developed by Cullender and Smith. A function subprogram was written for each technique. Gas deviation factors were obtained by Sarem's technique as modified for reduced pressures. A subroutine was written for obtaining gas deviation factors. The function subprogram for calculating the bottom-hole pressures call for the gas deviation factor subroutine numerous times.
- **Special Features:** RDAFLA incorporates all reservoir and well test data that are necessary to conduct a deliverability study. A special feature of the model is that a proposed take is inserted to obtain a deliverability schedule.

Non-DOE Input Sources:

- *Dwight's Energydata*, Inc., tape, Richardson, TX, 1985.

  Well Data

  - Gas specific gravity
  - Either static bottom-hole or static tubing pressure, psia
  - Either flowing bottom-hole or flowing tubing pressure, psia
  - Gas flow rate, thousand cubic feet per day
  - Back-pressure curve slope
  - Bottom-hole temperature, degrees Rankine
  - Wellhead flowing temperature, degrees Rankine
  - Depth, feet

  Reservoir Data

  - Initial gas in place, million cubic feet
  - Cumulative gas production at specified date, million cubic feet
  - Mole fraction of carbon dioxide
  - Mole fraction of nitrogen
  - Stabilization factor
  - Shrinkage factor.

DOE Data Input Sources:
Forms and Publications:

- Form EIA-23, "Annual Survey of Domestic Oil and Gas Reserve," 1984.

Well Data

- Gas specific gravity
- Either static bottom-hole or static tubing pressure, psia
- Either flowing bottom-hole or flowing tubing pressure, psia
- Gas flow rate, thousand cubic feet per day
- Back-pressure curve slope
- Bottom-hole temperature, degrees Rankine
- Wellhead flowing temperature, degrees Rankine
- Depth, feet

Reservoir Data

- Initial gas in place, million cubic feet
- Cumulative gas production at specified date, million cubic feet
- Mole fraction of carbon dioxide
- Mole fraction of nitrogen
- Stabilization factor
- Shrinkage factor

General Output Descriptions: The deliverability program produces two tables. The first table shows the production history. The second table presents deliverability and flow capacity for 20 years (1987 through 2006). All data are then summed by area. Data items are shown as follows:

Table 1

- Number of production wells
- Yearly production
- Cumulative production

Table 2

- Number of producing wells
- Annual capability
- Annual production
- Annual production as percent of capability
- Number of fields
- Fields producing at 100 percent flow capacity
- Fields producing below 100 percent flow capacity
- Cumulative production.

Computing Environment:

- **Hardware Used:** IBM 3084QX
- **Language Used:** FORTRAN
- **Core Requirement:** 300K
- **Estimated Cost to Run:** 6 minutes
- **Special Features:** None.

Independent Reviews Conducted: None.

Status of Evaluation Efforts by Sponsor: None.

Resource Allocation and Mine Costing Model (RAMC)

Abstract: RAMC produces supply-price relationships for 30 coal types (further distinguished between surface and deep mines) and 32 producing regions based on the 1987 EIA Demonstrated Reserve Base, engineering estimates of mining costs for various surface and underground mines, and region-specific and coal-type-specific cost elements. This model serves as a major component of the Intermediate Future Forecasting System (IFFS), the National Coal Model (NCM), the International Coal Trade Model (ICTM), and the Coal Supply and Transportation Model (CSTM).

Type: Basic

Last Model Update: February 1989.

Part of Another Model? IFFS, NCM, ICTM, and CSTM.

Model Interfaces: CSTM, NCM, ICTM, and IFFS.

Sponsor:

Office:	Coal, Nuclear, Electric and Alternate Fuels
Division:	Coal
Branch:	Data Analysis and Forecasting, EI-522
Model Contact:	B.D. Hong
Telephone:	586-6532

Documentation:

- Energy Information Administration, *Documentation of the Resource Allocation and Mine Costing Model*, DOE/EIA-M021, (Washington, DC, May 1987).
- Energy Information Administration, *Documentation of the Inputs to the Resource Allocation and Mine Costing (RAMC) Model*, DOE/EIA-M024, (Washington, DC, June 1987).
- Energy Information Administration, *RAMC Surface Mining Cost Equations Development*, DOE/EIA-0432, (Washington, DC, September 1983).
- Energy Information Administration, *RAMC Underground Mining Cost Equations Development*, DOE/EIA-0433, (Washington, DC, September 1983).
- Energy Information Administration, *Documentation of the Reserve Related Data Inputs to the Resource Allocation and Mine Costing Model*, DOE/NBB-0026, (Washington, DC, September 1982).
- Energy Information Administration, *Documentation of the Resource Allocation and Mine Costing (RAMC) Model*, DOE/NBB-0020, (Washington, DC, September 1982).
- *Reclamation Cost Inputs for the Resource Allocation and Mine Costing Model*, Science Applications International Corporation, November 1984.
- *Coal Preparation*, Science Applications International Corporation, June 1984.

Previous Documentation:

- *Coal and Electric Utilities Model Documentation*, ICF, Incorporated, May 1980.

Archive Media and Installation Manual(s):

- RAMC79 - *Annual Report to Congress 1979*
- RAMC80 - *Annual Report to Congress 1980*
- RAMC81 - *Annual Report to Congress 1981*
- RAMC82 - *Annual Energy Outlook 1982*
- RAMC82A - *Clean Air Act Study*
- RAMC982 - Existing documentation
- RAMC83 - *Annual Energy Outlook 1983*
- RAMC84 - *Annual Energy Outlook 1984*
- RAMC85 - *Annual Energy Outlook 1985*
- RAMC86 - *Annual Energy Outlook 1986*
- RAMC87 - *Annual Energy Outlook 1987*
- RAMC88 - *Annual Outlook for U.S. Coal 1988*
- RAMC89 - *Annual Outlook for U.S. Coal 1989*.

Purpose: The RAMC is used to develop coal supply curves for EIA's coal supply models. It can be used to analyze the impact of changes in coal supply or costs due to changes in taxes, production and preparation costs, productivity, and other supply-related costs.

Energy System Described by Model: Potential coal supply at various minemouth costs.

Coverage:

- **Geographic:** Supply curves for 32 coal-producing regions
- **Time Unit/Frequency:** 1987 through 2000
- **Product(s):** 30 coal types, underground and surface
- **Economic Sector(s):** Coal Mining.

Modeling Features:

- **Model Structure:** RAMC employs a structural approach using engineering and economic algorithms
- **Modeling Technique:** Two steps: (1) Calculates reserves and (2) determines minimum acceptable selling price
- **Special Features:** None.

Non-DOE Input Sources:
Consolidated Omnibus Budget Reconciliation Act of 1986

- Black lung payments - surface mines
- Black lung payments - deep mines

Demand for Western Coal and Its Sensitivity to Key Uncertainties, ICF, Incorporated

- Abandoned mine tax - lignite
- Abandoned mine tax - surface
- Abandoned mine tax - deep

Summary of Coal Severance and Production Taxes, National Coal Association

- Severance tax (percent of sales)
- Severance tax (dollars per ton)

Coal and Electric Utilities Model Documentation, ICF, Incorporated

- Federal royalty - surface
- Federal royalty - underground
- License fee

RAMC Surface Mining Cost Equations Development, Science Applications, International Corporation

- Welfare fund payment (surface) dollars/ton
- Welfare fund payment (surface) dollars/man-day

RAMC Underground Mining Cost Equations Development, Science Applications, International Corporation

- Welfare fund payment (deep) dollars/ton
- Welfare fund payment (deep) dollars/man day

National Council on Compensation Insurance, State Worker's Compensation Offices and other State Agencies

- Exposure insurance (surface)
- Exposure insurance (deep)

Reclamation Cost Inputs for the RAMC, Science Application, Incorporated

- Reclamation Costs

Internal Revenue Service

- Corporate tax rates

DOE Data Input Sources:
Forms and Publications:

- EIA-7A, " *Coal Production* Report" and EIA-7A(Supp), " *Coal Production* Report (Supplement)"
  - Committed underground reserves
  - Committed surface reserves
  - Seam thickness for underground mines
  - Current production and price.
- *Demonstrated Reserve Base of Coal in the United States on January 1, 1987*; *Demonstrated Reserve Base of Coal in the United States on January 1, 1971*, EIA-7A, EIA--Analytical File
  - Underground reserves by State
  - Surface reserves by State

Models and Other:

- Energy Information Data
  - Coal industry rate of return
  - Model mine cost escalator
  - Utility discount rate
  - Power and supply escalator
  - Labor escalator
  - Capital escalator
  - Curve year
  - Base year
  - Case year
- *Demonstrated Reserve Base of Coal in the United States on January 1, 1971*, (contains data from BOM Information Circulars 8680 and 8693).
  - Bed-county distribution for coal reserves with each State
  - Btu content for bed-county combinations
  - Sulfur content for bed-county combinations
- EIA Analytical File
  - Btu content per bed-county combinations
  - Sulfur content per bed-county combinations
  - County location for a mine
  - Name of seam in which mine is located
  - Mining method by mine
  - Coal type.

General Output Descriptions: Coal supply curves for the Energy Information Administration's coal supply models. RAMC can be used to analyze the impact of changes in coal supply or costs due to various factors.

Computing Environment:

- **Hardware Used:** IBM 3084QX
- **Language Used:** FORTRAN
- **Core Requirement:** 1024K
- **Estimated Cost to Run:** Approximately 47 CPU seconds for one complete set of supply curves
- **Special Features:** None.

Independent Reviews Conducted: Compliance With EIA Model Documentation for Seven Models: William Walmsley and Margaret Harpine, June 15, 1983.

Documentation of the Resource Allocation and Mine Costing (RAMC) Model, Stanley Subaleksi, Independent Expert Reviewer, June 1988.

Status of Evaluation Efforts by Sponsor: None.

Revenue Requirements Modeling System (RRMS)

Abstract: The RRMS is designed to estimate the impacts of various regulatory and economic policy variables on the revenue requirements of individual electric utilities. The model assesses the impact of changes in construction work in progress (CWIP), in rate base policies, capital structures, costs of capital, and demand on total estimated revenue requirements.

Type: Basic

Last Model Update: February 1987.

Part of Another Model? The Single Asset Model (SAM) and the Revenue Requirements Model (RRM) combine to form the Revenue Requirements Modeling System (RRMS).

Model Interfaces: Financial Information Analysis System (FIAS).

Sponsor:

Office: Coal, Nuclear, Electric and Alternate Fuels

Division: Electric Power

Branch: Data Analysis and Forecasting, EI-542

Model Contact: John Conti

Telephone: 586-9856

Documentation: *Revenue Requirements Modeling System Documentation* (RRMS), International Energy Associates, Limited, DOE/PE/70403, March 1986.

Archive Media and Installation Manual(s): RRM85 - for the 1985 *Annual Energy Outlook*

RRM85A - Archived for "The President's Tax Proposal"

RRMS86 - for the *Investor-Owned Electric Utilities Study.*

Purpose: The RRMS estimates the cost of service of the electric operations of investor-owned electric utilities utilizing a simplified regulatory accounting framework. The RRMS specifically addresses the following components of revenue requirements; return on investment, depreciation expense, fuel expenses, nonfuel operations and maintenance expenses, and other (gross receipts) taxes.

Energy System Described by Model: RRMS produces electric utility financial information.

Coverage:

- **Geographic:** Single utility
- **Time Unit/Frequency:** Annual
- **Product(s):** Pro forma financial statments
- **Economic Sector(s):** Electric utilities.

Modeling Features:

- **Model Structure:** The methodology used in the RRMS consists of three basis steps. First, a generalized cost-of-service framework is constructed. Second, an external data file interface provides the regulatory and economic environment to be studied by assigning values to key model parameters and variables. Finally, the user is able to produce standard preformatted reports designed to highlight the impacts of the assumed change in regulatory or economic environments.
- **Modeling Technique:** RRMS is a deterministic model that estimates certain financial relationships based on a simplified accounting framework represented by a series of linear equations.
- **Special Features:** RRMS uses either a SAS data set or a sequential card image file for input data. In addition, the current version of RRMS allows the user to assess the likely impacts of various provisions of the Tax Reform Act of 1986.

Non-DOE Input Sources:
User-defined or Estimated.

Standard and Poor's Utility COMPUSTAT II Data Base

DOE Data Input Sources:
Forms and Publications:

- FERC Form-1, "Annual Report of Major Electric Utilities, Licensees, and Others"
  - Utility plant in service aggregated by type
  - Construction work in progress
  - Accumulated provisions for depreciation, amortization, and depletion
  - Total capitalization by type
  - Taxes (Federal, State, general, other)
  - Embedded cost of capital (debt and preferred)
  - Electric revenues
  - Deferred taxes (income and investment tax credits)

Models and Other:

- None.

General Output Descriptions: The RRMS generates pro forma financial statements for evaluation of changes in electric utility policy and regulation. These data are used to produce a series of reports on a base case and a hypothetical case to summarize key financial output variables.

Computing Environment:

- **Hardware Used:** IBM 3084QX
- **Language Used:** Statistical Analysis System (SAS), and PL1
- **Core Requirement:** 2000K
- **Estimated Cost to Run:** Estimated typical execution time of less than 29 CPU seconds for com-

pany. Printed output for one company requires approximately 3K.

- **Special Features:** None.

Independent Reviews Conducted: None.

Status of Evaluation Efforts by Sponsor: On-going.

Short-Term Coal Analysis System (SCOAL)

Abstract: SCOAL projects domestic coal production, imports, consumption, and exports six to eight quarters into the future, based on assumed trajectories of coal prices relative to prices of other fuels, electric generation, industry activity, and weather variables. All markets are defined at the national level except bituminous coal and lignite production, which are defined at the State level.

Type: Basic

Last Model Update: January 1989.

Part of Another Model? No

Model Interfaces: SCOAL bases its projections on assumed relative energy price trajectories, domestic and foreign steel industry activity, domestic coal-based generation capacity and utilization, other industry activity levels, and heating- degree days. The assumptions may be drawn from: - Data Resources, Inc., macroeconomic forecasts (or similar sources, e.g., Chase Econometrics) - Forecasts from the *Short-Term Energy Outlook* - Forecasts from the *Annual Report to Congress* or other user specified sources. SCOAL's coal production forecasts are used by the Short-Term Integrated Forecasting System and are published in the *Short-Term Energy Outlook* .

Sponsor:

Office:	Coal, Nuclear, Electric and Alternate Fuels
Division:	Coal
Branch:	Data Analysis and Forecasting, EI-522
Model Contact:	Frederick Freme
Telephone:	586-6853

Documentation:

- Energy Information Administration, *Short-Term Coal Analysis System (SCOAL) Model Documentation Abstract*, DOE/EIA-0394, (EX), (Washington, DC, April 1983).
- Energy Information Administration, *Short-Term Coal Analysis System (SCOAL) Model Documentation*, Volume 1, Model Overview, DOE/EIA-0394, (Washington, DC, April 1983).
- Energy Information Administration, *Short-Term Coal Analysis System (SCOAL) Model Documentation*, Volume 2, Model Description, DOE/EIA-0394, (Washington, DC, April 1983).
- Energy Information Administration, *Short-Term Coal Analysis System (SCOAL) Model Documentation*, Volume 3, Data Documentation, DOE/EIA-0394, (Washington, DC, September 1984).

Previous Documentation: Update and Documentation of the Short-Term Demand and Supply Model, JWK International Corp., September 1982.

Archive Media and Installation Manual(s):

- SCOAL - for the existing documentation
- SCOAL82 - for the *Short-Term Energy Outlook* (*STEO*) 4th Quarter 1982
- SCOAL83A - *STEO* 1st Quarter 1983
- SCOAL83B - *STEO* 2nd Quarter 1983
- SCOAL83C - *STEO* 3rd Quarter 1983
- SCOAL83D - *STEO* 4th Quarter 1983
- SCOAL84A - *STEO* 1st Quarter 1984
- SCOAL84B - *STEO* 2nd Quarter 1984
- SCOAL84C - *STEO* 3rd Quarter 1984
- SCOAL84D - *STEO* 4th Quarter 1984
- SCOAL85A - *STEO* 1st Quarter 1985
- SCOAL85B - *STEO* 2nd Quarter 1985
- SCOAL85C - *STEO* 3rd Quarter 1985
- SCOAL85D - *STEO* 4th Quarter 1985
- SCOAL86A - *STEO* 1st Quarter 1986
- SCOAL86B - *STEO* 2nd Quarter 1986
- SCOAL86C - *STEO* 3rd Quarter 1986
- SCOAL86D - *STEO* 4th Quarter 1986
- SCOAL87A - *STEO* 1st Quarter 1987
- SCOAL87B - *STEO* 2nd Quarter 1987
- SCOAL87C - *STEO* 3rd Quarter 1987
- SCOAL87D - *STEO* 4th Quarter 1987
- SCOAL88A - *STEO* 1st Quarter 1988
- SCOAL88B - *STEO* 2nd Quarter 1988
- SCOAL88C - *STEO* 3rd Quarter 1988.

Purpose: SCOAL is used to support preparation of short-term projections of bituminous coal and lignite production at the State level, and anthracite production, domestic imports of coal, and domestic and export demand at the National level.

Energy System Described by Model: Short-term coal demand at the National level and supply at the National and State levels.

Coverage:

- **Geographic:** United States and 26 coal-producing States
- **Time Unit/Frequency:** Quarterly
- **Product(s):** Coal
- **Economic Sector(s):** International sector, coke plants, electric utilities, retail and general industries.

Modeling Features:

- **Model Structure:** Nine separate steps: seven steps for coal-consuming sectors and two for coal production.
- **Modeling Technique:** Ordinary least squares regressions.
- **Special Features:** SCOAL incorporates the primary economic, engineering, climatic, and institutional factors that are assumed to determine quarterly domestic coal market balances. Its inclusion of relative energy price information on both the supply and demand sides makes it unique among short-term energy market models.

Non-DOE Input Sources:
Bureau of Mines, *Mineral Industry Yearbook*, various issues

- Coal production, by State
- Distribution of production, by State
- Distribution of production, by region
- U.S. quarterly anthracite production.

U.S. Department of Commerce, Bureau of the Census, "Monthly Report IM-145"

- Coal imports
- Coke imports.

U.S. Department of Commerce, Bureau of the Census, "Monthly Report EM-522"

- Coal exports
- Coke exports
- Metallurgical coal exports to Canada, the Far East, and the rest-of-the-world
- Steam coal and anthracite exports to Canada, the Far East, and the rest-of-the-world

Data Resources, Inc. (DRI) data base

- Index of primary metals production for Canada, not seasonally adjusted
- Crude steel production, Japan
- Crude steel production, Italy
- Crude steel production, France
- Ratio of the wholesale price index for all fuels to the wholesale price index for coal, not seasonally adjusted
- Heating degree-days for 12 States weighted by other industry consumption shares
- Heating degree-days for 14 States weighted by population shares
- Value-added index, SIC-28, Chemicals and Allied Products, not seasonally adjusted
- Value-added index, SIC-28, Chemicals and Allied Products, seasonally adjusted
- U.S. pig iron production
- Value-added index, SIC-331, Blast Furnaces, Steel Works, and Rolling and Finishing Mills, not seasonally adjusted
- Value-added index, SIC-331, Blast Furnaces, Steel Works, and Rolling and Finishing Mills, seasonally adjusted.

DOE Data Input Sources:
Forms and Publications:

- Energy Information Administration, Form EIA-2, "Monthly Coal Report - Retail Dealers and Upper Lake Docks," *Quarterly Coal Report*, DOE/EIA-0121, and Form EIA-6, "*Coal Distribution* Report," (Washington, DC)
  - Residential/commercial coal consumption
  - Other industry coal consumption
  - Nonelectric utility coal stocks
- Energy Information Administration, Form EIA-3, "Quarterly Coal Consumption Report - Manufacturing Plants" and *Quarterly Coal Report*, DOE/EIA-0121, (Washington, DC)
  - Other industry coal consumption
  - Other industry coal stocks
- Energy Information Administration, Form EIA-5, "*Coke Plant Report*" and *Quarterly Coal Report*, DOE/EIA-0121, (Washington, DC)
  - Coking coal consumption
  - Coking coal stocks
  - Coke production

- Coke stocks
- Coke consumption

- Form EIA-7, "Bituminous Coal and Lignite Production and Mine Operation" and Form EIA-7A, "*Coal Production* Report"
  - Coal price, Appalachia
  - Coal price, Interior
  - Coal price, National
  - Coal price, Western Region
- FERC-423, "Monthly Report of Cost and Quality of Fuels for Electric Plants"
  - Oil price, Appalachia
  - Oil price, Interior
  - Oil price, National
  - Natural gas price, Western Region
  - Total electric utility coal consumption
  - Total electric utility generation
  - Coal-based electric generation
  - Coal-based generation capacity
  - Utility coal stocks
- EIA-860, "Annual Electric Generator Report"
  - Coal-based generating capacity
- Energy Information Administration, *Monthly Energy Review*, DOE/EIA-0035 (Washington, DC)
  - F.A.S. steam coal export price to Canada, the Far East and the rest-of-the-world
  - Oil export price per barrel from Saudi Arabia and Indonesia to Canada, the Far East and the rest-of-the-world
- Energy Information Administration, *Quarterly Coal Report*, DOE/EIA-0121, and *Weekly Coal Report*, DOE/EIA-0218 (Washington, DC)
  - Coal production by State
  - Distribution of production, by region
  - U.S. quarterly anthracite production.

Models and Other:

- None.

General Output Descriptions: SCOAL is used by the Energy Information Administration's (EIA) Data Analysis and Forecasting Branch (DAFB) on a continuing basis to prepare projections of quarterly domestic coal market balances from the present over a six-to-eight-quarter horizon. EIA's coal production forecasts (National and State level) are developed using SCOAL. Forecasts of coal production at the national level appear in EIA's *Short-Term Energy Outlook* (*STEO*) and at the State level in the *Quarterly Coal Report*. SCOAL is also available to other parts of the U.S. Department of Energy, other agencies of the Federal Government, and to public and private institutions for analyses of short-term coal market behavior.

Computing Environment:

- **Hardware Used:** IBM 3084QX
- **Language Used:** Time Series Processor (TSP) and Matrix Arithmetic Programming System (MAPS)
- **Core Requirement:** 1999K
- **Estimated Cost to Run:** Approximately 110 CPU seconds to run all SCOAL programs once
- **Special Features:** None.

Independent Reviews Conducted: Compliance With EIA Model Documentation for Seven Models: William Walmsley and Margaret Harpine, June 15, 1983.

Status of Evaluation Efforts by Sponsor: Most recent evaluation completed September 1984.

Short-Term Integrated Forecasting System (STIFS)

Abstract: STIFS (complete system) is the system used for producing the forecasts in the *Short-Term Energy Outlook* . It consists of the Unified Demand and Price Analysis System (UDAPAS), and the Short-Term Integrating Model (STIM). The forecasts of energy prices and energy product consumption together with data and forecasts from other sources, are integrated by STIM into balances for major petroleum products, total petroleum, natural gas, coal, electricity, and total energy.

Type: Basic

Last Model Update: January 1989.

Part of Another Model? No.

Model Interfaces: Demand and price models from STIFS integrating model.

Sponsor:

Office:	Energy Markets and End Use
Division:	Energy Analysis and Forecasting
Branch:	Supply Analysis and Integration, EI-622

Model Contacts:

Supply Paul Kondis (586-1469))

Demand David Costello (586-1468)

Documentation: Energy Information Administration, 1988 *Model Documentation Report: Short-Term Integrated Forecasting System*, DOE/EIA-M030(Washington, DC).

Archive Media and Installation Manual(s):

- STIFSF82 - *STEO* February 1982
- STIFSA82 - *STEO* August 1982
- STIFSF83 - *STEO* February 1983
- STIFSA83 - *STEO* August 1983
- STIFSF84 - *STEO* February 1984
- STIFSA84 - *STEO* August 1984
- STIFS185 - *STEO* January 1985
- STIFS785 - *STEO* July 1985
- STIFS186 - *STEO* January 1986
- STIFS786 - *STEO* July 1986
- STIFS187 - *STEO* January 1987
- STIFS787 - *STEO* July 1987
- STIFS188 - *STEO* January 1988
- STIFS788 - *STEO* July 1988
- STIFS189 - *STEO* January 1989.

Purpose: STIFS projects demand, production, imports, and stock changes for all major fuels.

Energy System Described by Model: U.S. energy production, consumption, imports, exports, stocks, and prices.

Coverage:

- **Geographic:** National
- **Time Unit/Frequency:** Monthly; published results show only quarterly statistics including forecasts for up to eight quarters
- **Product(s):** Motor gasoline, distillate fuel oil, residual fuel oil, jet fuel, liquefied petroleum gases, other petroleum products, natural gas, coal, electricity, nuclear energy, hydroelectric power and gross and net energy consumption
- **Economic Sector(s):** Total United States, with explicit treatment given to electric utility and nonutility consumption, refinery fuel use, imports, and exports.

Modeling Features:

- **Model Structure:** Accounting and algorithmic to balance supply and demand
- **Modeling Technique:** Includes accounting, algorithmic, econometric, and time trending techniques
- **Special Features:** STIFS is updated every quarter to produce new demand forecasts for the *Short-Term Energy Outlook*.

Non-DOE Input Sources:
See underlying subsystems UDAPAS and STIM.

DOE Data Input Sources:
Forms and Publications:

- See underlying subsystems UDAPAS and STIM.
- EIA-860, "Annual Electric Generator Report"
  - monthly coal-fired electricity generating capacity in place.

Models and Other:

- See underlying subsystems UDAPAS and STIM.

General Output Descriptions: Monthly energy demand and prices of major energy products are forecast up to eight quarters into the future and are produced on a quarterly basis.

Computing Environment:

- **Hardware Used:** IBM 3084QX
- **Language Used:** SAS
- **Core Requirement:** 1500K
- **Estimated Cost to Run:** 120 CPU seconds for demands, and 90 CPU seconds for integration
- **Special Features:** None.

Independent Reviews Conducted: "Price Forecasting in DOE's Short-Term Integrated Forecasting System." Sitzer, S., Paxson, D., and Gamson, N., Energy Economics, Policy, and Management, winter 1982.

Status of Evaluation Efforts by Sponsor: None.

Short-Term Nuclear Annual Power Production Simulation Model (SNAPPS)

Abstract: SNAPPS simulates the operation of the U.S. nuclear power industry on a plant-by-plant basis. Such operations include additions of new generating capacity, shutdowns for refueling and maintenence, and lev-

els of operating performance. SNAPPS forecasts electricity generation (in kilowatthours), by month, year, and on a Department of Energy regional basis. A separate program can be run against the model output to produce projections of nuclear waste fund revenues by month, quarter and year.

Type: Basic

Last Model Update: September 1986.

Part of Another Model? No.

Model Interfaces: None.

Sponsor:

Office: Coal, Nuclear, Electric and Alternate Fuels

Division: Nuclear and Alternate Fuels

Branch: Data Analysis and Forecasting, EI-532

Model Contact: Roger Diedrich

Telephone: 586-9407

Documentation:

- *Short-Term Nuclear Annual Power Production Simulation Documentation*, System Sciences, Inc., November 1984, and Addendum, September 1986.
- *SNAPPS - Short-Term Nuclear Annual Power Production Simulation*, ORNL, CET-001/SNAPPS, August 1981

Archive Media and Installation Manual(s): SNAPPS84 - for the 1984 *Annual Energy Outlook.*

SNAPPS87 - for the 1987 *Annual Energy Outlook.*

Purpose: SNAPPS produces forecasts of electricity generation from nuclear power for the United States by month for up to a 10-year period.

Energy System Described by Model: Nuclear electricity supply.

Coverage:

- **Geographic:** U.S. Department of Energy regions
- **Time Unit/Frequency:** Up to 10 years by month
- **Product(s):** Net or gross generation in billion kWh

  - Nuclear waste fund revenues by month in millions of dollars

- **Economic Sector(s):** Electric utilities.

Modeling Features:

- **Model Structure:** The model consists of code which provides accounting for each nuclear reactor's generation over the projection period.
- **Modeling Technique:** The model develops reactor activity schedules, determining if the reactor is generating power or is in extended shutdown. Individual reactor monthly generation is computed by multiplying the designated capacity (net or gross) times the appropriate (according to reactor type and fuel cycle number) capacity factor times the hours the reactor operates in that month. This value is then multiplied by monthly seasonality factors and annual adjustment factors. The resulting reactor generation values are then cumulated into monthly, annual, and regional totals. The model contains the option of using positive refueling times in lieu of seasonality factors. A separate program accesses the projected generation for each unit and applies the one mill per kilowatthour fee and utility specific payment schedules to produce expected monthly waste fund revenues.
- **Special Features:** SNAPPS allows for individual reactor treatment for capacity, timing, and outages.

Non-DOE Input Sources:
Nuclear Regulatory Commission

- Month, day, year scheduled outages began

Nuclear Regulatory Commission Operating Reactor Reports

- Historical generation
- Planned refueling and maintenance outages

Nuclear Waste Contracts

- Nuclear waste contract number.

DOE Data Input Sources:
Forms and Publications:

- RW-859, "Nuclear Fuel Data"
  - Cycle number
  - Month, day, and year of start of cycle
  - Cycle generation time
  - Cycle capacity factor
  - Cycle full power days
  - Month, day, and year of start of refueling
  - Length of refueling outage
- EIA-759, "Monthly Power Plant Report"
  - Historical nuclear generation

- EIA-860, "Annual Electric Generator Report,"
  - Net summer capability of operating reactors.

Models and Other:

- NFACIL Data Base (maintained by Nuclear and Alternate Fuels Division, Energy Information Administration)
  - Reactor type
  - Reactor name
  - Reactor's gross capacity
  - Estimated net summer capability of reactors under construction
  - DOE region
  - State
  - Month and year of initial criticality
  - Month and year of first electricity
- Nuclear and Alternate Fuels Division Analysis
  - Capacity factor values
  - Full power days
  - Refueling time
  - Monthly capacity factor adjustment (seasonality) factors
  - Annual capacity factor adjustment factors.

General Output Descriptions: SNAPPS yields monthly and annual nuclear electricity generation forecasts for 10 years into the future and monthly and annual average capacity factors.

Computing Environment:

- **Hardware Used:** IBM 3084QX
- **Language Used:** FORTRAN
- **Core Requirement:** 390K
- **Estimated Cost to Run:** 7 CPU seconds
- **Special Features:** None.

Independent Reviews Conducted:

- Independent Expert Review of the Short-term Nuclear Annual Power Production Simulation (SNAPPS), Oak Ridge National Laboratory, October, 25, 1985
- *Short-Term Nuclear Annual Power Production Simulation Model Documentation Review,* (AMS No. G-183.88), Baghelai, Cyrus, Applied Management Sciences, November 20, 1983.

Status of Evaluation Efforts by Sponsor: Evaluation efforts are ongoing.

Stock Module of the Intermediate Future Forecasting System (STOCK)

Abstract: The Stock Module (STOCK) of the Intermediate Future Forecasting System (IFFS) calculates annual net stock withdrawals by fuel. IFFS is an analytical system for projecting the future state of the energy market. The system is based on the economic principle that the production of energy and the demand for it depend on the costs of producing and purchasing the fuels.

The objective of STOCK is to calculate: (1) crude oil and petroleum product stocks; (2) underground storage of natural gas; and (3) secondary coal stocks.

Type: Basic

Last Model Update: December 1988.

Part of Another Model? Yes, STOCK is a module of the Intermediate Future Forecasting System (IFFS).

Model Interfaces: STOCK is a component of IFFS. For convenience of documentation and maintenance, STOCK appears as a distinct module of IFFS. Unlike some other modules of IFFS, it is not executed separately from IFFS for independent analysis.

Sponsor:

Office:	Oil and Gas
Division:	Reserves and Natural Gas
Branch:	Analysis and Forecasting, EI-442
Model Contact:	Susan Shaw
Telephone:	586-4838

Documentation: Energy Information Administration, *Documentation of the Integrating Module and Stock Module of the Intermediate Future Forecasting System,* DOE/EIA-M005, (Washington, DC, June 1987).

Archive Media and Installation Manual(s): See archive information for IFFS.

Purpose: The objective of STOCK is to calculate net stock withdrawals by fuel type.

Energy System Described by Model: STOCK incorporates a system of balancing equations to project annual net storage withdrawals so that a constant day's supply of a given fuel is maintained. Storage withdrawals are projected on an annual basis for the 10 Federal regions, but results are published only at the national level.

Coverage:

- **Geographic:** 10 Federal regions aggregated to the national level.
- **Time Unit/Frequency:** Annually through the year 2010
- **Product(s):** Crude oil, petroleum products, natural gas, and coal.
- **Economic Sector(s):** End-use consumption of fuels.

Modeling Features:

- **Model Structure:** STOCK incorporates a system of balancing equations to project annual net storage withdrawals so that a constant day's supply of a given fuel is maintained.
- **Modeling Technique:** STOCK is the component of IFFS that calculates annual net stock withdrawals by fuel.
- **Special Features:** None.

Non-DOE Input Sources:
None.

DOE Data Input Sources:
Forms and Publications:

Energy Information Administration, *Petroleum Supply Annual*, DOE/EIA-0340; *Monthly Energy Review*, DOE/EIA-0035; *Electric Power Monthly*, DOE/EIA-0226; and *Annual Energy Review*, DOE/EIA-0384, (Washington, DC). These four publications listed as sources for the input variables used in STOCK. However, the variables are not matched to a specific source.

- Historical stock levels

Energy Information Administration, *Short-Term Energy Outlook* , DOE/EIA-0202, (Washington, DC)

- Annual closing stock levels for benchmarking

Models and Other:

- None.

General Output Descriptions: The STOCK module calculates net stock withdrawals for various major fuels which are used as input to the Intermediate Future Forecasting System (IFFS).

Computing Environment:

- **Hardware Used:** IBM 3084QX
- **Language Used:** FORTRAN 77
- **Core Requirement:** 5 megabytes for the IFFS model
- **Estimated Cost to Run:** 1 CPU second
- **Special Features:** None

Independent Reviews Conducted: None.

Status of Evaluation Efforts by Sponsor: None.

Subsystem: Short-Term Integrating Model (STIM)

Abstract: STIM, a subsystem of the Short-Term Integrated Forecasting System, (STIFS) provides a National monthly data base and accounting framework for energy supply, demand, stocks, and conversion processes (refineries and electric utilities). This model balances historical data and forecasts for the entire energy network for up to 2 years in the future.

Type: Subsystem

Last Model Update: Updated quarterly.

Part of Another Model? Yes, this is the integrating model for the complete Short-Term Integrated Forecasting System (STIFS).

Model Interfaces: STIFS subsystem, UDAPAS.

Sponsor:

Office:	Energy Markets and End Use
Division:	Energy Analysis and Forecasting
Branch:	Supply Analysis and Integration, EI-622
Model Contact:	Paul Kondis
Telephone:	586-1469

Documentation: Short Term Integrated Modeling System (referenced in document titles as Short-Term Integrated Forecasting System):

- Energy Information Administration, 1988 *Model Documentation Report: Short-Term Integrated Forecasting System* , DOE/EIA-M030 (Washington, DC, July 1988)
- *Short-Term Integrated Forecasting System (STIFS) Methodology and Model Descriptions*, Logistics Management Institute, December 1979
- *Short-Term Integrated Forecasting System Data Base Description*, Kilkeary, Scott & Associates, Inc., September 1981

- Energy Information Administration, *Model Documentation Report: Short-Term Integrated Forecasting System* , DOE/EIA-M017, (Washington, DC, March 1986).
- *Integrating Model of the Short-Term Integrated Forecasting System, Version II*, Model Description, Kilkeary, Scott & Associates, Inc., October 1986
- *Integrating Model of the Short-Term Integrated Forecasting System, Version II , Software Description*, Kilkeary, Scott & Associates, Inc., October 1986
- *Integrating Model of the Short-Term Integrated Forecasting System, Version II, Operations Manual*, Kilkeary, Scott & Associates, Inc., October 1986

Archive Media and Installation Manual(s): Archived as part of STIFS.

Purpose: STIM projects production, imports, and stock changes for all major fuels by quarter based on results from UDAPAS.

Energy System Described by Model: All major fuels: crude oil and petroleum products, natural gas, coal, and electricity.

Coverage:

- **Geographic:** National
- **Time Unit/Frequency:** Monthly
- **Product(s):** For all major fuels, projection of production, consumption, stocks, and imports
- **Economic Sector(s):** Utility and nonutility.

Modeling Features:

- **Model Structure:** Accounting and algorithmic to balance supply and demand
- **Modeling Technique:** Includes accounting, algorithmic, econometric, and time-trending techniques
- **Special Features:** Allows investigation of the effects of quantitative restrictions on oil imports.

Non-DOE Input Sources:
None.

DOE Data Input Sources:
Forms and Publications:

- Energy Information Administration, *Monthly Energy Review*, DOE/EIA-0035, *Petroleum Supply Monthly*, DOE/EIA-0109, *Electric Power Monthly*, DOE/EIA-0226, and *Quarterly Coal Report*, DOE/EIA-0121. Within the four energy subnetworks, electric utilities, oil, natural gas, and coal and coke, historical data for the following categories are input: for the following categories are input:
  - Primary fuel production
  - Stocks
  - Imports
  - Exports
  - Net imports
  - Flows to and from conversion processes
  - Total supplies of finished products
  - Demands for finished energy products
  - Losses
  - Discrepancies ("Unaccounted for").

Models and Other:

- Energy Information Administration, Dallas Field Office
  - Crude oil production
  - Dry gas production
- Energy Information Administration, Office of Oil and Gas
  - Net imports of dry gas
- Energy Information Administration, Office of Energy Markets and End Use, Demand Analysis and Forecasting Branch
  - Consumption and price projections
- Energy Information Administration, Office of Coal, Nuclear, Electric and Alternate Fuels
  - Coal production and electricity generation by nuclear power and hydroelectric power.

General Output Descriptions: STIM balances historical data and forecasts production imports, and stock changes for all major fuels by quarter for the entire energy network based on results from UDAPAS.

Computing Environment:

- **Hardware Used:** IBM 3084QX
- **Language Used:** SAS
- **Core Requirement:** 1500K
- **Estimated Cost to Run:** 90 CPU seconds
- **Special Features:** None.

Independent Reviews Conducted:

- *Assessment of the Compliance of Short-Term Integrated Forecasting System (STIFS) Methodology and Model Descriptions* , Logistics Management Institute, Washington, DC, 1979
- *Assessment of the Short-Term Integrated Forecasting System Methodology and Model Descriptions*, James A. Edmonds, June 13, 1980, Independent Expert Reviewer

- *Short-Term Integrated Forecasting System Data Base Documentation*, Thomas J. Kneisner, December 11, 1980, Independent Expert Reviewer.

Status of Evaluation Efforts by Sponsor: An Assessment of the Forecast Integration Process of the Short-Term Integrated Forecasting System, Wharton Data Analysis Project, January 1982.

Subsystem: Unified Demand and Price Analysis - Demand (UDAPAS-D)

Abstract: UDAPAS - D, a subsystem of the Short-Term Integrated Forecasting System Demand Model (STIFS), forecasts monthly consumption for major petroleum products, nonutility petroleum consumption, electricity sales and generation, and natural gas and coal demand, at the national level, based on prices, income, and weather.

Type: Subsystem

Last Model Update: Updated quarterly.

Part of Another Model? Yes, a subsystem of the Short-Term Integrated Forecasting System.

Model Interfaces: Data Resources, Inc., (DRI) macro model; Short-Term Integrating Model (STIM), and the Unifed Demand and Price Analysis System: Price Component (UDAPAS - P)

Sponsor:

Office:	Energy Markets and End Use
Division:	Energy Analysis and Forecasting
Branch:	Demand Analysis and Forecasting, EI-621
Model Contact:	David Costello
Telephone:	586-1468

Documentation: Energy Information Administration, Final Unified Demand and Price Analysis Subsystem: Specification, Decision Analysis Corporation, (Washington, DC, September 1988)

Energy Information Administration, Final Convert Demand Model Programs to Modularized Form, Decision Analysis Corporation, (Washington, DC, February 1989)

Energy Information Administration, Unified Demand and Price Analysis System: Report Writer, Decision Analysis Corporation, (Washington, DC, March 1989).

Archive Media and Installation Manual(s): Archived as part of STIFS.

Purpose: UDAPAS - D produces energy demand forecasts in support of the *Short-Term Energy Outlook* published quarterly by EIA.

Energy System Described by Model: UDAPAS - D covers domestic U.S. demands for petroleum, electric utility generation and sales, demand for natural gas by sectors, and demand for coal by all sectors.

Coverage:

- **Geographic:** United States
- **Time Unit/Frequency:** Monthly
- **Product(s):** Motor gasoline, distillate fuel oil, residual fuel oil, jet fuel, LPG, other petroleum, electricity, natural gas, and coal
- **Economic Sector(s):** All major domestic energy markets.

Modeling Features:

- **Model Structure:** Econometric single-equation models
- **Modeling Technique:** Ordinary least squares, Yule-Walker, and other iterative methods
- **Special Features:** UDAPAS - D projects coal, natural gas, and electricity demand by sector

Non-DOE Input Sources:

U. S. Department of Labor, Bureau of Labor Statistics

- Price of gasoline (all grades)
- Producer price index, all commodities, not seasonally adjusted
- Producer price index for petroleum products, deflated by the producer price index for all items
- Consumer price index, all urban, seasonally adjusted

U. S. Department of Commerce, Bureau of Economic Analysis

- Real disposable personal income (1982 dollars)
- Real gross national product (GNP)
- Real investment

U. S. Department of Commerce, Report FT-410, *Commodities by Country*, and Report FT-546, *Commodities by Country*

- Monthly coke exports
- Monthly coke imports

- Monthly coal imports
- Monthly coal exports

U. S. Federal Reserve Board

- Industrial production index, all manufacturing
- Industrial production indices, two-digit SIC level

Traffic Volume Trends, (monthly), Federal Highway Administration

- Monthly total vehicle miles travelled in the United States

National Oceanic and Atmospheric Administration

- Monthly heating degree-days and cooling degree-days. National 1980 population-weighted
- Electricity customer-weighted heating and cooling degree-days
- Gas customer-weighted heating degree-days

Annual Statistical Report, 1980, and *Raw Steel and Pig Iron Production Reports*, American Iron and Steel Institute

- Monthly raw steel production.

DOE Data Input Sources:
Forms and Publications:

- Energy Information Administration, *Monthly Energy Review*, DOE/EIA-0035, (Washington, DC, monthly)
  - Nonutility distillate fuel oil product supplied
  - Utility distillate fuel oil product supplied
  - Nonutility residual fuel oil product supplied
  - Utility residual fuel oil product supplied
  - Monthly electricity generation (million kilowatthours)
  - Net imports of electricity
  - Monthly electricity generated from coal
  - Monthly fossil fuel consumption at utilities, all fuels
  - Monthly electricity generation, all sources
  - Monthly electricity sales, all sectors
  - Retail price of kerosene jet fuel
  - Retail price of residual fuel oil average of all sulfur contents
  - Residential price of electricity
  - Price of coal to electric utilities
  - Price of natural gas to electric utilities
  - Price of natural gas to residential, industrial, and commercial
  - Price of natural gas at the wellhead
  - Composite refiners' acquisition cost of crude oil
  - Price of imported crude oil
- Energy Information Administration, *Quarterly Coal Report*, DOE/EIA-0121, (Washington, DC, quarterly)
  - End-of-quarter coal stocks, all sources
  - Quarterly coal consumption, all sectors
- Energy Information Administration, *Petroleum Marketing Monthly*, DOE/EIA-0380, (Washington, DC, monthly).
  - No. 2 diesel fuel product supplied
  - Retail price of No. 2 distillate fuel
  - Wholesale price of No. 2 distillate fuel
  - Retail price of No. 2 diesel fuel
  - Wholesale price of No. 2 diesel fuel
  - Retail price of propane (consumer grade)
- Energy Information Administration, *Petroleum Supply Monthly*, DOE/EIA-0109, (Washington, DC, monthly).
  - Total motor gasoline product supplied
  - Liquefied petroleum gases, product supplied, excluding ethane, seasonally adjusted
  - Kerosene-type jet fuel product supplied, seasonally adjusted
  - Petrochemical feedstocks product supplied
  - Kerosene product supplied, seasonally adjusted
  - Road oil and asphalt product supplied, seasonally adjusted
  - Petroleum coke product supplied, seasonally adjusted
  - Miscellaneous products supplied, seasonally adjusted
  - Ethane product supplied
- Energy Information Administration, *Natural Gas Monthly*, DOE/EIA-0130, (Washington, DC, monthly)
  - Sectoral natural gas consumption
- Economic Regulatory Administration, *Electricity Transactions Across International Borders*, (Washington, DC)
  - Net imports of electricity, monthly

Models and Other:

- Energy Information Administration, Form EIA-860, "Annual Electric Generator Report"
  - Monthly total coal-fired electricity generating capacity in place (nameplate capacity)

- Internal Energy Information Administration documents on individual plant use of coal
  - Synfuels-related consumption of coal.

General Output Descriptions: UDAPAS - D produces energy demand forecasts in support of the *Short-Term Energy Outlook* , published quarterly by the Energy Information Administration.

Computing Environment:

- **Hardware Used:** IBM 3084QX
- **Language Used:** Statistical Analysis System (SAS)
- **Core Requirement:** 2000K for demands
- **Estimated Cost to Run:** 119 CPU seconds
- **Special Features:** None.

Independent Reviews Conducted: None.

Status of Evaluation Efforts by Sponsor: Comparisons of forecasted to reported values for major projections will be published in the *Short-Term Energy Outlook* , Annual Supplement, DOE/EIA-0202 (Washington, DC).

Subsystem: Unified Demand and Price Analysis: Prices (UDAPAS-P)

Abstract: UDAPAS - P, a subsystem of the Short-Term Integrated Forecasting System, forecasts monthly prices for major petroleum products, electricity, natural gas, and coal at the national level. This model reflects the effects on prices likely to result from inventories, world oil prices, and inflation rates.

Type: Subsystem

Last Model Update: Updated quarterly.

Part of Another Model? Yes, the Short-Term Integrating Forecasting System (STIFS).

Model Interfaces: Data Resources, Inc., (DRI) macro model and the Short-Term Integrating Model (STIM).

Sponsor:

Office: Energy Markets and End Use

Division: Energy Analysis and Forecasting

Branch: Demand Analysis and Forecasting, EI-621

Model Contact: Neil Gamson

Telephone: 586-2418

Documentation: Unified Demand and Price Analysis Subsystem, DAC Corporation, September 1988.

Archive Media and Installation Manual(s): Archived as part of STIFS.

Purpose: UDAPAS - P produces energy price forecasts in support of the *Short-Term Energy Outlook*, published quarterly by the EIA.

Energy System Described by Model: Domestic U.S. prices for petroleum products, prices of electricity, natural gas, and coal.

Coverage:

- **Geographic:** United States
- **Time Unit/Frequency:** Monthly
- **Product(s):** Motor gasoline, distillate fuel oil, diesel, kerosene-type jet fuel, residual fuel oil, electricity, natural gas and coal
- **Economic Sector(s):** For petroleum - retail; for electricity - residential; for natural gas - residential, industrial, commercial, and utility; for coal - utility.

Modeling Features:

- **Model Structure:** Econometric single-equation models
- **Modeling Technique:** Ordinary least squares, Yule-Walker and other iterative methods
- **Special Features:** Refiner and retail margins are calculated for motor gasoline, heating oil, and residual fuel. SAS graphs are also produced.

Non-DOE Input Sources:
United States Department of Labor, Bureau of Labor Statistics

- CPI (Consumer Price Index all commodities, not seasonally adjusted)
- Price of gasoline (all grades)
- PPI (*Producer Price Index* all commodities, not seasonnally adjusted)
- Producer price index for petroleum products

United States Department of Commerce, Bureau of Economic Analysis

- Disposable personal income in constant 1982 dollars.

Merrill Lynch (DRI)

- AA utility bond rate

DOE Data Input Sources:
Forms and Publications:

- EIA-804, "Weekly Imports Report"
  - Price of imported crude oil
  - Price of domestic crude oil
- FERC-423, "*Cost and Quality of Fuels for Electric Utility Plants*"
  - Price of heavy oil to utilities
  - Price of coal to electric utilities
  - Price of natural gas to utilities
- EIA-826, "Monthly Electric Utility Sales and Revenue Report with State Distributions"
  - Residential price of electricity
- Energy Information Administration, *Petroleum Marketing Monthly*, DOE/EIA-0380 (Washington, DC).
  - Wholesale price of motor gasoline
  - Retail price of residual fuel oil, all sulfur contents
  - Retail price of No. 2 distillate fuel
  - Retail price of No. 2 diesel fuel
  - Retail price of kerosene-type jet fuel
  - Wholesale price of No. 2 heating oil
- Energy Information Administration, *Natural Gas Monthly*, DOE/EIA-0130 (Washington, DC).
  - Price of natural gas at the wellhead.
  - Industrial, commercial, and residential natural gas prices

Models and Other:

- None.

General Output Descriptions: Petroleum prices by product, electricity, natural gas, and coal prices. Output includes monthly numbers, history and forecast. Moreover, margins for gasoline, heating oil, and residual fuel are printed. Also, all inputs, history and forecast are printed out.

Computing Environment:

- **Hardware Used:** IBM 3084QX
- **Language Used:** SAS
- **Core Requirement:** 2000 K
- **Estimated Cost to Run:** 40 CPU seconds
- **Special Features:** Graphs.

Independent Reviews Conducted: None.

Status of Evaluation Efforts by Sponsor: Comparisons of forecasted to reported values for major projections are published in the *Short-Term Energy Outlook*, Annual Supplement.

Transportation and Refining of International Petroleum (TRIP)

Abstract: TRIP provides a simulation of world petroleum activities. Petroleum supply functions, such as crude oil production and transportation, refinery operations, and product distribution, are integrated to satisfy specified demand slates.

Type: Basic

Last Model Update: Currently under revision.

Part of Another Model? None.

Model Interfaces: Oil Market Simulation Model.

Sponsor:

Office:	Energy Markets and End Use
Division:	International and Contingency Information
Branch:	Analysis, EI-632
Model Contact:	Daniel Butler
Telephone:	586-9503

Documentation: Energy Information Administration, Transportation and Refining of International Petroleum (TRIP) Model Documentation, Volume 1, The Trip Model Overview and Process Flow, (Washington, DC, February 1989).

Energy Information Administration, Transportation and Refining of International Petroleum (TRIP) Model Documentation, Volume 2, Detailed Description of TRIP Model Framework and Data Sources, (Washington, DC, February 1989).

Archive Media and Installation Manual(s): Available.

Purpose: TRIP is used to forecast international trade patterns in crude oil and refined products, and optimum refining operations. It is used to estimate future sources of petroleum imports to the United States and to calculate expected shortfalls in those imports that would result from various supply disruptions. This model is used principally in the preparation of EIA service reports.

Energy System Described by Model: TRIP simulates international flows of petroleum-crude oil from producing regions to refineries; and products from refineries to marketing centers. It determines optimum supply activites that conform as closely as possible to historical patterns.

Coverage:

- **Geographic:** Free world with comprehensive coverage of OECD countries. Minor interface with CPE countries.
- **Time Unit/Frequency:** Provides one unit of time, either 1 month, quarter, or year (but usually used quarterly or annually)
- **Product(s):** Crude oils by source, gasoline, distillate and residual fuel oils, jet fuel, liquefied petroleum gases, and other.
- **Economic Sector(s):** All petroleum consumers in the aggregate.

Modeling Features:

- **Model Structure:** Over 8,500 equations representing worldwide petroleum supply, demand, transportation, and refinery operations Over 85% of the equations correspond to individual world refinery regions that are represented by the RYM components of the Refinery Evaluation Modeling System (REMS).
- **Modeling Technique:** Linear programming

Non-DOE Input Sources:
Oil and Gas Journal

- International Refinery Capacity

United Nations Annual Report

- World Historical Trade Patterns (non-OECD Countries)

OECD Quarterly Statistics Report

- OECD Historical Trade Patterns

CIA Bi-monthly International Statistics Report

- CPE Data.

DOE Data Input Sources:
Forms and Publications:

Energy Information Administration, *International Energy Outlook*, DOE/EIA-0484 (Washington, DC)

- World Demand Forecasts

Energy Information Administration, *Petroleum Supply Annual*, DOE/EIA-0340 (Washington, DC)

- U.S. Refinery Capacity

Models and Other:

Intermediate Future Forecasting System (IFFS) and the Short-Term Integrated Forecasting System (STIFS)

- U.S. Supply/Demand

Oil Market Simulation Model (OMS)

- World Supply/Demand

International Petroleum Statistics Report

- World Supply.

General Output Descriptions: Worldwide trade flows of crude oil and refined products, optimum refining operations, equilibrium values of crude oils and products.

Computing Environment:

- **Hardware Used:** IBM 3084QX
- **Language Used:** OMNI, MPS3, FORTRAN
- **Core Requirement:** 5000K
- **Estimated Cost to Run:** 6 - 10 CPU Hours
- **Special Features:** Lengthy turnaround; strictly an overnight turnaround model.

Independent Reviews Conducted: Currently being reviewed by the Office of Energy Markets and End Use.

Status of Evaluation Efforts by Sponsor: Evaluation efforts are currently being made.

Transportation Energy Demand Model (TED-PC)

Abstract: TED-PC describes consumption by automobiles, trucking and other modes of transportation as a function of vehicle miles travelled or industrial economic growth. Automobile or trucking efficiency trends and fuel prices are key assumptions for projecting future transportation fuel demand.

Type: Basic

Last Model Update: January 1989

Part of Another Model? Part of the PC-AEO (Personal Computer-- *Annual Energy Outlook*) modeling system.

Model Interfaces: From MAIN spreadsheet, real GNP, real output by economic sector, GNP price deflator, consumer price index, real exports, real imports, real

fuel prices, population, world oil price, calibration factors, and real regional disposable personal income, natural gas consumption by the residential, commercial, industrial and utility sectors. To MAIN--fuel demand by Census region.

Sponsor:

Office: Energy Markets and End Use

Division: Energy Analysis and Forecasting Division

Branch: Demand Analysis and Forecasting Branch, EI-621

Model Contact: Barry Cohen

Telephone: 586-5359

Documentation: Energy Information Administration, *Model Documentation for the Transportation Spreadsheet Model for the Annual Energy Outlook 1987* (Washington, DC, February 1988).

Archive Media and Installation Manual(s): Archived as part of the PC-AEO model on floppy disk.

Purpose: TED-PC provides the transportation demand forecasts used in the integrated spreadsheet modeling system which in turn is used to produce forecasts for the *Annual Energy Outlook*.

Energy System Described by Model: Demand for major fuels by the transportation sector (as defined in the State Energy Data System).

Coverage:

- **Geographic:** Census Region (for totals of each fuel across sectors) and United States (for fuel use, travel, etc., by sector)
- **Time Unit/Frequency:** Annual, 1985 through the year 2000
- **Product(s):** motor gasoline, aviation gasoline, diesel/distillate, residual oil, electricity, jet fuel, LPG, lubricants
- **Economic Sector(s):** Forecasts are produced for personal travel, freight trucks, railroads, domestic marine, international marine and aviation, and military use.

Modeling Features:

- **Model Structure:** Recursive, requiring no equation solver
- **Modeling Technique:** Econometrics (for passenger travel, aviation, and lubricants), exogenous engineering and judgment (mpg and various freight characteristics), and data-driven accounting mainly for fleet structure
- **Special Features:** None.

Non-DOE Input Sources:

- Argonne National Laboratory freight model
  - Truck diesel share
  - Average truck miles per gallon
  - Freight truck, vehicle miles travelled
  - Rail and domestic shipping, ton miles travelled
- Federal Aviation Administration
  - Jet load factor
  - Private plane jet fuel use
- Department of Defense
  - Military jet fuel forecasts.

DOE Data Input Sources:
Forms and Publications:

- Energy Information Administration, Residential Transportation Energy Consumption Survey, Form EIA-876A/C; and the *State Energy Data Report*, DOE/EIA-0214, (Washington, DC)
  - Residual and distillate fuels for international and domestic shipping
  - Motor gasoline in domestic shipping
  - Motor gasoline and distillate fuel consumption in personal travel and freight travel
  - Jet fuel, aviation gasoline, lubricants, LPG
  - Electricity in railroads.

General Output Descriptions: TED-PC produces reports on fuel use, travel and assumed efficiencies.

Computing Environment:

- **Hardware Used:** Compaq 386 Personal Computer. Or can be used with any IBM compatible personal computer.
- **Language Used:** Lotus 1-2-3, Version 2.01
- **Core Requirement:** Stand-alone requires 640K
- **Estimated Cost to Run:** 4 seconds stand-alone mode, integrating version varies.
- **Special Features:** None.

Independent Reviews Conducted: Currrently under review by an Independent Expert Reviewer.

Status of Evaluation Efforts by Sponsor: To be updated, revised yearly for each *Annual Energy Outlook*.

Uranium Market Model (UMM-PC)

Abstract: The Uranium Market Model (UMM-PC) projects prices, production, imports, inventory, capital expenditures, and employment in the uranium mining and milling industry. The model considers every major production center and utility on a worldwide basis (with centrally planned economies considered in a limited way).

Type: Basic

Last Model Update: October 1988.

Part of Another Model? None.

Model Interfaces: None

Sponsor:

Office:	Coal, Nuclear, Electric and Alternate Fuels
Division:	Nuclear and Alterate Fuels
Branch:	Data Analysis and Forecasting
Model Contact:	Diane L. Jackson
Telephone:	586-1309

Documentation: Energy Information Administration, Documentation of the Uranium Market Model (UMM-PC), (Washington, DC, November 1988).

Archive Media and Installation Manual(s): Archived in 1988.

Purpose: The UMM-PCis used to model international uranium mining, milling, and marketing activities.

Energy System Described by Model: International uranium mining and milling.

Coverage:

- **Geographic:** World
- **Time Unit/Frequency:** Annually
- **Product(s):** Natural uranium
- **Economic Sector(s):** Buyer and producer regions.

Modeling Features:

- **Model Structure:** Uranium supplied by the mining and milling industry is matched to the demand for uranium by electric utilities possessing nuclear power plants. Equations are listed in Chapter II, "Technical Specifications," of the Model Documentation Report.
- **Modeling Technique:** Microeconomic simulation model
- **Special Features:** none.

Non-DOE Input Sources:
Nuclear Assurance Corporation (NAC), U308 Status Report, "Detailed U308 Commitment Status by Supplier," February 1988, Norcross, Georgia

- Production center capacities

Nuclear Assurance Corporation (NAC), U308 Status Report, "Fuel-Trac Report on Requirements and Commitment Status for U308 for Country and Country Group," July 1987, Norcross, Georgia

- Enrichment overcommitments

Nuclear Resources International, "Estimates of Behavioral, Management and Market Data," February 1984, for ORNL/SUB/UIX-7038V/1

- Years of desired inventory

DOE Data Input Sources:
Forms and Publications:

- Form EIA-858, " *Uranium Industry Annual* Survey"

  - Inventory data.

- Energy Information Administration, "Domestic Uranium Mining and Milling Industry", 1986, "Viability Assessment; Appendix E", November 1987, Washington, DC

  - Inventory data.

General Output Descriptions:

- World spot price

- Domestic or region-specific spot prices

- World contract price

- Domestic or region-specific contract prices

- Production from every major production center in the world

- Production on a country- or region-specific basis

- Net imports into each region

- Utilities' inventories, tabulated from inventories of individual utility groups on a worldwide basis

- Annual drawdown of utilities' inventories

- Capital expenditures by the mining and milling industry

- Employment in the mining and milling industry.

Computing Environment:

- **Hardware Used:** IBM compatible personal computer (PC/AT)
- **Language Used:** Turbo Pascal
- **Core Requirement:** 640 Kb of RAM
- **Estimated Cost to Run:** Runs in less than 9 seconds on a 20-MHz personal computer
- **Special Features:** Model requires a math co-processor and a hard disk plus a version of DOS that is 2.1 or greater.

Independent Reviews Conducted: None.

Status of Evaluation Efforts by Sponsor: None.

Uranium Supply - Import Model (USI)

Abstract: The Uranium Supply - Import (USI) Model is an intermediate term (15 - 20 years), annual, uranium supply/demand balancing model, which uses a simple technique of progressive aggregation of two regions, the U.S. and the foreign region (the remainder of the World Outside Communist Areas). The USI Model's principal outputs consist of a "Market Clearing Summary" which presents the total domestic supply, net imports, and foreign supply at the projected market clearing price for each year of the forecast horizon.

Type: Auxiliary

Last Model Update: May 1987.

Part of Another Model? No.

Model Interfaces: The USI Model uses mine/mill property

Sponsor:

Office: Coal, Nuclear, Electric and Alternate Fuels

Division: Nuclear and Alternate Fuels

Branch: Data Analysis and Forecasting, EI-532

Model Contact: Diane L. Jackson

Telephone: 586-1309

Documentation: *Uranium Supply - Import Model, Model Overview*, Decision Analysis Corporation of Virginia, December 1987.

Uranium Supply - Import Model, Users Guide, Decision Analysis Corporation of Virginia, December 1987.

Archive Media and Installation Manual(s): (Tape SI87) Archive Tape and Model Installation Manual, Decision Analysis Corporation of Virginia, October 1987.

Purpose: The main purpose of the model is to determine the potential net imports of uranium to the United States as a function of domestic uranium production.

Energy System Described by Model: The energy system described by the model consists of the productive capacity and forward marginal costs associated with uranium mining/milling properties within the United States and the foreign region (remaining countries within the World Outside Communist Areas, or WOCA).

Coverage:

- **Geographic:** U.S. and foreign region (WOCA)
- **Time Unit/Frequency:** Annual
- **Product(s):** U308 domestic production capability, net imports capability, and foreign supply
- **Economic Sector(s):** Uranium mining and milling properties and aggregate U.S. and foreign reactor requirements.

Modeling Features:

- **Model Structure:** Simple mathematical supply/demand balance which:
  - initializes data to present domestic and foreign uranium productive capacity and forward marginal costs of production
  - ranks foreign and U.S. individual mining/milling properties by forward marginal costs
  - satisfies foreign uncommitted reactor requirements by selecting least-cost foreign uranium properties
  - satisfies domestic reactor requirements by selecting the foreign and domestic productive capacity at increasing forward marginal cost until the domestic supply/demand balance is achieved and the market clearing forward marginal cost (price) is determined
  - projects U.S. production, net imports, total foreign supply and the market clearing marginal cost (price) by forecast year.
- **Modeling Technique:** Recursive mathematical supply/demand balance representing a partial

price equilibrium of the uranium industry assuming totally inelastic domestic and foreign demand.

- **Special Features:** Can provide the effects of tariffs imposed on foreign imports, price floors on production from countries or specific properties, and legislative constraints or political decisions causing deferral of productive capacity to future years.

Non-DOE Input Sources:

- Nuclear Assurance Corporation
  - Forward marginal cost information.

DOE Data Input Sources:
Forms and Publications:

- EIA-858, *Uranium Industry Annual* Survey
  - Net imports.

Models and Other:

- International Nuclear Model
  - Foreign and domestic reactor requirements.

General Output Descriptions: None.

Computing Environment:

- **Hardware Used:** IBM 3084QX
- **Language Used:** FORTRAN and SAS/Tell-A-Graph
- **Core Requirement:** 400K Bytes
- **Estimated Cost to Run:** 8 CPU seconds
- **Special Features:** None.

Independent Reviews Conducted: None.

Status of Evaluation Efforts by Sponsor: None.

World Integrated Nuclear Evaluation System (WINES)

Abstract: WINES is used by the Energy Information Administration (EIA) to project domestic and international nuclear energy requirements into the long-term (through 2020). WINES, an aggregate demand-based partial equilibrium model, generates nuclear energy requirements in a broad context of national economic activity, labor force population and productivity, energy demand measured at end uses, price and income effects, and electricity production. The WINES model serves as a flexible tool with which to assist the Department of Energy program offices and other government agencies in their analyses of long-term nuclear energy demand and supply, and to support cooperative efforts between the United States, the Nuclear Energy Agency of the Organization for Economic Cooperation and Development (OECD).

Type: Basic

Last Model Update: February 1987.

Part of Another Model? No.

Model Interfaces: NPAPS System.

Sponsor:

Office:	Coal, Nuclear, Electric and Alternate Fuels
Division:	Nuclear and Alternate Fuels
Branch:	Data Analysis and Forecasting, EI-532
Model Contact:	Roger Diedrich
Telephone:	586-9407

Documentation:

- Energy Information Administration, Model Documentation of the World Integrated Nucler Evaluation System, E.H. Pechan and Associates, (Washington, DC, June 1985)
  - Volume 1, Model Documentation
  - Volume 2, Model Description
  - Volume 3, Executive Summary
- Energy Information Administration, *Model Documentation of the World Integrated Nuclear Evaluation System*, (Washington, DC, December 1984)
  - Executive Summary
  - Model Overview, Volume 1, DOE/EI/19656-1/1
  - Model Description, Volume 2, DOE/EI/19656-1/2
  - Data Documentation, Volume 3 Part A, DOE/EI/19656-1/3A
  - Data Documentation, Volume 3 Part B, DOE/EI/19656-1/3B
  - Model Abstract, Volume 4, DOE/EI/19656-1/4
- Energy Information Administration, *World Integrated Nuclear Evaluation System (WINES) User's Guide and Model Documentation*, MATHTECH, Inc, (Washington, DC, April 1983).

- Energy Information Administration, *NPAPS User's Guide, Volume I*, CNP Work Station, Washington, DC, February 20, 1989.

Archive Media and Installation Manual(s): WINES85 - for the report, *Commercial Nuclear Power 1985*

WINES86 - for the report, *Commercial Nuclear Power 1986*

WINES87 - for the report, *Commercial Nuclear Power 1987*.

Purpose: WINES produces long-term (through the year 2000) projections of nuclear power generation and capacity requirements.

Energy System Described by Model: Estimates are made of country-specific delivered energy, and electricity and nuclear generation requirements.

Coverage:

- **Geographic:** Countries comprising the world ouside of centrally planned economic areas with commercial nuclear programs
- **Time Unit/Frequency:** Five year intervals
- **Product(s):** Growth rates for gross domestic product, delivered energy, electricity generation, and nuclear generation and capacity
- **Economic Sector(s):** Country-specific aggregate demand.

Modeling Features:

- **Model Structure:** Basic four equation representation of economic growth, aggregate energy demand, and electricity and nuclear generation requirements
- **Modeling Technique:** Simulation based on long-term growth relationships
- **Special Features:** Long-term, highly aggregated model using logistic curves to estimate market penetration for electricity and nuclear generation.

Non-DOE Input Sources:

Future Energy Consumption of the Third World with Special Reference to Nuclear Power, Fritz, M., Pergammon Press, 1981

- Long run elasticity of energy demand

Survey of Long-Term Price and Elasticity Estimates, Hoffman, K., Riordan, B., and Mayo, D. Mathtech, Inc. Prepared for U.S. Arms Control and Disarmament Agency, Technical Report No. 870-80-2

- Long-term income elasticity of energy demand
- Long run price elasticity of energy demand

World Energy Outlook, International Energy Agency, OECD, Paris 1982

- Installed nuclear capacity

Yearbook of Labour Statistics, International Labour Organization

- Labor participation growth rate

Forecasting Nuclear Generating Capacity: The MATHGEN Model, Mathtech, Inc., prepared for U.S. Arms Control and Disarmament Agency, May 1981

- Average delivered energy price growth rate
- Long run price elasticity of energy demand
- Long run income elasticity of energy demand
- Electrical energy share of delivered energy
- Nuclear share of electricity generation
- Labor participation growth rate
- Nuclear generation capacity factor
- Nuclear share asymptotic limit

Energy Modeling for an Uncertain Future, National Academy of Sciences, Modeling Resource Group, 1978

- Labor productivity growth rate
- Average delivered energy price growth rate
- Aggregate energy prices

Summary of Nuclear Power and Fuel Cycle Data in OECD Member Countries, OECD Nuclear Energy Agency, Paris, March 1983

- Total primary energy requirements
- Nuclear generation
- Installed nuclear capacity

Tabulation of WPNFCR Questionnaire Responses from Non-OECD States, OECD Nuclear Energy Agency, Paris, annual

- Total primary energy requirements
- Nuclear generation
- Installed nuclear capacity

Tabulation of WPNFCR Questionnaire Responses from OECD Member Countries, OECD Nuclear Energy Agency, Paris, " *Brown Book* ," annual

- Total primary energy requirements
- Nuclear generation

Statistical Yearbook of the United Nations (32nd ed.), United Nations, New York, New York, annual

- Gross domestic product growth rate

- Total primary energy consumption and production

Yearbook of World Energy Statistics , United Nations, New York, New York, annual

- Total primary energy requirements
- Nuclear generation

Short-term Population Projection, 1980-2000 and Long-term Projection, 2000 to Stationary Stage by Age and Sex for All Countries of the World, Vu, M.T. and Elwan, A., World Bank, July 1982

- Labor age population growth rate

World Development Report, World Bank, Oxford University Press, New York, annual

- Gross domestic product growth rate

Price Prospects for Major Primary Commodities, Volume V: Energy , World Bank, annual

- Average delivered energy price growth rate
- Aggregate energy prices
- Price elasticity of energy demand
- Income elasticity of energy demand

OECD (NEA) Long Term Energy Forecasts, Jones, P.M.S., OECD Nuclear Energy Agency, November 1979

- Nuclear share asymptotic limit

Proposed Asymptotic Limits for Electricity Consumption OECD North America, Gene R. Clark and Andrew W. Reynolds, OECD Nuclear Energy Agency, September 1980

- Electrical share asymptotic limit

The Probable Range of Growth Rates of Electricity Over the Next Two Decades and Sources of Uncertainty, Mary Proctor, U.S. Office of Technology Assessment, Discussion Paper, August 1982

- Electrical share asymptotic limit

Energy-Global Prospects 1985-2000, Wilson, Carroll, L., Workshop on Alternative Energy Strategies, McGraw-Hill, 1977

- Price elasticity of energy demand
- Income elasticity of energy demand

Labor Force Estimates, International Labour Office, Geneva, Switzerland, 1977

- Labor force participation

The Puzzling Drop in Productivity, Denison, E.F., Challenge, May-June 1979

- Labor productivity

Productivity Trends and Prospects in Continental Western Europe, Maddison, Angus, in "The Future of Productivity," National Center for Productivity and Working Life, Washington, DC, winter 1977

- Labor productivity

World Population Projections: Short- and Long-Term Estimates by Age and Sex with Related Demographic Statistics, World Bank, annual

- Labor age population projections

Nuclear Energy and Its Fuel Cycle: Prospects to 2025, OECD, Nuclear Energy Agency, Paris, 1982

- Asymptomatic nuclear share of electricity generation

U.S. Macroeconomic Model and Energy Model, Data Resources, Inc., Lexington, MA

- Average delivered energy price growth rate
- U.S. total primary energy consumption
- U.S. GNP growth rate
- U.S. total electricity generation.

DOE Data Input Sources:
Forms and Publications:

- Energy Information Administration, *Annual Energy Outlook*, DOE/EIA-0383 (Washington, DC, annual)
  - Average delivered energy price growth rate
  - U.S. total primary energy consumption
  - U.S. total electricity generation
  - U.S. GNP growth rate.

Models and Other:

- NFACIL Data Base (maintained by the Coal, Nuclear, Electric, and Alternate Fuels Division).
  - Aggregated operable capacity by country.

General Output Descriptions: WINES provides projections of both installed nuclear capacity and the intermediate variables necessary to project nuclear capacity by nation or aggregated using selected geographic and economic criteria.

Computing Environment:

- **Hardware Used:** Compaq 386 Personal Computer
- **Language Used:** FORTRAN
- **Core Requirement:** 512K
- **Estimated Cost to Run:** 10 CPU seconds

- **Special Features:** Automated interface with NFACIL Data Base and a text editor for the *Commercial Nuclear Power Report*.

Independent Reviews Conducted: None.

Status of Evaluation Efforts by Sponsor: Evaluation efforts are underway as development continues.

Appendix A

Major Modeling Systems and Contributing Models

Appendix A

Major Modeling Systems and Contributing Models

PC- *Annual Energy Outlook* Modeling System

Coal Price and Supply Model (COAL-PC)

Commercial Sector Energy Model (CSEM-PC)

Household Model of Energy (HOME3-PC)

Industrial Energy Model (IEM-PC)

Mini-Macroeconomic Personal Computer Model (MINMAC-PC)

Oil Market Model Spreadsheet (OMM-PC)

Petroleum Financial Analysis System (PETFAS-PC)

Transportation Energy Demand Model (TED-PC)

Electric Utility Model - Capacity (UTILCAP-PC)

Electric Utility Model - Financial/Pricing (UTILFIN-PC)

Electric Utility Model - Generating (UTILGEN-PC)

Gas Analysis Modeling System:

Control

Market

NXTSYS (proprietary)

Outer Continental Shelf Oil and Gas Model

Production of Onshore Lower 48 Oil and Gas Model

Intermediate Future Forecasting System:

(Supply Side)

Coal:

Coal Supply and Transportation Model

International Coal Trade Model

Resource Allocation and Mine Costing Model

Electric Utilities:

Electric Market Model

Natural Gas and Oil:

Gas Analysis Modeling System including the Production of Onshore Lower 48 Oil and Gas Model

Oil and Gas: Outer Continental Shelf Oil and Gas Supply Model

Refinery: Oil Market Module

(Demand Side)

Personal Computer - *Annual Energy Outlook*

PC-AEO provides demand for residential, commercial, industrial, and transportation sectors.

Refinery Evaluation Modeling System:

Oil Refinery and Distribution Model

Refinery Yield Modeling System

Revenue Requirements Modeling System:

Revenue Requirements Model

Single Asset Model

Short-Term Integrated Forecasting System:

Unified Demand and Price Analysis System

Short-Term Integrating Model

Appendix B

Currently Active Models by Type

Appendix B

Currently Active Models by Type

Basic Models

1. Coal Price and Supply Model (COAL-PC)
2. Coal Supply and Transportation Model (CSTM)
3. Commercial Sector Energy Model (CSEM-PC)
4. Electric Utility Model - Capacity (UTILCAP-PC)
5. Electric Utility Model - Financial/Pricing (UTILFIN-PC)
6. Electric Utility Model - Generating (UTILGEN-PC)
7. Electricity Market Model (EMM)
8. Gas Analysis Modeling System (GAMS)
9. Household Model of Energy (HOME3-PC)
10. Industrial Energy Model (IEM-PC)
11. Intermediate Future Forecasting System (IFFS)
12. International Coal Trade Model (ICTM)
13. International Nuclear Model (INM)
14. Mini-Macroeconomic Personal Computer Model (MINMAC-PC)
15. National Coal Model (NCM)
16. National Utility Financial Statement Model (NUFS)
17. Non-OPEC Oil Production Model (NOPEC-PC)
18. Oil and Gas Spreadsheet Model (OGS-PC)
19. Oil Market Module (OMM)
20. Oil Market Module (Spreadsheet) (OMM-PC)
21. Oil Market Simulation Model (OMS)
22. Outer Continental Shelf Oil and Gas Supply Model (OCSM)
23. Petroleum Financial Analysis System (PETFAS-PC)
24. Production of Onshore Lower 48 Oil and Gas Model (PROLOG)
25. Refinery Evaluation Modeling System (REMS)
26. Resource Allocation and Mine Costing Model (RAMC)
27. Revenue Requirements Modeling System (RRMS)
28. Short-Term Coal Analysis System (SCOAL)
29. Short-Term Integrated Forecasting System (STIFS)

30. Short-Term Nuclear Annual Power Production Simulation Model (SNAPPS)
31. Stock Module of the Intermediate Future Forecasting System (STOCK)
32. Transportation and Refining of International Petroleum (TRIP)
33. Transportation Energy Demand Model (TED-PC)
34. Uranium Market Model (UMM-PC)
35. World Integrated Nuclear Evaluation System (WINES)

Auxiliary Models

1. Drilling Cost Estimates Model (DCEM)
2. Energy Disaggregated Input-Output Model (EDIO)
3. Levelized Nuclear Fuel Cycle Cost Model (LNFCC-PC)
4. Reserves and Deliverability Analysis FORTRAN Louisiana (RDAF)
5. Uranium Supply - Import Model (USI)

Appendix C

Developing Models

Appendix C

Developing Models

NAME OF MODEL	MODEL CONTACT	PHONE NUMBER
Organization for Economic Cooperation and Development Energy Demand Model (OECD)	A. David Sandoval	586-6581