Directory of EIA Models 2001

This directory was prepared by the Energy Information Administration, National Energy Information Center, by Mary Ellen Golby. Questions concerning the general content of this directory should be referred to Mary Ellen on (202) 586-1094. Questions relating to the uses of specific models may be directed to the individual model contacts listed in the model descriptions. Questions about this publication, as well as other energy inquiries, may be directed to the National Energy Information Center on (202) 586-8800.

Preface

This directory revises and updates the *Directory of Energy Information Administration Models 1999*, DOE/EIA-0293(99), Energy Information Administration (EIA), U.S. Department of Energy, November 1999. The Transportation Energy Model of the World Energy Projection System (TEM) has been included for the first time. Since the last Directory was published, five models are inactive and not in use: (1) Low-Income Household Energy Assistance Program (LIHEAP); (2) Resource Allocation and Mine Costing Model (RAMC); (3) Petroleum Financial Analysis System (PETFAS-PC); (4) Short-Term Coal Analysis System (SCOAL); and (5) Refinery Yield Model Spreadsheet System (RYMSS-PC). One new model has been added: Short Term Hydroelectric Generation Model (STHGM).

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.

With respect to its modeling efforts, EIA issued the following standards in 1991: Standard 91-01-01, Model Acceptance; Standard 91-01-02, Active Model Inventory Requirements; Standard 91-01-03, Model Documentation; and Standard 91-01-4, Model Archival. In 1992, Standard 92-01-05, Proprietary Models, was issued. It describes the necessary actions governing the use of proprietary models (i.e., models available to EIA through license, purchase, or subscription) in EIA reports and modeling systems.

This directory contains information about each model, including the title, acronym, description, followed by more details on characteristics, uses, and requirements. Sources for additional information are identified. Included in this directory are 29 EIA active models as of August 2001. The models are divided into two groups and listed in alphabetical order within those groups, except for the Integrating Module, which is listed first. The first group lists those models which are part of the National Energy Modeling System (NEMS). The second group lists all other EIA models that are not part of NEMS.

Contents

Models of the National Energy Modeling System

Other EIA Models

Models of the National Energy Modeling System

Integrating Module of the National Energy Modeling System (INT)

Description:

The National Energy Modeling System (NEMS) represents a general equilibrium solution of the interactions between the U.S. energy markets and the economy. The model achieves a supply-and-demand balance in the end-use demand regions, defined as the nine Census Divisions, by solving for the prices of each energy type so that the quantities producers are willing to supply equal the quantities consumers wish to consume. The system reflects market economics, industry structure, and energy policies and regulations that influence market behavior.

Last Model Update:

October 2000

Part of Another Model?

Part of the National Energy Modeling System

Model Interfaces:

NEMS comprises the following modules with model contacts as indicated:

Integrating Module	Daniel Skelly (202) 586-1722
Residential Sector Demand Module	John H. Cymbalsky (202) 586-4815
Commercial Sector Demand Module	Erin Bodecker (202) 586-4791
Transportation Sector Demand Module	John Maples (202) 586-1757
Industrial Demand Module	Crawford Honeycutt (202) 586-1420
Macroeconomic Activity Module	Ron Earle (202) 586-1398
International Energy Module	Dan Butler (202) 586-9503
Coal Market Module	Mike Mellish (202) 586-2136
Renewable Fuels Module	Tom Petersik (202) 586-6582
Electricity Market Module	Robert Eynon (202) 586-2315
Natural Gas Transmission and Distribution Module	Joseph Benneche (202) 586-6132
Oil and Gas Supply Module	Ted McCallister (202) 586-4820
Petroleum Market Module	Han-Lin Lee (202) 586-4247
DRI Model of the U.S. Economy	Ron Earley (202) 586-1398
World Oil Refining, Logistics, and Demand Model	Dan Butler (202) 586-9503

Sponsor:

- **Office:** Office of Integrated Analysis and Forecasting
- **Division:** Energy Demand and Integration Division
- **Model Contact:** Dan Skelly
- **Telephone:** (202) 586-1722
- **E-Mail Address:** *dskelly@eia.doe.gov*

Documentation:

- Energy Information Administration, I*ntegrating Module of the National Energy Modeling System: Model Documentation*, DOE/EIA-M057 (2001) (Washington, DC, December 2000) *http://tonto.eia.doe.gov/FTPROOT/modeldoc/m057(2001).pdf.*
- Energy Information Administration, *National Energy Modeling System: An Overview 2000*, DOE/EIA-0581(2000) (Washington, DC, March 2000) *http://tonto.eia.doe.gov/FTPROOT/forecasting/05812000.pdf.*

Archive Media and Installation Manual(s):

Archived for the reference case published in the *Annual Energy Outlook, 2001*, DOE/EIA-0383 (2001). The archive contains all of the modules of the NEMS as used in the reference case. The archive, containing source code, inputs and outputs, stored at *ftp://eia.doe.gov/pub/temp/aeo/aeo2001.exe* as a self-extracting zip file. The archive does not contain an executable for NEMS. Preparing an executable required Compaq Visual Fortran (*http://www.compaq.com/fortran/index.html*) and the Optimization Modeling Library from Ketron Management Science (*http://ketronms.com*).

Coverage:

- **Geographic:** Nine Bureau of Census Divisions. Some component analytical modules represent energy production or conversion at different levels of regional detail
- **Time Unit/Frequency:** Annual through 2020
- **Product(s):** Natural gas, electricity, coal, steam coal, metallurgical coal, distillate fuel oil, residual fuel oil, motor gasoline, jet fuel, liquefied petroleum gases, petrochemical feedstocks, kerosene, other petroleum products, methanol, ethanol, nuclear power, hydropower, and other renewable sources
- **Economic Sector(s):** Residential, commercial, industrial, and transportation end-use consumption; coal supply; oil and gas production and natural gas markets; utility and nonutility capacity, and generation of electricity; oil product pricing.

Modeling Features:

- **Model Structure:** NEMS provides an equilibrium framework in which the economic forces of supply and demand can be simulated. Its modular structure allows each individual module to be represented in a different fashion if desired
- **Modeling Technique:** NEMS is a simulation of the impacts of present and planned energy market conditions upon the supplies of and demands for energy products. Different techniques are applied in different sectors, as appropriate
- **Special Features:** The primary design feature of NEMS is its modularity. That is, the model is organized by fuel production — oil, natural gas, coal, and electricity — and by end-use consumption sector. The modularity allows any single module or group of modules to be run independently as a debugging aid or for stand-alone analysis. Furthermore, modularity also allows the flexibility for each sector to be represented in the most appropriate way, highlighting the particular issues important for the sector, including the most appropriate regional structure.

Non-DOE Input Sources:

All data sources are listed under the appropriate modules of NEMS, which are listed in the Model Interfaces section.

DOE Data Input Sources:

All data sources are listed under the appropriate modules of NEMS, which are listed in the Model Interfaces section.

Computing Environment:

- **Hardware Used**: A multiuser environment is implemented using two networked Compaq Proliant Servers, model 5500R, each with four 550 mhz Pentium III Xeon processors, 2.5 gigabytes RAM, 54 gigabytes hard disk space; supplemented by a distributed computer sharing system using 8 Dell workstations (model Precision 410), each with two 500mhz Pentium III processors, 512 megabyte RAM, and 18 gigabytes hard disk space
- **Operating System:** Windows NT 4
- **Language/Software Used:** Compaq Visual FORTRAN 6.1; Ketron Management Science's Optimization Modeling Library; MKS Toolkit
- **Memory Requirement (image size):** 305 megabytes
- **Storage Requirement**: 2 gigabytes
- **Estimated Run Time:** 2.5-3 hours CPU time for a single run with all modules on. Often, 3 runs are executed in sequence, or "cycled," to improve convergence. Such 3-cycle runs take between 7.5 and 9 hours.

Coal Market Module (CMM)

Description:

The CMM has three submodules. The ***Coal Production Submodule*** produces supply-price relationships for 12 coal types and 11 producing regions, addressing the relationship between the minemouth price of coal and corresponding levels of coal production, labor productivity, and the cost of factor inputs (mine labor, mining equipment, and fuel). The model serves as a major component in the National Energy Modeling System (NEMS). The purpose of the model is to produce annual domestic coal supply curves for the mid-term (to 2020) for the Coal Distribution Submodule of the Coal Market Module of NEMS

Coal Distribution Submodule — United States coal production, national and international coal transportation industries. The model is used to forecast annual coal supply and distribution to domestic markets

Coal Distribution Submodule (International Coal Flows) — The international component of the CDS projects coal trade flows from 16 coal-exporting regions (five of which are in the United States) to 20 demand or importing regions (four of which are in the United States) for three coal types — premium bituminous, low-sulfur bituminous, and subbituminous. The model consists of supply, demand, trade and transportation components. The major coal exporting countries represented include: United States, Australia, South Africa, Canada, Indonesia, China, Columbia, Venezuela, Poland, and the countries of the Former Soviet Union. The model is used to forecast international coal trade. It provides U.S. coal export forecasts to the domestic component of the Coal Distribution Submodule.

Last Model Update:

November 2000

Part of Another Model?

Part of the National Energy Modeling System (NEMS)

Sponsor:

- Office: Office of Integrated Analysis and Forecasting
- Division: Coal and Electric Power Division
- Model Contact: Michael Mellish
- Telephone: (202) 586-2136
- E-Mail Address: Michael.Mellish@eia.doe.gov

Documentation:

- **Coal Production Submodule (CPS):**
  - Energy Information Administration, *Model Documentation, Coal Market Module of the National Energy Modeling System, Part I*, DOE/EIA-M060 (01) (Washington, DC, January 2001)
- **Coal Distribution Submodule (CDS):**
  - Energy Information Administration, *EIA Model Documentation, Coal Market Module of the National Energy Modeling System, Part II-A*, DOE/EIA-M060 (01) (Washington, DC, January 2001)
- **Coal Distribution Submodule (CDS) (International Coal Trade):**
  - Energy Information Administration, Model Documentation, Coal Market Module of the National Energy Modeling System, Part II-B, DOE/EIA-M060 (01) (Washington, DC, January 2001) *http://tonto.eia.doe.gov/FTPROOT/modeldoc/m060(2001).pdf.*

Archive Media and Installation Manual(s):

See Integrating Module for the National Energy Modeling System (NEMS).

Coverage:

Coal Production Submodule (CPS):

- **Geographic:** Supply curves for 11 geographic regions
- **Time Unit/Frequency:** 1990 through 2020
- **Product(s):** 12 coal types
- **Economic Sector(s):** Coal producers and importers.

Coal Distribution Submodule (CDS):

- **Geographic:** United States, including Hawaii, Puerto Rico, and the U.S. Virgin Islands
- **Time Unit/Frequency:** Annual forecasts for 1990-2020
- **Product(s):** Bituminous, subbituminous and lignite coals in steam and metallurgical coal markets
- **Economic Sector(s):** Forecasts coal supply to 2 residential/commercial, 3 industrial, 2 domestic metallurgical, 4 export, and 7 electric utility subsectors (a synthetic fuel subsector is present but not operational in the CDS) to 13 domestic demand regions

Coal Distribution Submodule (CDS) (International Coal Flows):

- **Geographic:** 16 export regions (5 of which are in the United States) and 20 import regions (4 of which are in the United States)
- **Time Unit/Frequency:** Each run represents a single forecast year. Model can be run for any forecast year for which input data are available
- **Product(s):** Coking, low-sulfur bituminous coal, and subbituminous coal
- **Economic Sector(s):** Coking and steam.

Modeling Features:

Coal Production Submodule (CPS):

- **Model Structure:** The CPS employs a regression model to estimate price-supply relationships for underground and surface coal mines by region and coal type, using projected levels of production, productivity, miner wages, capital costs of mining equipment, and fuel prices.
- **Modeling Technique:** Three main steps are involved in the construction of the coal supply curves:
  - Calibrate the regression model to base-year production and price levels by region, mine type (underground and surface), and coal type
  - Convert the regression equation into supply curves
  - Construct step-function supply curves for input to the CDS.

Coal Distribution Submodule (CDS):

- **Model Structure:** The CDS uses 35 coal supply sources representing 12 types of coal produced in 11 supply regions. Coal shipments to consumers are represented by transportation rates specific to NEMS sector and supply curve/demand region pair, based on historical differences between minemouth and delivered prices for such coal movements. In principle there are 8,190 such rates for any forecast year; in practice there are less since many rates are economically infeasible. Coal supplies are delivered to up to 18 demand sectors in each of the 13 demand regions. A single model run represents a single year, but up to 31 consecutive years (1990-2020) may be run in an iterative fashion. Currently, the NEMS system provides demand input for the 1990-2020 period
- **Modeling Technique:** The model utilizes a linear programming that minimizes delivered cost to all demand sectors
- **Special Features:**
  - All demands are exogeneous to the CDS
  - Supply curves (there are 35 supply sources) depicting the U.S. coal reserve base are exogenous to CDS and are reported in the CDS from 11 coal supply regions
  - CDS currently contains no descriptive detail on coal transportation by different modes and routes. Transportation modeling consists only of sector-specific rates between demand regions and supply curves that are adjusted annually for changes in factor input cost changes, the producer price index for transportation equipment, and a time trend
  - CDS output includes tables of aggregated output for NEMS system and approximately 20 single-year reports providing greater regional and sectoral detail on demands, production distribution patterns, and rates charged
  - Coal imports are treated as a static input that is subtracted from demand before solving the CDS. Imports are reported to NEMS and detailed in some single-year reports
  - CDS reports minemouth, transport, and delivered coal prices, coal shipment origins and destinations (by region and economic sub-sector), and energy and sulfur content of coal

Coal Distribution Submodule (CDS) (International Coal Trade):

- **Model Structure:** Satisfies coal import demands at the lowest cost based on specified supply and transportation costs, and subject to projected overall levels of available coal export capacities by region and by coal type
- **Modeling Technique:** The model is a Linear Program (LP), which satisfies demands at all points at the minimum overall "world" coal cost plus transportation cost and is embedded within the Coal Market Module
- **Special Features:** The model is designed for the analysis of legislation concerned with SO2 emissions and trade of nonconventional coals (subbituminous coals).

Non-DOE Input Sources:

Coal Production Submodule (CPS):

- U.S. Department of Labor, Bureau of Labor Statistics
  - Average Hourly Earnings of Production Workers (Coal Mining), Series ID: EEU10120006
  - PPI for Mining Machinery and Equipment, Series ID: PCU3532#
- DRI/McGraw Hill
  - Yield on Utility Bonds

Coal Distribution Submodule (CDS):

- U.S. Department of Commerce
  - Form EM-545
- U.S. Department of Commerce
  - Form IM-145
- Association of American Railroads (Washington, DC, quarterly)
  - *AAR Railroad Cost Indices*
- Rand McNally and Co. (Chicago, IL, 1988)
  - *Handy Railroad Atlas of the United States*
- Caplan, Abby, et al, eds. (Washington, DC, 1996)
  - *1996-1997 Fieldston Coal Transportation Manual*

Coal Distribution Submodule (CDS) (International Coal Flows):

- SSY Consultancy and Research, McClosky Coal Information, Ltd., and the International Energy Agency. Published trade and business journal articles, including *Coal Week International, Energy Publishing, LLC's International Coal Trade, Financial Times International Coal Report, and World Coal*.
  - Coal Import Demands
  - Coal Supply Curves
  - Diversity Constraints
  - Ocean Freight Rates
  - Sulfur Emission Constraints
  - Subbituminous and High-Sulfur Coal Constraints.

DOE Data Input Sources:

Coal Production Submodule (CPS):

- Energy Information Administration, Forms EIA-3, EIA-3A, EIA-5, EIA-5A, EIA-6A, and EIA-7A
  - Historical data for the regression model used for estimating coal supply curves.
  - Base year values for U.S. coal production, productivity, and prices
  - Heat and sulfur content averages, and carbon emission factors by supply curve

- Energy Information Administration, *Electric Power Annual 1998, Volume II* (DOE/EIA-0348(99) (Washington, DC, October 1999)
  - Base year electricity prices and wages
- Energy Information Administration, *State Energy Price and Expenditure Report 1997* (DOE/EIA-0214(97) (Washington, DC, September 1999).
  - Historical electricity prices for the regression model used for estimating coal supply curves.
- Federal Energy Regulatory Commission
  - FERC Form-423 database

Coal Distribution Submodule (CDS):

- **Data Sources:**
  - Form EIA-3, *Quarterly Coal Consumption Report, Manufacturing Plants*
  - Form EIA-5, *Coke Plant Report — Quarterly*
  - Form EIA-6A, *Coal Distribution Report*
  - Form EIA-7A, *Coal Production Report*
  - FERC Form 423, *Monthly Report of Cost and Quality of Fuels for Electric Plants*
  - FERC Form 580, *Interrogatory on Fuel and Energy Purchase Practices*
- **Physical:** Forecasts of annual coal supply tonnages (and trillion Btu) by economic sector and subsector, coal supply region, coal Btu, sulfur content, and demand region
  - *Demand shares by sector and region:* (1) residential/commercial (trillion Btu); (2) industrial steam coal (trillion Btu); (3) industrial metallurgical coal (trillion Btu); (4) import supplies (millions of short tons)
  - *Coal supply/transportation contracts:* (1) coal supply regions; (2) coal demand regions; (3) coal quality (Btu and sulfur content); (4) contract annual volumes (trillion Btu); (5) contract expiration dates (forecast year)
  - *Coal quality data for supply curves:* (1) million Btu per short ton: (2) lbs. sulfur per million Btu
  - Coal quality specifications for regional subsectoral demands on electricity generation and other sectors
- **Economic:** Forecasts of annual minemouth, transportation, and delivered coal prices by coal type, economic sector, coal demand, and supply regions
  - Supply curves relating minemouth prices to cumulative production levels
  - *Transportation rates:* (1) 1987 dollars per short ton; (2) specified by subsector, differ by sector; (3) differ also by supply and demand region pair
  - *Transportation rate escalation factors:* (1) exogenous; (2) based on estimates of factor input costs (labor, fuel, etc.); (3) used to adjust for productivity change
  - *Minemouth price adjustments:* (1) can be made by supply region and forecast year; (2) currently used only by forecast year; (3) used to escalate and de-escalate transportation rates for forecast year
  - *Transportation rate adjustments:* (1) can be used by demand sector and demand region; (2) derived from off-line program that subtracts base year minemouth costs from delivered costs reported in Forms EIA-3 and -5, and FERC Form 423 to produce transport rate, calculates ratio between model rate and rate from forms, preserve ratio as model parameter; (3) used to calibrate rates in model.

Coal Distribution Submodule (CDS) (International Coal Trade):

None.

Computing Environment:

See Integrating Module of the National Energy Modeling System.

Commercial Sector Demand Module (CSDM)

Description:

The NEMS Commercial Sector Demand Module is a simulation tool based upon economic and engineering relationships that models commercial sector energy demands at the nine Census Division level of detail for 11 distinct categories of commercial buildings. Commercial equipment selections are performed for the major fuels of electricity, natural gas, and distillate fuel, for the major services of space heating, space cooling, water heating, ventilation, cooking, refrigeration, and lighting. The market segment level of detail is modeled using a constrained life-cycle cost minimization algorithm that considers commercial sector consumer behavior and time preference premiums. The algorithm also models the minor fuels of residual oil, liquefied petroleum gas, steam coal, motor gasoline, and kerosene, the renewable fuel sources of wood and municipal solid waste; and the minor services of office equipment (with a separate breakout of personal computers), and "other" in less detail than the major fuels and services. Distributed generation and cogeneration are represented using a detailed cumulative positive cash flow approach to model penetration of distributed resources. Numerous specialized considerations are incorporated, including the effects of changing building shell efficiencies and consumption to provide district services.

Last Model Update:

December 2000

Part of Another Model?

National Energy Modeling System (NEMS)

Sponsor:

- **Office:** Office of Integrated Analysis and Forecasting
- **Division:** Energy Demand and Integration Division
- **Model Contact:** Erin Boedecker
- **Telephone:** (202) 586-4791
- **E-Mail Address:** Erin.Boedecker@eia.doe.gov

Documentation:

U.S. Department of Energy, Energy Information Administration, *Model Documentation Report: Commercial Sector Demand Model of the National Energy Modeling System*, DOE/EIA-M066 (2001) (Washington, DC, December 2000). *http://tonto.eia.doe.gov/FTPROOT/modeldoc/m066(2001).pdf*

Archive Media and Installation Manual(s):

See Integrating Module of the National Energy Modeling System (NEMS).

Coverage:

- **Geographic:** Nine Census Divisions: New England, Mid Atlantic, East North Central, West North Central, South Atlantic, East South Central, West South Central, Mountain, and Pacific
- **Time Unit/Frequency:** Annual through 2020
- **Product(s):** Electricity, natural gas, distillate, residual oil, liquefied petroleum gas, steam coal, motor gasoline, kerosene, wood, municipal solid waste
- **Economic Sector(s):** Eleven building categories: assembly, education, food sales, food services, healthcare, lodging, large office, small office, mercantile and service, warehouse, other. Ten services: space heating, space cooling, water heating, ventilation, cooking, lighting, refrigeration, PC-related office equipment, non PC-related office equipment, and other.

Modeling Features:

- **Model Structure:** Sequential calculation of forecasted commercial floorspace, service demand, distributed resources penetration, technology choice, and end-use consumption
- **Modeling Technique:** Simulation of technology choice by decision type, within a service, within a building and Census division, for the current year of the forecast. Commercial Buildings Energy Consumption Survey 1995 data are used for initial floorspace, market shares, fuel shares, district service shares. Engineering analyses are used for initial efficiency estimates
- **Special Features:** Technology choice data base and simulation technique is capable of accommodating an extensive range of policy analyses, including but not limited to demand-side management capital incentives, tax credits, and equipment efficiency standards.

Non-DOE Input Sources:

- Data Resources Inc. (DRI), F.W. Dodge
  - Commercial sector floorspace growth by Census division and building type
  - Description of floorspace categorization to enable mapping to DOE sources
- Arthur D. Little Technical Reports, EPRI Technical Assessment Guide, GRI Baseline Data Book (references provided in Appendix C to the report)
  - Commercial sector existing equipment characteristics, including typical equipment capacity, installed capital cost, operating and maintenance (O&M) cost, expected physical lifetime based on data from the years 1990-1998
  - Equipment research and development (R&D) advances and projected dates of model introduction, projections for technology availability encompassing the years 1999-2015
- Onsite Energy commercial combined heat and power report
  - Current and projected distributed generation technology cost and performance.

DOE Data Input Sources:

- Form EIA-871, *Commercial Buildings Energy Consumption Survey 1995* (CBECS 1995)
  - Base year floorspace by Census division, building type, building age cohort, energy-consuming characteristics
  - Base year district service consumption totals and relative shares
  - Base year Energy Use Intensity (EUI) by Census division, building type, and energy service
  - Base year equipment stock characteristics by Census division and energy service
  - Base year energy consumption for calculation of nonbuilding consumption to benchmark
- Form EIA-860B, *Annual Electric Generator Report—Nonutility*, forms for years 1995-1998
  - Historical commercial sector quantities of cogenerated electricity by Census division, generating fuel, and building type
  - Annual consumption of fuels for cogeneration by Census division and building type
  - Current status of commercial sector generating facilities
- National Renewable Energy Laboratory (NREL) Interlaboratory Documentation, 1990
  - Forecasted commercial sector renewable energy demand, by renewable source and energy service.

Computing Environment:

See Integrating Module of the National Energy Modeling System (NEMS).

DRI Model of the U.S. Economy (DRI)

Description:

The DRI Model represents national economic production and income corresponding to the National Income and Product Accounts published by the Department of Commerce. These forecasts of national activity extend 25 years and serve as the basis for EIA macroeconomic forecasts. EIA alters the DRI forecasts so that the energy variables included in the macroeconomic model correspond to EIA energy price forecasts.

Last Model Update:

August 2000

Part of Another Model?

No

Sponsor:

- **Office:** Office of Integrated Analysis and Forecasting
- **Division:** International, Economic, and Greenhouse Gases Division
- **Model Contact:** Kay A. Smith
- **Telephone:** (202) 586-1455
- **E-Mail Address:** Kay.Smith@eia.doe.gov

Documentation:

Energy Information Administration, *Documentation of the DRI Model of the U.S. Economy*, DOE/EIA-M061 (Washington, DC, December 1993).
http://tonto.eia.doe.gov/FTPROOT/modeldoc/m061.pdf

Archive Media and Installation Manual(s):

See Integrating Module of the National Energy Modeling System.

Coverage:

- **Geographic:** Quarterly forecasts for 25 years at a national level
- **Time Unit/Frequency:** Quarterly
- **Product(s):** Personal consumption expenditures, producers durable equipment investment, nonresidential construction, residential construction and nondefense Federal Government expenditures, Federal defense expenditures, exports, imports, inventory change in final goods, and inventory change in materials and work-in-process
- **Economic Sector(s):** Domestic spending, domestic income, tax policy, international, financial, inflation, simulated supply potential, expectations.

Modeling Features:

- **Model Structure:** The DRI Model forecasts roughly 1,200 concepts encompassing final demands, aggregate supply, prices, incomes, interest rates, industrial detail, and international trade. There are eight blocks to the model: Domestic spending, domestic income, tax sector, prices, financial, international trade, expectations, and aggregate supply. The domestic spending, income and tax blocks correspond to the National Income and Product Accounts. The rest of the blocks interact with the blocks describing domestic activity
- **Modeling Technique:** Econometric simulation modeling techniques
- **Special Features:** None.

Non-DOE Input Sources:

- U.S. Department of Commerce (Washington, DC)
  - Consumption
  - Investment
  - Residential construction
  - Exports
  - Imports
  - Inventory change
  - Defense spending.

DOE Data Input Sources:

None.

Computing Environment:

See Integrating Module of the National Energy Modeling System.

Electricity Market Module (EMM)

Description:

The NEMS Electricity Market Module (EMM) provides a major link in the NEMS framework. In each model year, the EMM receives electricity demand from the NEMS demand modules, fuel prices from the NEMS fuel supply modules, expectations from the NEMS system module, and macroeconomic parameters from the NEMS macroeconomic module and then estimates the actions taken by electric utilities and nonutilities to meet demand in the most economical manner. The EMM then outputs electricity prices to the demand modules, fuel consumption to the fuel supply modules, emissions to the system module, and capital requirements to the macroeconomic module. The model is iterated until a solution is reached for that model year. The EMM consists of four submodules: Electricity Capacity Planning (ECP), Electricity Fuel Dispatch (EFD), Electricity Finance and Pricing (EFP), and Load and Demand-Side Management (LDSM).

Electricity Capacity Planning Submodule (ECP):

The purpose of the ECP is to determine how the electric power industry will change its mix of generating capacity over the forecast horizon. It is intended to consider investment decisions for both demand- and supply-side options. However, consumer responses are assumed to be represented in the end-use demand modules, so the structure for demand-side management (DSM) options is not utilized within the ECP. It evaluates retirement decisions for fossil and nuclear plants and captures responses to environmental regulations, such as the CAAA or limits on carbon emissions. It includes traditional and nontraditional sources of supply. The ECP also represents changes in the competitive structure (i.e., deregulation). Due to competition, no distinction is made between utilities and nonutilities as owners of new capacity.

Electricity Fuel Dispatch Submodule (EFD):

The objective of the EFD is to represent the economic, operational, and environmental considerations in electricity dispatching and trade. The EFD allocates available generating capacity to meet the demand for electricity on a minimum cost basis, subject to engineering constraints and to restrictions on emissions such as SO2, NOx, mercury, and carbon.

Electricity Finance and Pricing Submodule (EFP):

The EFP forecasts financial information for electric utilities on an annual basis given a set of inputs and assumptions concerning forecast capacity expansion plans, operating costs, regulatory environment, and financial data. The outputs of the model include electricity prices by end use sectors for North American Electric Reliability (NERC) and Census regions, financial statements, revenue requirements, and financial ratios for each state of production (generation, transmission and distribution).

Load and Demand-Side Management Submodule (LDSM):

Broadly speaking, the LDSM submodule has been designed to perform four major functions:

- Translate total electricity consumption forecasts into system load shapes
- Develop utility DSM programs for potential inclusion in future utility capacity expansion plans
- Translate census division demand data into NERC region data, and vice versa
- Report DSM impact on regional system demand.

Emissions

The EMM tracks emission levels for sulfur dioxide (SO2), nitrogen oxides (Nox), and mercury (hg). Facility development, retrofitting, and dispatch are constrained to comply with the constraints to the Clean Air Act Amendments of 1990 (CAAA90) and other pollution constraints. An innovative feature of this legislation is a system of trading emissions allowances. The trading system allows a utility with a relatively low cost of compliance to sell its excess compliance (i.e., the degree to which its emissions per unit of power generated are below maximum allowable levels) to utilities with a relatively high cost of compliance. The trading of emissions allowances does not change the national aggregate emissions level set by CAAA90, but it does tend to minimize the overall cost of compliance.

Last Model Update:

September 2001

Part of Another Model?

Part of the National Energy Modeling System (NEMS)

Sponsor:

- **Office:** Office of Integrated Analysis and Forecasting
- **Division:** Coal and Electric Power Division
- **Model Contact:** Jeffrey Jones
- **Telephone:** (202) 586-2038
- **E-Mail Address:** Jeffrey.Jones@eia.doe.gov

Documentation:

Energy Information Administration, *Model Documentation Report: The Electricity Market Module of the National Energy Modeling System,* DOE/EIA-M068 (Washington, DC, February 2001) *http://tonto.eia.doe.gov/FTPROOT/modeldoc/m0682001.pdf.*

Archive Media and Installation Manual(s):

See Integrating Module of the National Energy Modeling System.

Coverage:

- **Geographic:** 13 North American Electric Reliability Council (NERC) Regions and Subregions, called EMM regions
- **Time Unit/Frequency:** Annually through 2020
- **Product(s):**
  - Electricity prices and price components
  - Fuel demands
  - Capacity additions
  - Capital requirements
  - Emissions
  - Renewable capacity
  - Avoided costs
- **Economic Sector(s):** Electric utilities and non-utilities.

Modeling Features:

- **Model Structure:**
  - ***ECP —*** The ECP is executed once a year to determine planning decisions that must be initiated in the current forecast year and completed within the planning horizon. The ECP uses a linear programming (LP) formulation to compete options for meeting future demands for electricity and complying with environmental regulations. It selects the strategies that minimize the total present value of the investment and operating costs over a pre-specified period, subject to certain conditions. These conditions include requirements that demands for electricity (accounting for seasonal and daily fluctuations variations and transmission/distributions losses) are met, minimum reliability requirements are satisfied, and emissions limits are not exceeded.
  - ***EFD —*** The EFD addresses utility and nonutility supplies endogenously; i.e., the EFD dispatches new nonutility sources together with utility fossil-fuel, geothermal, biomass, and nuclear generating capacity. However, existing nonutility supply, along with nontraditional cogenerators, are considered “must run:” units and are placed such that they are always dispatched. Most of these facilities have contracts with utilities to purchase power, so this treatment ensures that the model output reflects actual usage. Traditional cogeneration and intermittent renewable technologies are represented exogenously with the load curve adjusted prior to dispatching other generating technologies.
  - ***EFP —*** The EFP is an accounting system that models regulatory practice and is completely deterministic. It has solution algorithms for the generation, transmission, and distribution stages of production. Pricing mechanisms are implemented for the generation and transmission stages of production to enhance the model’s flexibility in simulating emerging pricing techniques used in the electric power industry.

- ***LDSM —*** The LDSM submodule is designed to be a fully integrated part of the NEMS framework. The submodule models the impact of DSM activities in terms of changes in load shapes. To do this, the LDSM submodule has a database of end-use load shapes for each of the thirteen EMM regions, being modeled in the NEMS framework. The LDSM also uses a technologies database develops jointly with the demand modules. Individual DSM options then match a base technology ("FROM" technology) to a more efficient DSM technology ("TO" technology). The energy changes and the resulting changes in load shapes (delta load shapes) are computed for each option. These constitute the unit level impact of DSM options. To compute the system level impacts, the DSM options must first be penetrated over time, and then aggregated to a form that can be completed against supply-side options. Details of these processes are given in the sections that follow. The three primary functions of the LDSM submodule are to (a) develop regional system load duration curves from demand estimates for the ECP and EFD modules, (b) screen potential DSM options for analysis by the EMM Capacity Planning module, and (c) supply the demand modules with feedback from the ECP concerning the shifts in end-use technology resulting from the optimal choice of DSM options. In addition to these three functions, the LDSM also translates the nine Census division electricity demand estimates into the 13 NERC regions and subregions that the EMM requires.

- **Modeling Technique:**
  - ***ECP*** — The ECP uses a linear programming (LP) formulation to determine planning decisions for the electric power industry. The ECP contains a representation of planning and dispatching in order to examine the tradeoff between capital and operating costs. It simulates least-cost planning and competitive markets by selecting strategies for meeting expected demands and complying with environmental restrictions that minimize the discounted, present value of investment and operating costs. The ECP explicitly incorporates emissions restrictions imposed by the CAAA90 and provides the flexibility to examine potential regulations such as emissions taxes and carbon stabilization.
  - ***EFD*** — The EFD uses an heuristic approach to provide a least-cost solution to allocating (dispatching) capacity to meet demand. Dispatching involves deciding what generating capacity should be operated to meet the demand for electricity, which is subject to seasonal, daily, and hourly fluctuations. The objective of the EFD is to provide an economic/environmental dispatching procedure. In an economic (least-cost) dispatch, the marginal source of electricity is selected to react to each change in load. In environmental dispatching, the demand for electricity must be satisfied without violating certain emissions restrictions. The EFD integrates the cost-minimizing solution with environmental compliance options to produce the least-cost solution that satisfies electricity demand and restricts emissions to be within specified limits.
  - ***EFP*** — The EFP is an accounting system that models regulatory practice and is completely deterministic. It has solution algorithms for the generation, transmission, and distribution stages of production. Pricing mechanisms are implemented for the generation and transmission stages of production to enhance the model's flexibility in simulating emerging pricing techniques used in the electric power industry. There are many pricing mechanisms that could be used for this purpose. The one that has been included initially in this submodule is the traditional cost of service method. The modular design of this submodule will allow the user to plug in additional pricing methods as they are needed in the future.
  - ***LDSM*** — The basic algorithm can be thought of as end-use building block approach. The system demand is divided into a set of components called end-uses. The hourly loads for each end-use are forecast. Next the hourly loads of each end-use are summed to yield the forecast of system load at the customers' meters (i.e., hourly system sales). The final step is to simulate transmission and distribution losses. The regional hourly loads are calculated as the sum of hourly system sales and transmission and distribution losses.

Non-DOE Input Sources:

- The EPA 1985 National Utility Reference File (NURF), 1989. NURF data were submitted to the 10 EPA regions for review of the following key elements: 1985 SO2 emissions and emissions rate, 1985 total heat input, and 1985 SO2 emission limits and associated variables.
- Data Resources/McGraw-Hill, Inc., *Energy Review,* Winter 1986-1987
- ICF, Incorporated
  - A survey of Canadian taxes
- New England Power Pool, New York Power Pool, and Western Area Power Administration
- NERC Mid-Atlantic Area Council and Northeast Power Coordinating Council
  - Reliability data
    - Electricity prices are calculated by use of a traditional cost of service discounting method for regulated regions, marginal cost calculations for competitive regions, and a mix of both methods when warrented. Accounting also takes into consideration regulatory nuances among regions.

- Pacific Gas and Electric, Hydro-Quebec, Manitoba Hydro, and British Columbia Hydro
- Environmental Protection Agency: *The National Allowance Data Base, Version 2.11,* March 1993
  - Data base elements on utility combustion sources
- 1985 National Emissions Data System (NEDS) submittals
- EPRI, Technical Assessment Guide (TAG) Electricity Supply, 1989
- Oak Ridge National Laboratories, Energy Economic Database (EEDB), various program phases
- Electric Power Research Institute, *Technical Assessment Guide* (EPRI-TAG1993)
  - Photovoltatic cost and performance data
- EPRI, 1991: United Engineers and Constructors*, Technical Feasibility and Costs of Selective Catalytic Reduction NOx Control*, GS-7276
- EPRI, 1991: United Engineers and constructors*, Economic Evaluation of Flue Gas Desulfurization Systems*, GS-7193
- Vatabuk, *Estimating Costs of Air Pollution Controls,* Louis Publishers, 1990.

DOE Data Input Sources:

Forms and Publications:

- Energy Information Administration, Form EIA-860, *Annual Generator Report*
  - Capacity and fuel source information
- Energy Information Administration, Form EIA-867, *Annual Nonutility Power Producer Report*
  - Installed capacity, energy consumption, generation and electric energy sales to electric utilities and other nonutilities by facility
- EIA, Electric Plant Cost and Power Production Expenses, 1990
- Distributed Utility Associates, *Assessing Market Acceptance and Penetration for Distributed Generation in the United States*, Spring 1999, prepared for EIA. This report contains cost and performance characteristics for modeling distributed generation in the Electricity Market Module
- Energy Information Administration, Form EIA-767, *Steam Electric Plant Operation and Design Report*
  - Plant operations and equipment design (including boiler, generator, cooling system, flue gas desulfurization, flue gas particulate collectors, and stack data)
- Energy Information Administration, Form EIA-759, *Monthly Power Plant Report*
  - Monthly data on net generation, consumption of coal, petroleum, and natural gas; and end-of-the-month stocks of petroleum and coal for each plant by prime mover and fuel type combination
- Energy Information Administration, Form EIA-411, *Coordinated Regional Bulk Power Supply Program Report*
  - Actual energy and peak demand for the preceding year and 10 additional years; existing and future generating capacity; scheduled capacity transfers; projections of capacity, demand, purchases, sales, and scheduled maintenance; assessment of adequacy; generating capacity unavailability; bulk power system maps; near term transmission adequacy; future critical bulk power facilities that may not be in service when required; and system evaluation criteria.
- Federal Energy Regulatory Commission, Form FERC-423, *Monthly Report of Cost and Quality of Cost and Quality of Fuels for Electric Plants*
  - Cost and performance data for both existing and future units.

Models and Other:

- Energy Information Administration, Office of Integrated Analysis and Forecasting, "Cost and Performance Database for New Generating Technologies"
  - A database of current costs and performance characteristics
- Energy Information Administration, *Annual Outlook for U.S. Electric Power,* 1987
  - EIA survey data
- U.S. Department of Energy, *Northern Lights: The Economic and Practical Potential of Imported Power from Canada*, DOE/PE-0079 (Washington, DC, December 1987)
  - Capital costs to build
  - Variable and fixed operating and maintenance costs
  - Transmission costs
  - Various publications on Canadian energy supply cited in the Northern Lights bibliography

System Modules:

- Cogeneration and other electricity production, Commercial and Industrial Demand Modules
- Generation from renewable sources
- Renewables Fuels Module
- Fossil fuel prices — Fuel Supply Modules of NEMS
- SO2 and mercury emissions — Coal Market Module
- Bond rates — Macroeconomic Activity Module
- Capacity utilization by technology — Renewable Fuels Module
- Electricity consumption by sector and region, traditional cogeneration

Demand Modules:

- Fuel and variable O&M costs, fixed O&M costs, SO2 allowance costs, RPS allowance costs, trade results and nonutility generation — EFD
- Sectoral consumption by time period — LDSM
- New plant capital costs, plant type, ownership type, and retrofit decisions — ECP
- EIA, Advanced Reactor Sourcebook.

Industrial Demand Module (IDM)

Description:

The Industrial Demand Module is based upon economic and engineering relationships that model industrial sector energy consumption at the nine Census Division level of detail. The seven most energy-intensive industries are modeled at the detailed process step level and eight other industries are modeled at a less detailed level. The Industrial Demand Module incorporates three components: buildings; process and assembly; and boiler, steam, and cogeneration.

Last Model Update:

September 2000

Part of Another Model?

Part of the National Energy Modeling System (NEMS)

Sponsor:

- **Office:** Office of Integrated Analysis and Forecasting
- **Division:** Demand and Integration Division
- **Model Contact:** T. Crawford Honeycutt
- **Telephone:** (202) 586-1420
- **E-Mail Address:** Crawford.Honeycutt@eia.doe.gov

Documentation:

Energy Information Administration, *Model Documentation Report: Industrial Sector of the National Energy Modeling System,* DOE/EIA-M064 (Washington, DC, December 2000)
http://tonto.eia.doe.gov/FTPROOT/modeldoc/m064(2001).pdf.

Archive Media and Installation Manual(s):

See Integrating Module of the National Energy Modeling System.

Coverage:

- **Geographic:** Nine Census divisions: New England, Mid-Atlantic, East North Central, West North Central, South Atlantic, East South Central, West South Central, Mountain, and Pacific
- **Time Unit/Frequency:** Annual through 2020.

Modeling Features:

- **Model Structure:** Nine manufacturing and six nonmanufacturing industries. The manufacturing industries are further subdivided into the energy-intensive and nonenergy-intensive industries
  - Each industry is modeled as three separate but interrelated components consisting of the process/assembly component (PA), the buildings component (BLD), and the boiler/steam/cogeneration component (BSC)
- **Modeling Technique:** The energy-intensive industries are modeled through the use of a detailed process flow accounting procedure. The remaining industries use the same general procedure but do not include a detailed process flow.

Non-DOE Input Sources:

- National Energy Accounts
  - Historical dollar value of output in the industrial sector.

DOE Input Sources:

- Form EI-867, *Survey of Independent Power Producers*
  - Electricity generation, total and by prime mover
  - Electricity generation for own use and sales
  - Capacity utilization
- *Manufacturing Energy Consumption Survey 1994*, December 1997
- *State Energy Data System 1997,* September 1999.

Computing Environment:

See Integrating Module of the National Energy Modeling System.

International Energy Module (IEM)

Description:

IEM is a recursive model of world petroleum supply and demand by region derived from EIA's Oil Market Simulation (OMS-PC) Model with enhanced detail on U.S. market conditions from the NEMS Petroleum Market Model (PMM). IEM determines PAD District-level import supply schedules by refined product type and crude oil grade consistent with estimated world oil price. IEM outputs include forecasted world oil price, non-OPEC oil production and oil consumption by region, and OPEC oil production and capacity utilization.

Last Model Update:

February 1999

Part of Another Model?

National Energy Modeling System (NEMS)

Sponsor:

- **Office:** Office of Integrated Analysis and Forecasting
- **Division:**International, Economic, and Greenhouse Gases Division
- **Model Contact:** Dan Butler
- **Telephone:** (202) 586-9503
- **E-Mail Address:** george.butler@eia.doe.gov

Documentation:

Energy Information Administration, *Model Documentation Report: NEMS International Energy Module,* DOE/EIA-M071 (99) (Washington, DC, February 1999)
http://tonto.eia.doe.gov/FTPROOT/modeldoc/m07199.pdf.

Archive Media and Installation Manual(s):

See the Integrating Module of the National Energy Modeling System

Coverage:

- **Geographic:**
  - ***Demand Regions:*** United States (50 States and territories), Canada, Mexico, Japan, Australia and New Zealand, OECD Europe, Other Central and South America, Pacific Rim, Other Developing Countries, Former Soviet Union, Eastern Europe, China, OPEC
  - ***Supply Regions:*** United States (50 States and territories), Canada, Mexico, Japan, Australia and New Zealand, OECD Europe, Other Central and South America, Pacific Rim, Other Developing Countries, Former Soviet Union, Eastern Europe, China, OPEC
  - ***U.S. Detail:*** PAD District-level import supply curves
- **Time Unit/Frequency:** Annual through 2020
- **Product(s):** 5 grades of crude oil, 10 refined products, and 2 oxygenates (methanol and MTBE)
- **Economic Sector(s):** Major oil-consuming countries, regionalized above.

Modeling Features:

- **Model Structure:** The model includes three subcomponents: The World Oil Market (WOM); Petroleum Product Supply (PPS); and Oxygenates Supply (OS). The structure of the WOM component is based on the OMS model, with greater U.S. detail from NEMS PMM
- **Modeling Technique:** Recursive simulation (search for equilibrium oil price), linear programming (derive import supply curves), econometrics (estimate parameters of OPEC price reaction curve and rest of world crude demand/supply curves)
- **Special Features:** None.

Non-DOE Input Sources:

None.

DOE Data Input Sources:

- Energy Information Administration, *Annual Energy Review, Monthly Energy Review, International Energy Annual*, and *International Petroleum Statistics Report* (Washington, DC, annually)
  - U.S. crude oil supply and demand from PMM, reference demand and supply for rest of world (ROW) regions, initial (unadjusted) import supply curves from WORLD LP model.

Computing Environment:

See Integrating Module of the National Energy Modeling System.

Macroeconomic Activity Module (MAM)

Description:

MAM is comprised of four submodules: National, Employment, Interindustry, and Regional. The ***National Submodule*** is a kernel regression approximation of the proprietary U.S. Quarterly Macroeconomic Model developed by Data Resources/ McGraw-Hill, Inc. (DRI). The U.S. Quarterly Model is a 1,200 equation econometric specification that forecasts macroeconomic driver variables at the national level of detail.

The ***Interindustry Submodule*** is a response surface approximation of the DRI Personal Computer Input-Output (PCIO) Model. The DRI PCIO model is a detailed input-output representation of interindustry linkages that works in tandem with the full DRI U.S. Quarterly Model.

The ***Employment Submodule*** is a response surface approximation of the DRI Econometric Model of Employment by Industry. The DRI Econometric Model of Employment by Industry, on which the response surface Employment Submodule is based, uses interindustry gross output from DRI's Personal Computer Input-Output (PCIO) Model as its major input when determining employment.

The ***Regional Submodule*** consists of a set of shares at the nine Census Division level of detail developed from simulations of DRI's U.S. Quarterly Macroeconomic Model, PCIO Model, Employment Model, and Regional Model. The regional shares included as the Regional Submodule of MAM are used to disaggregate the national results generated by the National, Interindustry, and Employment Submodules of MAM to the nine Census Division level of detail.

Last Model Update:

December 2000

Part of Another Model?

National Energy Modeling System (NEMS)

Sponsor:

- **Office:** Office of Integrated Analysis and Forecasting
- **Division:** International, Economic, and Greenhouse Gases Division
- **Model Contact:** Ron Earley
- **Telephone:** (202) 586-1398
- **E-Mail Address:** Ronald.Earley@eia.doe.gov

Documentation:

Energy Information Administration, *Model Documentation Report: Macroeconomic Activity Module (MAM) of the National Energy Modeling System,* DOE/EIA-M065 (2001) (Washington, DC, December 2000).
http://tonto.eia.doe.gov/FTPROOT/modeldoc/m065(2001).pdf

Archive Media and Installation Manual(s):

See Integrating Module of the National Energy Modeling System.

Coverage:

- **Geographic:** Nine Census Divisions
- **Time Unit/Frequency:** Annual through 2020
- **Product(s):** Forecasts of domestic macroeconomic driver variables, at the national, interindustry, and nine Census Division levels of detail

- **Economic Sector(s):** National macroeconomic activity.

Modeling Features:

- **Model Structure:** MAM is composed of four Submodules: National, Interindustry, Employment, and Regional. The four submodules are executed sequentially in the order presented, and subsequent submodules build upon the results of previously executed submodules
- **Modeling Technique:** The National Submodule is a kernel regression representation, and the Employment and Interindustry Submodules of MAM are econometric response surface representations of large proprietary econometric models. The Regional Submodule of MAM is composed of shares developed from simulations of large econometric macroeconomic, interindustry, employment, and regional models
- **Special Features:** None.

Non-DOE Input Sources:

DRI input data from the DRI U.S. Quarterly Macroeconomic Model, the DRI PCIO Model, the DRI Employment Model, and the DRI Regional Model.

DOE Data Input Sources:

MAM relies upon the DRI input data to generate the baseline growth path. Alternative growth paths are developed based on alternative economic driver variable growth path assumptions. DOE data are not used to develop the MAM.

Computing Environment:

See Integrating Module of the National Energy Modeling System.

Natural Gas Transmission and Distribution Model (NGTDM)

Description:

The Natural Gas Transmission and Distribution Model (NGTDM) is the component of the National Energy Modeling System (NEMS) that represents the mid-term natural gas market. The purpose of the NGTDM is to derive natural gas supply and end-use prices and flow patterns for movements of natural gas through the regional interstate network. The prices and flow patterns are derived by obtaining a market equilibrium across the three main components of the natural gas market: the supply component, the demand component, and the transmission and distribution network that links them.

Last Model Update:

October 2000

Part of Another Model?

Yes, the National Energy Modeling System (NEMS)

Sponsor:

- **Office:** Office of Integrated Analysis and Forecasting
- **Division:** Oil and Gas Division
- **Model Contact:** Joseph Benneche
- **Telephone:** (202) 586-6132
- **E-Mail Address:** Joseph.Benneche@eia.doe.gov

Documentation:

- Energy Information Administration, *Model Documentation of the Natural Gas Transmission and Distribution Model (NGTDM) of the National Energy Modeling System (NEMS),* DOE/EIA-M062 (Washington, DC, February 2001) *http://tonto.eia.doe.gov/FTPROOT/modeldoc/m0622001.pdf.*

Archive Media and Installation Manual(s):

See Integrating Module of the National Energy Modeling System.

Coverage:

- **Geographic:** Demand regions are the 12 NGTDM regions, which are based on the 9 Census Divisions with Census Division 5 split further into South Atlantic and Florida, Census Division 8 split further into Mountain and Arizona/New Mexico, and Census Division 9 split further into California and Pacific, with Alaska and Hawaii handled separately. Production is represented in the lower 48 at 17 onshore and 3 offshore regions. Import/export border crossings include 3 at the Mexican border, 7 at the Canadian border, and 4 liquefied natural gas import terminals. A simplified Canadian representation is subdivided into an eastern and western region
- **Time Unit/Frequency:** Annual through 2020
- **Product(s):** Natural gas
- **Economic Sector(s):** Residential, commercial, industrial, electric generators, and transportation.

Modeling Features:

- **Model Structure:** Modular; three major components: the Interstate Transmission Module (ITM), the Pipeline Tariff Module (PTM), and the Distributor Tariff Module (DTM)
  - ***ITM***: Integrating module of the NGTDM. Simulates the natural gas price determination process by bringing together all major economic and technological factors that influence regional natural gas trade in the United States. Determines natural gas flows and prices, and pipeline and storage capacity expansion and utilization for a simplified network representing the interstate natural gas pipeline system
  - ***PTM***: Develops parameters for setting tariffs in the ITM for transportation and storage services provided by interstate pipeline companies
  - ***DTM:*** Develops markups for distribution services provided by local distribution companies and intrastate pipeline companies

- **Modeling Technique:**
  - ***ITM***: Heuristic algorithm, operates iteratively until supply/demand convergence is realized across the network
  - ***PTM***: Econometric estimation and accounting algorithm
  - ***DTM***: Empirical process.
- **Special Features:**
  - Represents interregional flows of gas and pipeline capacity constraints for two seasonal periods
  - Represents regional supplies
  - Determines the amount and the location of pipeline and storage facility capacity expansion on a regional basis
  - Captures the economic tradeoffs between pipeline capacity additions and increases in regional storage capability
  - Distinguishes end-use customers by type (core and noncore).

Non-DOE Input Sources:

- Information Resources, Inc., *Octane Week*
  - Federal vehicle natural gas (VNG) taxes
- Canadian Petroleum Association Statistical Handbook
  - Historical Canadian supply and consumption data
- Mineral Management Service, Federal Offshore Statistics 1995
  - Alabama and Louisiana State and Federal offshore production before 1990
- Mineral Management Service
  - Revenues and volumes for offshore production in Texas, California, and Louisiana
- Foster Pipeline Financial Cost Data
  - Pipeline financial data
- Alaska Department of Natural Resources
  - State of Alaska north to south historical natural gas consumption ratio
- Data Resources Inc., U.S. Quarterly Model
  - Yield on AA utility bonds
- Board of Governors of the Federal Reserve System Statistical Release, *Selected Interest Rates and Bond Prices*
  - Real average yield on 10-year U.S. government bonds.

DOE Data Input Sources:

Forms and Publications:

- Energy Information Administration, Form EIA-23, *Annual Survey of Domestic Oil and Gas Reserves*
  - Annual estimate of gas reserves by type and State
- Energy Information Administration, Form EIA-176, *Annual Report of Natural and Supplemental Gas Supply and Disposition*
  - Annual natural gas sources of supply, consumption, and flows on the interstate pipeline network
- Energy Information Administration, Form EIA-857, *Monthly Report of Natural Gas Purchases and Deliveries to Consumers*
  - Monthly natural gas price and volume data on deliveries to end users
- Energy Information Administration, Form EIA-895, *Monthly Quantity of Natural Gas Report*
  - Monthly natural gas production
- Energy Information Administration, Form EIA-860, *Annual Electric Generator Report*
  - Electric generators plant type and code information, used in the classification of power plants as core or noncore customers. Data from this report are also used in the derivation of historical prices and markups for firm interruptible service

- Energy Information Administration, Form EIA-767, *A Steam-Electric Plant Operation and Design Report*
  - Electric generators plant type and boiler information, by month, used in the classification of power plants as core or noncore customers. Data from this report are also used in the derivation of historical prices and markups for firm/interruptible service
- Energy Information Administration, Form EIA-759, *Monthly Power Plant Report*
  - Natural gas consumption by plant code and month, used in the classification of power plants as core or noncore customers. Data from this report are also used in the derivation of historical prices and markups for firm/interruptible services
- Rate case filings under Section 4 of the Natural Gas Policy Act, as submitted to FERC by each pipeline company
  - Contract demand data and cost allocation by pipeline company
- *Annual Energy Review*, DOE/EIA-0384
  - Gross domestic product and implicit price deflator
- Federal Energy Regulatory Commission, Form FERC-2, *Annual Report of Major Natural Gas Companies*
  - Financial statistics of major interstate natural gas pipelines
  - Annual purchases/sales by pipeline (volume and price)
- Federal Energy Regulatory Commission, Form FERC-567, *Annual Flow Diagram*
  - Pipeline capacity and flow information
- Energy Information Administration, Form EIA-191, *Underground Gas Storage Report*
  - Base gas and working gas storage capacity and monthly storage injection and withdrawal levels by region and pipeline company
- Energy Information Administration, Form EIA-846, *Manufacturing Energy Consumption Survey*
  - Base year average annual core industrial end-use prices
- *Capacity and Service on the Interstate Natural Gas Pipeline System 1990,* DOE/EIA-0556
  - Pipeline capacity and capacity reservations by customer
- Federal Energy Regulatory Commission, NGA Section 7(c) Filings, "Applications for Certification of Public Convenience and Necessity"
  - Planned pipeline capacity additions
- Energy Information Administration, *Short-Term Energy Outlook,* DOE/EIA-0131
  - National forecast targets for first two forecast years beyond history
- Federal Energy Regulatory Commission, Form 423*, Cost and Quality of Fuels for Electric Utility Plants*, DOE/EIA-0191
  - Natural gas prices to electric generators
- Department of Energy, www.afdc.doe.gov
  - Compressed natural gas vehicle taxes by state
- Department of Energy, *Natural Gas Imports and Exports,* Office of Fossil Energy
  - Import volumes by crossing in the most recent historical year
- Department of Energy, *The Climate Change Action Plan Technical Supplement*
  - Estimated savings from fugitive emissions.

Models and Other:

- Energy Information Administration, National Energy Modeling System (NEMS)
  - Domestic supply, imports, and demand representations are provided as inputs to the NGTDM from other NEMS modules.

Computing Environment:

See Integrating Module of the National Energy Modeling System.

Oil and Gas Supply Module (OGSM)

Description:

OGSM is used by the Oil and Gas Division in the Office of Integrated Analysis and Forecasting as an analytic aid to support preparation of projections of reserves and production of crude oil and natural gas at the regional and national levels. The annual projections and associated analyses appear in the *Annual Energy Outlook* (DOE/EIA-0383) of the Energy Information Administration. The projections also are provided as a service to other branches of the U.S. Department of Energy, the Federal Government, and non-Federal public and private institutions concerned with the crude oil and natural gas industry.

OGSM projects the following aspects of the crude oil and natural gas supply industry:

- production
- reserves
- drilling activity
- natural gas imports and exports.

Last Model Update:

January 2001

Part of Another Model?

National Energy Modeling System (NEMS)

Sponsor:

- **Office:** Office of Integrated Analysis and Forecasting
- **Division:** Oil and Gas Division
- **Model Contact:** Ted McCallister
- **Telephone:** (202) 586-4820
- **E-Mail Address:** Ted.McCallister@eia.doe.gov

Documentation:

Energy Information Administration, *Documentation of the Oil and Gas Supply Module* (OGSM), DOE/EIA-M063 (Washington, DC, January 2001)
http://tonto.eia.doe.gov/FTPROOT/modeldoc/m063(2001).pdf.

Coverage:

- **Geographic:** Six lower 48 onshore supply regions, three lower 48 offshore regions, and three Alaskan regions.
- **Time Unit/Frequency:** Annually through 2020
- **Product(s):** Crude oil and natural gas
- **Economic Sector(s):** Oil and gas field production activities and foreign natural gas trade.

Modeling Features:

- **Model Structure:** Modular, containing six major components
  - Lower 48 Onshore Supply Submodule
  - Unconventional Gas Recovery Supply Submodule
  - Offshore Supply Submodule
  - Foreign Natural Gas Supply Submodule
  - Enhanced Oil Recovery Submodule
  - Alaska Oil and Gas Supply Submodule
- **Modeling Technique:** The OGSM is a hybrid econometric/discovery process model. Drilling activities in the United States are determined by the discounted cash flow that measures the expected present value profits for the proposed effort and other key economic variables. LNG imports are projected on the basis of unit supply costs for gas delivered into the lower 48 pipeline network
- **Special Features:** Can run stand-alone or within the NEMS. Integrated NEMS runs employ short-term natural gas supply functions for efficient market equilibration.

Non-DOE Input Sources:

- Alaskan Oil and Gas Field Size Distributions, U.S. Geological Survey
- Alaska Facility Cost by Oil Field Size, U.S. Geological Survey
- Alaska Operating Cost, U.S. Geological Survey
- Basin Differential Prices, *Natural Gas Week*, Washington, DC.
- State Corporate Tax Rate, Commerce Clearing House, Inc., *State Tax Guide*
- State Severance Tax Rate, Commerce Clearing House, Inc., *State Tax Guide*
- Federal Corporate Tax Rate, Royalty Rate, U.S. Tax Code
- Onshore Drilling Costs – (1) American Petroleum Institute, *Joint Association Survey of Drilling Costs (1970-1998)*, Washington, DC.; (2) Additional unconventional gas recovery drilling and operating cost data from operating companies
- Shallow Offshore Drilling Costs, American Petroleum Institute, *Joint Association Survey of Drilling Costs (1970-1998)*, Washington, DC
- Shallow Offshore Lease Equipment and Operating costs, Department of Interior. Minerals Management Service (correspondence from Gulf of Mexico and Pacific OCS regional offices)
- Shallow Offshore Wells Drilled per Project, Department of Interior. Minerals Management Service (correspondence from Gulf of Mexico and Pacific OCS regional offices
- Shallow and Deep Offshore Technically Recoverable Oil and Gas Undiscovered Resources, Department of Interior. Minerals Management Service (correspondence from Gulf of Mexico and Pacific OCS regional offices)
- Deep Offshore Exploration, Drilling, Platform, and Production Costs, American Petroleum Institute, *Joint Association Survey of Drilling Costs (1995)*, ICF Resource Incorporated (1994), Oil and Gas Journals
- Canadian Royalty Rate, Corporate Tax Rate, Provincial Corporate Tax Rate, Energy Mines and Resources Canada. *Petroleum Fiscal Systems in Canada* (Third Edition, 1988)
- Canadian Wells Drilled, Canadian Petroleum Association, *Statistical Handbook (1976-1993)*
- Canadian Lease Equipment and Operating Costs, Sproule Associates Limited, *The Future Natural Gas Supply Capability of the Western Canadian Sedimentary Basin* (report prepared for TransCanada Pipelines Limited, January 1990)
- Canadian Recoverable Resource Base, National Energy Board, *Canadian Energy Supply and Demand 1990-2010*, June 1991
- Canadian Reserves, Canadian Petroleum Association, *Statistical Handbook (1976-1993)*
- Unconventional Gas Resource Data – (1) USGS 1995 National Assessment of United States Oil and Natural Gas Resources; (2) Additional unconventional gas data from operating companies
- *Unconventional Gas Technology Parameters – (1) Advanced Resources International Internal studies; (2) Data gathered from operating companies.*

DOE Data Input Sources:

- Onshore Lease Equipment Cost, Energy Information Administration. *Costs and Indexes for Domestic Oil and Gas Field Equipment and Production Operations (1980-1998)*, DOE/EIA-0815 (80-98)
- Onshore Operating Cost, Energy Information Administration. *Costs and Indexes for Domestic Oil and Gas Field Equipment and Production Operations (1980-1998)*, DOE/EIA-0815 (80-98)
- Emissions Factors, Energy Information Administration
- Oil and Gas Well Initial Flow Rates, Energy Information Administration, Office of Oil and Gas
- Wells Drilled, Energy Information Administration, Office of Oil and Gas
- Expected Recovery of Oil and Gas Per Well, Energy Information Administration, Office of Oil and Gas
- Undiscovered Recoverable Resource Base, Energy Information Administration, *The Domestic Oil and Gas Recoverable Resource Base: Supporting Analysis for the National Energy Strategy*, SR/NES/92-05
- Oil and Gas Reserves, Energy Information Administration. *U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves (1977-1998)*, DOE/EIA-0216 (77-98).

Computing Environment

See Integrating Module of the National Energy Modeling System.

Petroleum Market Model (PMM)

Description:

The Petroleum Market Model is a simulation of the U.S. petroleum industry. It includes 12 domestic crude oil production regions, three refining centers with full processing representations and capacity expansion capability and gas plant liquid production, and nine marketing regions. The heart of the model is a linear program optimization which ensures a rational economic simulation of decisions of petroleum sourcing, resource allocations, and the calculation of marginal price basis for the products. Eighteen refined products are manufactured, imported, and marketed. Seven of these products are specification blended, while the remaining 11 are recipe blended. Capacitated transportation systems are included to represent existing intra-U.S. crude oil and product shipments (liquefied petroleum gas, clean, dirty) via pipeline, marine tanker, barge, and truck/rail tankers. The export and import of crude oil and refined products are also simulated. All imports are purchased in accordance with import supply curves. Domestic manufacture of methanol is represented as though the processing plants were a part of the refinery complexes, whereas ethanol sources are treated as merchant. Transportation is allowed for ethanol shipments to the demand region terminals for splash blending. The program is written in FORTRAN, which includes callable subroutines allowing full communication with the LP portion of the model, which is in the form of an MPS resident file.

Last Model Update:

February 2001

Part of Another Model?

National Energy Modeling System (NEMS)

Sponsor:

- **Office:** Office of Integrated Analysis and Forecasting
- **Division:** Oil and Gas Division
- **Model Contact:** Han-Lin Lee
- **Telephone:** (202) 586-4247
- **E-Mail Address:** HLee@eia.doe.gov

Documentation:

- Energy Information Administration, *EIA Model Documentation: Petroleum Market Model of the National Energy Modeling System* (NEMS), DOE/EIA-M059 (2001) (Washington, DC, February 2001) *http://tonto.doe.eia.gov/FTPROOT/modeldoc/m0592001.pdf.*

Archive Media and Installation Manual(s):

See Integrating Module of the National Energy Modeling System.

Coverage:

- **Geographic:** Twelve domestic crude oil production regions (East Coast, Gulf Coast, Mid-Continent, Permian Basin, Rocky Mountain, West Coast, Atlantic Offshore, Gulf Offshore, Pacific Offshore, Alaska South, Alaska North, and Alaska Offshore); three refining regions (PAD District I, an aggregate of PAD Districts II-IV, and PAD District V); nine market regions, the Census divisions (New England, Mid Atlantic, East North Central, West North Central, South Atlantic, East South Central, West South Central, Mountain, and Pacific)
- **Time Unit/Frequency:** Annual through 2020
- **Product(s):** LPG, conventional motor gasoline, conventional high-oxygen motor gasoline, reformulated motor gasoline, California Air Resources Board (CARB) gasoline, M85, E85, jet fuel, distillate fuel oil, highway diesel, low-sulfur residual fuel oil, high-sulfur residual fuel oil, petrochemical feedstocks, asphalt/road oil, marketable coke, still gas, other
  - ***Refinery Processes:*** crude distillation, vacuum distillation, delayed coker, fluid coker, visbreaker, fluid catalytic cracker, thermal cracker, hydrocracker-dist, hydrocracker-resid, solvent deasphalter, resid desulfurizer, FCC feed hydrofiner, distillate HDS, naphtha hydrotreater, catalytic reformer-450 psi, catalytic reformer-200 psi, alkylation plant, catalytic polymerization, pen/hex isomerization, butane isomerization, etherification, butanes splitter, dimersol, butylene isomerization, total recycle isomerization, naphtha splitter, C2-C5 dehydrogenator, cyclar unit hydrogen plant, sulfur plant, aromatics recovery plant, lube + wax plants, FCC gasoline splitter, gas/H2 splitter, stream transfers, fuel system, steam production, power generation

– ***Crude Oil:*** Alaska low sulfur light, Alaska mid sulfur heavy, domestic low sulfur light, domestic midsulfur heavy, domestic high sulfur light, domestic high sulfur heavy, domestic high sulfur very heavy, imported low sulfur light, imported mid sulfur heavy, imported high sulfur light, imported high sulfur heavy, imported high sulfur very heavy

– ***Transportation Modes:*** Jones Act dirty marine tanker, Jones clean marine tanker, LPG marine tanker, import tankers, clean barge, dirty barge, LPG pipeline, clean pipelines, dirty pipelines, rail/truck tankers. These cover all significant U.S. links.

Modeling Features:

- **Model Structure:** FORTRAN callable subroutines, which update the linear programming matrix, re-optimize, extract and post-process the solution results, update system variables, and produce reports
- **Modeling Technique:** Optimization of linear programming representation of refinery processing and transportation which relates the various economic parameters and structural capabilities with resource constraints to produce the required product at minimum cost, thereby producing the marginal product prices in a manner that accounts for the major factors applicable in a market economy
- **Special Features:** Choice of imports or domestic production of products is modeled, capacity expansion is determined endogenously, product prices include fixed and environmental costs, oxygenated and reformulated gasolines and low-sulfur diesel fuel are explicitly modeled.

Non-DOE Input Sources:

Information Resources Inc. (IRI), WORLD Model data; National Petroleum Council; ICF Resources, *Oil and Gas Journal.*

DOE Data Input Sources:

- EIA-14, *Refiners' Monthly Cost Report*
- EIA-182, *Domestic Crude Oil First Purchase Report*
- EIA-782A, *Refiners'/Gas Plant Operators' Monthly Petroleum Product Sales Report*
- EIA-782B, *Reseller/Retailer's Monthly Petroleum Product Sales Report*
- EIA-782C, *Monthly Report of Prime Supplier Sales of Petroleum Products Sold for Local Consumption*
- EIA-759, *Monthly Power Plant Report*
- EIA-810, *Monthly Refinery Report*
- EIA-811, *Monthly Bulk Terminal Report*
- EIA-812, *Monthly Product Pipeline Report*
- EIA-813, *Monthly Crude Oil Report*
- EIA-814, *Monthly Imports Report*
- EIA-817, *Monthly Tanker and Barge Movement Report*
- EIA-820, *Annual Refinery Report*
- EIA-826, *Monthly Electric Utility Sales and Revenue Report with State Distributions*
- EIA-856, *Monthly Foreign Crude Oil Acquisition Report*
- EIA-860B, *Electric Generation Report — Nonutility*
- FERC-423, *Monthly Report of Cost and Quality of Fuels for Electric Plants*
- In addition to the above, information is obtained from several Energy Information Administration formal publications: *Petroleum Supply Annual, Petroleum Supply Monthly, Petroleum Marketing Annual, Petroleum Marketing Monthly, Fuel Oil and Kerosene Sales, Natural Gas Annual, Natural Gas Monthly, Annual Energy Review, Monthly Energy Review, State Energy Data Report,* and *State Energy Price and Expenditure Report.*

Computing Environment:

See Integrating Module of the National Energy Modeling System.

Renewable Fuels Module (RFM)

Description:

The RFM consists of five analytical submodules that represent major renewable energy resources — landfill gas, wind energy, solar, biomass, and geothermal electric.

The purpose of the RFM is to define the technological, cost and resource size characteristics of renewable energy technologies. They are provided to the Electricity Market Module (EMM***)*** for grid-connected electricity capacity planning decisions. The characteristics include available energy capacity, capital costs, fixed operating costs, variable operating costs, capacity factor, heat rate, construction lead time, and fuel product price.

The ***Landfill Gas Submodule (LFG)*** provides the NEMS Electricity Market Module with annual regional projections of energy produced from landfill gas. The submodule provides regional forecasts of electric capacity to be decremented from electric utility capacity requirements, as well as capital and operating costs for the calculation of electricity prices.

The purpose of the ***Wind Energy Submodule (WES)*** is to project the cost, performance, and availability of wind-generated electricity, and provide this information to the Electricity Capacity Planning (ECP) component of the Electric Market Module (EMM) for building the new capacity in competition with other sources of electricity generation.

The purpose of the NEMS ***Solar Submodule (SOLAR)*** is to define the costs and performance characteristics of central station Solar Thermal (ST) and Photovoltaic (PV) electricity generating technologies and to pass them to the EMM for capacity planning decisions.

The ***Biomass Submodule*** passes to the EMM cost and performance characteristics by EMM regions and years. The fuel component of the cost characteristics is determined from the regional biomass supply schedules and then converted to a variable O&M cost.

The purpose of the ***Geothermal Electric Submodule (GES)*** is to provide the Electricity Capacity Planning (ECP) module the amounts of available geothermal generating capacity and its cost and performance characteristics for competition in the ECP for new regional electricity supply in the Western United States.

Last Model Update:

February 2001

Part of Another Model?

National Energy Modeling System (NEMS)

Sponsor:

- **Office:** Office of Integrated Analysis and Forecasting
- **Division:** Coal and Electric Power Division
- **Model Contact:** Zia Haq
- **Telephone:** (202) 586-2869
- **E-Mail Address:** Zia.Haq@eia.doe.gov

Documentation:

Energy Information Administration, *Model Documentation Report, Renewable Fuels Module of the National Energy Modeling System,* DOE/EIA-M069 (2001) (Washington, DC, February 2001)
http://tonto.eia.doe.gov/FTPROOT/modeldoc/m0692001.pdf.

Archive Media and Installation Manual(s):

See Integrating Module of the National Energy Modeling System.

Coverage:

Landfill Gas Submodule:

- **Geographic:** Thirteen modified EMM regions
- **Time Unit/Frequency:** Annual through 2020
- **Product(s):** Generating capacity
- **Economic Sector(s):** Electric utility sector.

Wind Energy Submodule:

- **Geographic:** 13 EMM Regions: East Central, Texas, Mid-Atlantic, Mid-America, Mid-Continent, Northeast, New England, Florida, Southeastern, Southwest, Western, Rocky Mountain, California and South Nevada
- **Time Unit/Frequency:** Annual through 2020
- **Product(s):** Electricity
- **Economic Sector(s):** Electric utility sector, nonutility generators (NUGS).

Solar Submodule:

- **Geographic:** *For PV 13 EMM* Regions: East Central, Texas, Mid-Atlantic, Mid-America, Mid-Continent, Northeast, New England, Florida, Southeastern, Southwest, Western, Rocky Mountain and Arizona, California and South Nevada. *For solar thermal:* Western, Rocky Mountain, California, and South Nevada
- **Time Unit/Frequency:** Annual through 2020
- **Product(s):** Electricity.

Biomass Submodule:

- **Geographic:** 13 EMM Regions
- **Time/Unit Frequency:** Annual through 2020
- **Product(s):** Electricity.

Geothermal Electric Submodule:

- **Geographic:** EMM Regions 11, 12, 13
- **Time Unit/Frequency:** Annual through 2020
- **Product(s):** Electricity
- **Economic Sector(s):** Electric generators.

Modeling Features:

Landfill Gas Submodule:

- **Model Structure:** Sequential calculation of landfill gas to electricity generation, followed by derivation of regional and sector energy shares based on estimates of the percentage of landfill gas combusted
- **Modeling Technique:** Econometric estimation of municipal solid waste generation, coupled with an energy share allocation algorithm for deriving electric generation capacity and energy quantities by sector and region
- **Special Features:** Allows for the modeling of regional and national resource recovery efforts.

Wind Energy Submodule:

- **Model Structure:** Sequential calculation of available wind capacity by EMM Region, wind class and year, with a deduction of that year's installed capacity from the remaining available capacity
- **Modeling Technique:** Accounting function of available windy land area and conversion of land area to swept rotor area and then to available generation capacity
- **Special Features:** Accounting for policy and/or production incentives.

Solar Submodule:

- **Model Structure:** Read input file for time-of-day and seasonal capacity factors by region
- **Modeling Technique:** None
- **Special Features:** None.

Biomass Submodule:

- **Model Structure:** Data from nine Census divisions are restructured into 13 EMM supply regions
- **Modeling Technique:** None
- **Special Features:** Accounting for production tax incentives.

Geothermal Electric Submodule:

- **Model Structure:** The model operates at the level of individual geothermal sites aggregated to segmented EMM regional averages
- **Modeling Technique:** Levelized electricity costs from each supply segment of each site in each region are arrayed in increasing cost order, then aggregated into three increasing average-cost segments in each iteration in each year, along with attendant quantities (megawatts) and average heat rates and capacity factors
- Incorporates short-term cost elasticities of supply, technological optimism, and learning.

Non-DOE Input Sources:

Landfill Gas Submodule:

- Franklin Associates, data prepared for the Environmental Protection Agency
  - National annual quantity of municipal solid waste generated
  - Current annual percentages of municipal solid waste combusted and landfilled
- Government Advisory Associates, Resource Recovery Database, and *Resource Recovery Yearbook*
  - Plant-specific electricity generation, Btu energy content of MSW
  - Plant locations and energy-consuming sectors
- Electric Power Research Institute, *TAG Technical Assessment Guide*
  - Capital cost; fixed and variable operation and maintenance costs
  - Plant capacity factor.

Wind Energy Submodule:

- Princeton Economic Research, Incorporated (PERI)
  - WNDSLICE preprocessing program
- Electric Power Research Institute and U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy
  - *Renewable Energy Technology Characterizations* (EPRI TR-109496, December 1997).

Solar Submodule:

- California Energy Commission:
  - Cost and performance characteristics, solar thermal technology
- Electric Power Research Institute and U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy
  - *Renewable Energy Technology Characterizations* (EPRI TR-109496, December 1997)
- Electric Power Research Institute
  - Cost and performance characteristics, PV technology
- IRS Tax Code
  - 10-percent investment tax credit
- National Solar Radiation Database
  - Regional Insulation.

Biomass Submodule:

None.

Geothermal Electric Submodule:

DynCorp I&ET, "Geothermal Supply and Cost Performance Characteristics," contract deliverable for Purchase Order #36727 for the Energy Information Administration, Coal and Electric Power Division, Office of Integrated Analysis and Forecasting, June 30, 2000.

DOE Data Input Sources:

Landfill Gas Submodule:

- Source reduction factor
- Waste stream adjustment factor
- Landfill gas-fueled capacity
- Projected shares of MSW combusted and landfilled
- Heat content of MSW
- Current capacities for MSW and landfill gas-fueled units.

Wind Energy Submodule:

- Energy Information Administration, *Annual Energy Review 1991,* DOE/EIA-0384(91) (Washington, DC, June 1992)
- Pacific Northwest Laboratory
  - Reports PNL-7789, DOE/CH10093-4, and PNL-3195
- DOE/EPRI, Turbine Verification Program — "TVP Project-at-a-Glance" Series.

Solar Submodule:

- Electric Power Research Institute and U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, "Technology Characterizations," EPRI (TR-109496, December 1997).

Biomass Submodule:

None.

Geothermal Electric Submodule:

None.

Computing Environment:

See Integrating Module of the National Energy Modeling System.

Residential Sector Demand Module (RSDM)

Description:

The NEMS Residential Sector Demand Module is an integrated dynamic modeling system that projects residential energy demand by service, fuel, and Census Division. The modeling methodology is based on accounting principles and considers important issues related to consumer behavior. Housing and equipment stocks are tracked over the forecast period for ten major services. The major services considered are space heating, space cooling, clothes washing, dish washing, water heating, cooking, clothes drying, lighting, refrigeration, and freezers. A logit function is used to estimate market shares of each equipment technology within each major service based on either the installed capital and operating costs or the life-cycle cost. Miscellaneous appliance consumption is calculated as a function of Unit Energy Consumption (UEC), a measure of energy intensity developed from the Residential Energy Consumption Survey (RECS) data base.

Last Model Update:

December 2000

Part of Another Model?

The Residential Sector Demand Module is designed, executed, and maintained as part of the National Energy Modeling System (NEMS)

Sponsor:

- **Office:** Office of Integrated Analysis and Forecasting
- **Division:** Energy Demand and Integration Division
- **Model Contact:** John H. Cymbalsky
- **Telephone:** (202) 586-4815
- **E-Mail Address:** John.Cymbalsky@eia.doe.gov

Documentation:

Energy Information Administration, *Model Documentation Report: Residential Sector Demand Model of the National Energy Modeling System,* DOE/EIA-M067 (2001) (Washington, DC, December 2000)
http://tonto.eia.doe.gov/FTPROOT/modeldoc/m0672001.pdf.

Archive Media and Installation Manual(s):

See Integrating Module of the National Energy Modeling System.

Coverage:

- **Geographic:** Nine Census Divisions: New England, Middle Atlantic, East North Central, West North Central, South Atlantic, East South Central, West South Central, Mountain, and Pacific
- **Time Unit/Frequency:** Annual through 2020
- **Product(s):** Fuel consumption including: electricity, natural gas, distillate, liquefied petroleum gas, kerosene, geothermal, wood, solar thermal, and coal. Energy consumption per household. Equipment stock and efficiency.
- **Economic Sector(s):** Domestic residential sector
  - ***Services:*** Space heating, space cooling, clothes washers, dishwashers, water heating, cooking, clothes drying, refrigeration, freezers, lighting, other color televisions, furnace fans, personal computers, electric appliances, other appliances, and secondary space heating
  - ***Housing Types:*** Single-Family, Multifamily, and Mobile Homes.

Modeling Features:

- **Model Structure:** Sequential algorithm composed of housing and equipment stock flow algorithms, technology choice algorithm, housing shell integrity algorithm, end-use consumption, and emissions calculations
- **Modeling Technique:** Housing and equipment stock turnover are modeled using linear decay functions. Market shares for each type of equipment choice are based on a logit function employing installed capital costs and operating costs. Unit energy consumption estimates, fuel prices, and equipment market shares are user inputs that drive the calculation of final end-use consumption

- **Special Features:** Technology choice logit function has the ability to use installed capital, and operating costs or life-cycle costs to determine new market shares.

Non-DOE Input Sources:

- American Home Appliance Manufacturers Association
  - Shipment-weighted efficiency ratings for refrigerators, clothes washers, dishwashers, freezers, and room air conditioners
- U.S. Bureau of the Census, Current Construction Report-Series *C25 Characteristics of New Housing: 1996* (Washington, DC, 1998).
  - New housing and base year market shares for some services and equipment types
- Gas Appliance Manufactures Association, *Consumers' Directory for Certified Efficiency Ratings, 1994*
- Lawrence Berkeley Laboratory, *Energy Data Sourcebook for the U.S. Residential Sector, 1997*
  - Residential equipment technical characterization data
  - Expected minimum and maximum appliance lifetimes
  - Expected lifetimes of housing types.
- Arthur D. Little, *EIA Technology Forecast Updates — Residential and Commercial Buildings*, 1998
- Arthur D. Little*, Electricity Consumption by Small End Uses in Residential Buildings*, 1998.

DOE Data Input Sources:

- U.S. Department of Energy, Energy Information Administration, *A Look at Residential Energy Consumption in 1997*
  - Base-year market shares for services and equipment types
  - Base-year housing stock
  - Unit energy consumption values (UECs).

Computing Environment:

See Integrating Module of the National Energy Modeling System.

Transportation Sector Module (TRAN)

Description:

The Transportation Sector Module incorporates an integrated modular design which is based upon economic, engineering, and demographic relationships that model transportation sector energy consumption at the nine Census Division level of detail. The Transportation Sector Module comprises the following components: Light Duty Vehicles, Light Duty Fleet Vehicles, Commercial Light Trucks, Freight Transport (truck, rail, and marine), Aircraft, and Miscellaneous Transport (military, mass transit, and recreational boats). The model provides sales estimates of 2 conventional and alternative fuel/advanced technology light duty vehicles, and consumption estimates of 12 main fuels.

Last Model Update:

February 2001

Part of Another Model?

Yes, part of the National Energy Modeling System (NEMS)

Sponsor:

- **Office:** Office of Integrated Analysis and Forecasting
- **Division:** Energy Demand and Integration Division
- **Model Contact:** John Maples
- **Telephone:** (202) 586-1757
- **E-Mail Address:** John.Maples@eia.doe.gov

Documentation:

Energy Information Administration, *Model Documentation Report: Transportation Sector Model of the National Energy Modeling System,* DOE/EIA-M070 (2001) (Washington, DC, February 2001) *http://tonto.eia.doe.gov/FTPROOT/modeldoc/m0702001.pdf.*

Archive Media and Installation Manual(s):

See Integrating Module of the National Energy Module System.

Coverage:

- **Geographic:** Nine Census Divisions: New England, Mid Atlantic, East North Central, West North Central, South Atlantic, East South Central, West South Central, Mountain, and Pacific
- **Time Unit/Frequency:** Annual through 2020
- **Product(s):** Motor gasoline, aviation gasoline, diesel/distillate, residual oil, electricity, jet fuel, LPG, CNG, methanol, ethanol, hydrogen, lubricants, pipeline fuel natural gas
- **Economic Sector(s):** Forecasts are produced for personal and commercial travel, freight trucks, railroads, domestic and international marine, aviation, mass transit, and military use.

Modeling Features:

- **Model Structure:** Light-duty vehicles are classified according to the six EPA size classes for cars and light trucks. Freight trucks are divided into medium-duty and heavy-duty size classes. Buses are subdivided into commuter, intercity, and school buses. The air transport module contains both wide- and narrow-body aircraft. Rail transportation is composed of freight rail and three modes of personal rail travel: commuter, intercity and transit. Shipping is divided into domestic and international categories
- **Modeling Technique:** The modeling techniques employed in the Transportation Sector Module vary by module: econometrics for passenger travel, aviation, and new vehicle market shares; exogenous engineering and judgement for MPG, aircraft efficiency, and various freight characteristics; and structural for light-duty vehicle and aircraft capital stock estimations
- **Special Features:** The Transportation Sector Module has been created to allow the user to change various exogenous and endogenous input levels. The range of policy issues that the transportation model can evaluate are: fuel taxes and subsidies, fuel economy levels by size class, CAFE levels, vehicle pricing policies by size class, demand for performance within size classes; fleet vehicle sales by technology type, alternative fuel/advanced technology light duty vehicle sales shares, the Energy Policy Act; Low Emission Vehicle Program, VMT reduction, and greenhouse gas.

Non-DOE Input Sources:

- National Energy Accounts
- Federal Highway Administration, *Highway Statistics*, FHWA-PL-017, November 1999
- Department of Transportation Air Travel Statistics
- U.S. Department of Transportation, Bureau of Transportation Statistics, *Air Carrier Traffic Statistics Monthly*, December 1997/1996
- National Highway Traffic and Safety Administration, *Mid-Year Fuel Economy Report*, 1999
- Oak Ridge National Laboratory, *Energy Data Book* 20, ORNL-6959, October 2000
- Oak Ridge National Laboratory, *Fleet Vehicles in the U.S.*, 1992
- Federal Aviation Administration, *FAA Aviation Forecasts: Fiscal Years 1993-2004*, February 1998
- Department of Commerce, Bureau of the Census, *Truck Inventory and Use Survey*, 1992
- California Air Resources Board, *Proposed Regulations for Low-Emission Vehicles and Clean Fuels*, Staff Report, August 13, 1990.

DOE Data Input Sources:

- State Energy Data System (SEDS), DOE/EIA-0214 (97), September 1999
- *Short-Term Energy Outlook (STEO)*, DOE/EIA-0202 (00/3Q).

Computing Environment:

See Integrating Module of the National Energy Modeling System.

World Oil Refining, Logistics, and Demand Model (WORLD)

Description:

The *WORLD* model is a linear programming model which simulates the operation of the worldwide petroleum industry based on user-specified assumptions regarding the time horizon and scenario of interest. The *WORLD* model simulates regional effects. Insights at the level of individual countries or refinery type can be obtained, but only where the model has been appropriately disaggregated.

Last Model Update:

December 2000

Part of Another Model?

No

Sponsor:

- **Office:** Office of Integrated Analysis and Forecasting
- **Division:** International, Economic, and Greenhouse Gases Division
- **Model Contact:** Dan Butler
- **Telephone:** (202) 586-9503
- **E-Mail Address:** George.Butler@eia.doe.gov

Documentation:

Energy Information Administration, *WORLD Oil Refining Logistics Demand Model,* DOE/EIA-M058 (Washington, DC, March 1994)
http://tonto.eia.doe.gov/FTPROOT/modeldoc/m05894.pdf.

Archive Media and Installation Manual(s):

See Integrating Module of the National Energy Modeling System.

Coverage:

- **Geographic:** Regional Disaggregation
  - Representation of the world's major regions with flexibility to redefine regions to meet specific needs
  - Flexibility to create refining subregions, e.g., to distinguish different classes of refiners
- **Time Unit/Frequency:** Annual through 2020
- **Product(s):** Crude oils and refined products
- **Economic Sector(s):** Petroleum refining and transportation.

Modeling Features:

- **Model Structure:** *WORLD* is a linear programming model which simulates the operation of the world-wide petroleum industry based on user-specified assumptions regarding the time horizon and scenario of interest
- **Modeling Technique:** Linear programming
- **Special Features:** None.

Non-DOE Input Sources:

Various industry sources for refinery processes, crude oil assays, and refined product specifications

- *Oil and Gas Journal*
- IEA/OECD, Quarterly and annual statistics on OECD Nations but also numerous other countries
- UN, mainly for third world countries
  - Crude supply and product demand data
- Hydrocarbon Processing
- NPRA, API, and NPC data.

DOE Data Input Sources:

Energy Information Administration, *International Energy Annual,* DOE/EIA-0219 (Washington, DC, annually)

- *Petroleum Supply Annual*
- *International Energy Annual*, *Annual Energy Outlook, International Energy Outlook*
  - Crude supply and product demand data.

Computing Environment:

See Integrating Module of the National Energy Modeling System.

Other EIA Models

Disruption Impact Simulator Model (DIS)

Description:

The Disruption Impact Simulator (DIS) is a Lotus 1-2-3 spreadsheet model that forecasts the world oil price and key economic effects of an oil supply disruption. Given a set of user-defined assumptions, such as inventory behavior and fuel-switching potential, the DIS estimates the world oil price, losses in the Gross Domestic Product (GDP), increases in the inflation and unemployment rates, terms of trade and total economic losses, and national end use prices for gasoline and heating oil for six quarters. By using easy to understand interface screens, the user has more interaction with the DIS than most other spreadsheet models. DIS can also simulate how policy decisions, such as drawing the Strategic Petroleum Reserve, will affect world oil markets. The model also estimates whether the International Energy Program (IEP) would be activated by the International Energy Agency (IEA), and, if so, what the effect would be on several IEA countries, including the United States.

Last Model Update:

October 1999

Part of Another Model?

No

Sponsor:

- **Office:** Office of Energy Markets and End Use
- **Division:** Energy Markets and Contingency Information Division
- **Model Contact:** Erik Kreil
- **Telephone:** (202) 586-6573
- **E-Mail Address:** Erik.Kreil@eia.doe.gov

Documentation:

Energy Information Administration, *Model Documentation for the Disruption Impact Simulator (DIS)* (Washington, DC, December 28, 1989).

Archive Media and Installation Manual(s):

- DIS4Q99.WK4 is available on a diskette from the model contact
- READ.ME describes any installation requirements and is available on a diskette
- Archived as part of the WEPS94 model in support of the *International Energy Outlook 1994*.

Coverage:

- **Geographic:** Countries in the International Energy Agency, the Organization of Petroleum Exporting Countries, former Centrally Planned Economies, and developing countries
- **Time Unit/Frequency:** Any six quarters, although generally used for the most current six quarters
- **Product(s):** Crude oil and petroleum products
- **Economic Sector(s):** Generally, most results are limited to the market economies of the world.

Modeling Features:

- **Model Structure:** Equilibrium simulation
- **Modeling Technique:** Accounting of supply and demand changes from Business-As-Usual (BAU) data
- **Special Features:** Specially designed interface screens simplify the use of this model. Automatic generation of reports and graphs also simplify analysis of the model results.

Non-DOE Input Sources:

None.

DOE Data Input Sources:

- Energy Information Administration, *Short-Term Energy Outlook,* DOE/EIA-0202 (Washington, DC)
  - BAU supply and demand
- Energy Information Administration, *International Petroleum Monthly*
  - World refinery gains and discrepancies.

Models and Other:

None

Computing Environment:

- **Hardware used:** IBM-compatible personal computer
- **Operating System:**
- **Language/Software Used:** Windows-based Lotus 1-2-3, Version 2.0 or greater
- **Memory Requirement:** 250 Kb
- **Storage Requirement:** 300 Kb
- **Estimated Run Time:** Solving the model takes under 10 seconds. Specifying assumptions for a run can take a couple of minutes
- **Special Features:** Fast turnaround and user interface.

Distillate Market Model (DMM)

Description:

The DMM performs a short-term (six- to nine-month) forecast of demand and price in the U.S. No. 2 fuel oil market. The model also calculates the end-of-month stock level. The model is used to analyze certain market behavior assumptions or market shocks and to determine their effect on market price, demand, and stocks.

Last Model Update:

September 1993

Part of Another Model?

None

Sponsor:

- **Office:** Office of Oil and Gas
- **Division:** Petroleum Marketing Division
- **Model Contact:** John Zyren
- **Telephone:** (202) 586-6405
- **E-Mail Address:** John.Zyren@eia.doe.gov

Documentation:

Energy Information Administration, *Model Documentation of the Distillate Activity Market Model*, DOE/EIA-M056 (Washington, DC, September 1993).

Archive Media and Installation Manual(s):

Archived on floppy disks.

Coverage:

- **Geographic:** National
- **Time Unit/Frequency:** Monthly
- **Product(s):** Retail No. 2 Distillate Fuel Oil
- **Economic Sector(s):** Retail No. 2 Distillate Market.

Modeling Features:

- **Model Structure:** Multi-equation model
- **Modeling Technique:** Ordinary least squares, with correction for autocorrelation
- **Special Features:** None.

Non-DOE Input Sources:

- Data Resources, Inc. (DRI) database, data from Bureau of Economic Analysis and Bureau of Labor Statistics
  - Macroeconomic production and price index variables
- U.S. Department of Commerce, National Oceanographic and Atmospheric Administration, Data Source DRD 964X
  - Actual and normal statewide monthly heating degree day values.

DOE Data Input Sources:

Forms and Publications:

- Energy Information Administration, *Petroleum Supply Annual*, DOE/EIA-0340, and *Petroleum Supply Monthly*, DOE/EIA-0109 (Washington, DC)
  - No. 2 distillate stocks and product supplied
- Energy Information Administration, *Petroleum Marketing Annual*, DOE/EIA-0487, and *Petroleum Marketing Monthly*, DOE/EIA-0380 (Washington, DC)
  - Average imported crude oil refiner's acquisition costs, residential No. 2 fuel oil prices.

Models and Other:

- Energy Information Administration, Short-Term Integrated Forecasting System
  - Forecasts of economic and refinery variables.

Computing Environment:

- **Hardware Used:** IBM-compatible personal computer
- **Operating System:** MS-DOS
- **Language/Software Used:** Micro-TSP, Version 7.01 or higher
- **Memory Requirement:** 640 Kb
- **Storage Requirement:** 640 Kb
- **Estimated Run Time:** 30 seconds calculation time on an 80386 PC operating under DOS 5
- **Special Features:** None.

International Nuclear Model — Personal Computer (PCINM)

Description:

The Personal Computer International Nuclear Model (PCINM) is a deterministic model used by the Energy Information Administration (EIA) to project domestic and international nuclear energy requirements. The EIA uses the PCINM to project aggregate spent fuel discharges, fuel cycle requirements, on-line and year-end capacities, and electricity generation for domestic and foreign nuclear reactors on an annual basis, using a simple accounting technique. PCINM can be used to produce projections for any country in the world for any specified time period. Currently, eight different country groups are being projected through the year 2020. To produce the forecasts, EIA develops a set of operational assumptions for capacity factors, full power days, reactor size, and reload quantities. These assumptions are derived statistically from historical operating data and from utilities' projected fuel management schemes and are incorporated into fuel management plans. Estimates of nuclear fuel cycle trends are determined by surveying utilities, fuel vendors, and other industry experts.

Last Model Update:

July 1992

Part of Another Model?

No

Sponsor:

- **Office:** Office of Coal, Nuclear, Electric and Alternate Fuels
- **Division:** Coal, Nuclear and Renewables Division
- **Model Contact:** Roger Diedrich
- **Telephone:** (202) 287-1757
- **E-Mail Address:** roger.diedrich@eia.doe.gov

Documentation:

- *Nuclear Fuel Cycle Requirements System, Benchmarking Procedures Report*; Z, Inc. (January 15, 1992)
- *Nuclear Fuel Cycle Requirements System, Program Specifications for Fuel Cycle Requirements Forecasting*; Z, Inc. (August 23, 1991)
- *Nuclear Fuel Cycle Requirements System, Phase I Development*; Z, Inc. (March 1, 1991)
- *International Nuclear Model: Volume 1, Model Overview*; David A. Andress (March 1985)
- *International Nuclear Model: Volume 2, Database Relationships*; David A. Andress (April 1985)
- *International Nuclear Model: Volume 3, Program Description*; David A. Andress (June 1985)
- *International Nuclear Model Personal Computer* (PCINM), Z, Inc., DOE/EIA-M051 (92), (Washington, DC, September 1993).

Archive Media and Installation Manual(s):

- PCINM92 — for the *World Nuclear Capacity and Fuel Cycle Requirements*
- PCINM93 — for the *World Nuclear Capacity and Fuel Cycle Requirements.*

Coverage:

- **Geographic:** Any country or predefined country group (user specified, limited to data availability)
- **Time Unit/Frequency:** Specified by user or on an annual basis, no limitation on number of years
- **Product(s):** Nuclear fuel cycle requirements, spent fuel discharges, electrical generation projections, and on-line and year-end capacities
- **Economic Sector(s):** Electric commercial utility sector with emphasis on the nuclear fuel-cycle requirements.

Modeling Features:

- **Model Structure:** Deterministic model based upon factual input data and scenario assumptions. Derives cycle-by-cycle, reactor-by-reactor interim values to determine final annual projections of uranium and enrichment requirements, spent fuel discharges, electricity generation, and on-line and year-end capacities
- **Modeling Technique:** Accounting method on an annual basis — there is only one correct solution for a given set of input data and selected scenario assumptions
- **Special Features:** Flexible analysis of fuel management capabilities.

Non-DOE Input Sources:

- NAC International, Norcross, GA
  - "U3O8 Status Report," "Enrichment Status Report," "Discharge Fuel/Reprocessing Report"
  - Foreign core size, capacity factors, full power days, reload fraction, U235 enrichment assay
- Nuclear Regulatory Commission
  - Domestic reactor capacity factors, nominal capacity, reload fraction, and U235 enrichment assay
- *Nucleonics Week*, Washington, DC
  - Foreign capacity factors.

DOE Data Input Sources:

Forms and Publications:

- Department of Energy, Energy Information Administration, Form RW-859, *Nuclear Fuel Data*
  - Electric utility survey data used to set starting inventory levels of spent fuel
  - Survey data used to determine and update reactor near-term operating characteristics
- Department of Energy, Office of Nuclear Energy
  - Tails assay estimates.

Models and Other:

- Energy Information Administration, World Integrated Nuclear Evaluation System (WINES)
  - Projects long-term nuclear generating capacities worldwide.

Computing Environment:

- **Hardware Used:** IBM compatible 386, VGA monitor, 40 Mb hard drive, math coprocessor, printer
- **Operating System:** DOS 3.3 or higher
- **Language/Software Used:** CLIPPER (version 5.01), dBASE IV, C
- **Memory Requirement:** 7 Mb RAM
- **Storage Requirement:**
  - For Databases, Program Library, and CLIPPER EXE files: 2 Mb
  - For temporary and memory files: TBD upon final benchmarking results
- **Estimated Run Time:** Approximately 4 minutes per scenario
- **Special Features:** None.

Levelized Nuclear Fuel Cycle Cost Model (LNFCC-PC)

Description:

LNFCC-PC computes an electric utility's levelized nuclear fuel cost. 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.

Last Model Update:

April 1990

Part of Another Model?

No

Sponsor:

- **Office:** Office of Integrated Analysis and Forecasting
- **Division:** Coal and Electric Power Division
- **Model Contact:** Laurence Sanders
- **Telephone:** (202) 586-2049
- **E-Mail Address:** Laurence.Sanders@eia.doe.gov

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*
- LNFCC90
  - *Annual Energy Outlook 1990.*

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)
  - Uranium price
  - Conversion price
  - Fabrication price
  - Enrichment price
  - Unit cost of waste disposal

- DRI, *Utility Cost of Finance for Debt, Preferred Equity, and Common Equity*
  - Utility cost of capital
  - Lag for revenue collection
- Standard and Poor's Compustat Services, Inc., *The Compustat Tapes*, Denver, CO, and subsequent releases
  - Utility cost of capital
  - Lag for revenue collection.

DOE Data Input Sources:

Forms and Publications:

- Energy Information Administration, *World Nuclear Fuel-Cycle Requirements*, DOE/EIA-0436 (Washington, DC, September 1988)
  - Thermal rating of nuclear plant
  - Electrical ratings
  - Cycle length
  - Full power days per cycle
  - Fresh fuel assay
  - Discharge burnup
  - Batch fraction
  - Process loss
  - Lead time.

Models and Other:

- Office of the Assistant Secretary for Nuclear Energy, Office of the Deputy Assistant Secretary for Uranium Enrichment
  - Enrichment contracting terms (base enrichment price, VTAO surcharge, enrichment tails assay).

Computing Environment:

- **Hardware Used:** IBM-compatible personal computer
- **Operating System:** MS-DOS
- **Language/Software Used:** Lotus 1-2-3, Version 1.0
- **Memory Requirement:** 640 Kb
- **Storage Requirement:** 27 Kb
- **Estimated Run Time:** On an IBM AT, 30-40 CPU seconds
- **Special Features:** Interactive.

Motor Gasoline Market Model (MGMM)

Description:

The MGMM performs a short-term (6- to 9-month) forecast of demand and price in the U.S. motor gasoline market. The model also calculates the end-of-month stock level. The model is used to analyze certain market behavior assumptions or market shocks and to determine their effect on market price, demand, and stocks.

Last Model Update:

April 1993

Part of Another Model?

No

Sponsor:

- **Office:** Office of Oil and Gas
- **Division:** Petroleum Marketing Division
- **Model Contact:** John Zyren
- **Telephone:** (202) 586-6405
- **E-Mail Address:** John.Zyren@eia.doe.gov

Documentation:

Energy Information Administration, *Motor Gasoline Market Model Documentation Report*, DOE/EIA-M054 (Washington, DC, September 1993).

Archive Media and Installation Manual(s):

Archived on floppy disks, with internal documentation. Available from sponsoring office.

Coverage:

- **Geographic:** National
- **Time Unit/Frequency:** Monthly
- **Product(s):** Motor Gasoline
- **Economic Sector(s):** Retail motor gasoline market.

Modeling Features:

- **Model Structure:** Recursive multi-equation model
- **Modeling Technique:** Ordinary least squares, with correction for autocorrelation
- **Special Features:** None.

Non-DOE Input Sources:

- Data Resources Inc. (DRI) data base, data from Bureau of Economic Analysis and Bureau of Labor Statistics
  - Macroeconomic production price and income variables
  - Retail price of motor gasoline
- Federal Highway Administration, *Traffic Volume Trends,* various issues
  - Vehicle miles traveled.

DOE Data Input Sources:

Forms and Publications:

- Energy Information Administration, *Petroleum Supply Annual,* DOE/EIA-0340, and *Petroleum Supply Monthly,* DOE/EIA-0109
  - Finished motor gasoline and blending component stocks

- Energy Information Administration, *Petroleum Marketing Annual,* DOE/EIA-0487, and *Petroleum Marketing Monthly,* DOE/EIA-0380
  - Average crude oil refiner's acquisition costs.

Models and Other:

- Energy Information Administration, *Short-Term Integrated Forecasting System*
  - Forecasts of economic and refinery variables.

Computing Environment:

- **Hardware Used:** IBM-compatible personal computer
- **Operating System:** MS DOS
- **Language/Software Used:** Micro-TSP, Version 7.01 or higher
- **Memory Requirement:** 640 Kb
- **Storage Requirement:** 640 Kb
- **Estimated Run Time:** 30 seconds calculation time on an 80386 personal computer operating under DOS 5
- **Special Features:** None.

Oil Market Simulation Model (OMS-PC)

Description:

OMS-PC projects future world oil prices and world oil supplies and demands by region (the United States, Canada, Japan, and the Organization for Economic Cooperation and Development (OECD)-Europe, the Organization of Petroleum Exporting Countries (OPEC), developing countries, and net Communist trade) on an annual basis through the year 2010. The OMS-PC model is used as an adjunct to the World Energy Projection System (WEPS-PC).

Last Model Update:

July 1994

Part of Another Model?

No

Sponsor:

- **Office:** Office of Integrated Analysis and Forecasting
- **Division:** International, Economic, and Greenhouse Gases Division
- **Model Contact:** George (Dan) Butler
- **Telephone:** (202) 586-9503
- **E-Mail Address:** George.Butler@eia.doe.gov

Documentation:

Energy Information Administration, *Oil Market Simulation Model Documentation Report,* DOE/EIA-M028 (Washington, DC, May 1985).

Archive Media and Installation Manual(s):

- OMS85
  - *International Energy Outlook 1985*
- OMS86
  - *International Energy Outlook 1986*
- OMS87
  - *International Energy Outlook 1987*
- OMS89
  - *International Energy Outlook 1989*
- OMS90
  - *International Energy Outlook 1990* and the *Annual Energy Outlook 1990*
- OMS91
  - *International Energy Outlook 1991* and the *Annual Energy Outlook 1991*
- OMS92
  - *International Energy Outlook 1992* and the *Annual Energy Outlook 1992*
- OMS93
  - *International Energy Outlook 1993* and the *Annual Energy Outlook 1993*
- OMS94
  - *International Energy Outlook 1994* and the *Annual Energy Outlook 1994.*

Coverage:

- **Geographic:** U.S., Canada, Japan, OECD-Europe, OPEC, and developing countries
- **Time Unit/Frequency:** Annually through 2010
- **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:

- Cambridge Energy Research Associates, *The Capacity Race — The Future of World Oil Supply*
  - Reference price — international
- Central Intelligence Office of Economic Research, *International Energy Statistical Review*
  - OPEC production capacity — through 1980.

DOE Data Input Sources:

Forms and Publications:

- Energy Information Administration, *Annual Energy Outlook,* DOE/EIA-0383 (Washington, DC)
  - U.S. supply/demand projections
- Energy Information Administration, *Short-Term Energy Outlook,* DOE/EIA-0202 (Washington, DC)
  - U.S. supply/demand projections
- Energy Information Administration, *International Petroleum Statistics,* DOE/EIA-0520 (Washington, DC)
  - Historical consumption — international
  - Historical production — international
  - Data used to estimate price elasticities, income elasticities, feedback elasticities and lags
- Energy Information Administration, *International Energy Annual,* DOE/EIA-0219 (Washington, DC)
  - Historical consumption — international
  - Historical production — international
  - Data used to estimate price elasticities, income elasticities, feedback elasticities and lags
- Energy Information Administration, *Monthly Energy Review,* DOE/EIA-0035 (Washington, DC)
  - World oil prices
  - U.S. historical supply/demand
- Energy Information Administration, *Annual Energy Review,* DOE/EIA-0384.
  - World oil price
  - U.S. historical supply/demand
- Office of International Affairs, *International Energy Indicators,* DOE/IA/0010/6, December 1980 (Washington, DC)
  - OPEC production capacity — through 1980.

Models and Other:

- Internal estimates from International, Economic, and Integrated Forecasting Branch, EI-812
  - OPEC production capacity — 1981 forward.

Computing Environment:

- **Hardware Used:** IBM-compatible personal computer
- **Operating System:** MS DOS
- **Language/Software Used:** Lotus 1-2-3, Release 2
- **Memory Requirement:** 1.2 Mb to load Lotus 1-2-3 and retrieve the OMS model (the largest file on the OMS diskette), 200 Kb to use the DEMO diskette
- **Storage Requirement:** 300 Kb
- **Estimated Run Time:** 10 seconds
- **Special Features:** Fast turnaround.

Propane Market Model (PPMM)

Description:

The PPMM performs a short-term (6- to 9-month) forecast of demand and price in the residential U.S. propane market; the model also calculates the end-of-month stock level. The model can also be used to calculate the demand and end-of-month stock level in several PAD districts. The model is used to analyze certain market behavior assumptions or market shocks and to determine their effect on market price, demand, and stocks.

Last Model Update:

October 1993

Part of Another Model?

No

Sponsor:

- **Office:** Office of Oil and Gas
- **Division:** Petroleum Marketing Division
- **Model Contact:** John Zyren
- **Telephone:** (202) 586-6405
- **E-Mail Address:** John.Zyren@eia.doe.gov

Documentation:

Energy Information Administration, *Model Documentation of the Propane Market Model* DOE/EIA-M055 (Washington, DC, October 1993).

Archive Media and Installation Manual(s):

Archived on micro-floppy disks.

Coverage:

- **Geographic:** National, PAD Districts 1 and 2
- **Time Unit/Frequency:** Monthly
- **Product(s):** Consumer-grade propane
- **Economic Sector(s):** Residential propane market.

Modeling Features:

- **Model Structure:** Multi-equation model
- **Modeling Technique:** Ordinary least squares, with correction for autocorrelation
- **Special Features:** None.

Non-DOE Input Sources:

- Data Resources, Inc. (DRI) database, data from the Bureau of Labor Statistics
  - Producer price index data
- U.S. Department of Commerce, National Oceanographic and Atmospheric Administration, Data Source DRD 964X
  - Actual and normal statewide monthly heating degree day values.

DOE Data Input Sources:

Forms and Publications:

- Energy Information Administration, *Petroleum Supply Annual,* DOE/EIA-0340 and *Petroleum Supply Monthly,* DOE/EIA-0109 (Washington, DC)
  - Propane/propylene stocks and product supplied
- Energy Information Administration, *Petroleum Marketing Annual,* DOE/EIA-0487 and *Petroleum Marketing Monthly,* DOE/EIA-0380 (Washington, DC)
  - Average imported crude oil refiner acquisition costs, refiner price of propane (consumer-grade) sales to end users
- Energy Information Administration, *Winter Fuels Report,* DOE/EIA-0538, various issues
  - Residential propane prices.

Models and Other:

- Energy Information Administration, Short-Term Integrated Forecasting System
  - Forecasts of economic and refinery variables.

Computing Environment:

- **Hardware Used:** IBM-compatible personal computer
- **Operating System:** MS-DOS
- **Language/Software Used:** Micro-TSP, Version 7.01 or higher
- **Memory Requirement:** 640 Kb
- **Storage Requirement:** 640 Kb
- **Estimated Run Time:** 30 seconds calculation time on an 80386 personal computer operating under DOS 5
- **Special Features:** None.

Short-Term Hydroelectric Generation Model (STHGM)

Description:

The STHGM performs a short-term (18- to 27-month) forecast of hydroelectric generation in the United States using an autoregressive integrated moving average (ARIMA) time series model with precipitation as an explanatory variable. The model results are used as input for the *Short-Term Energy Outlook.*

Last Model Update:

May 1993

Part of Another Model?

None

Sponsor:

- **Office:** Office of Coal, Nuclear, Electric and Alternate Fuels
- **Division:** Coal, Nuclear and Renewables Division
- **Model Contact:** Jim Knaub
- **Telephone:** (202) 287-1733
- **E-Mail Address:** James.Knaub@eia.doe.gov

Documentation:

Energy Information Administration, *Model Documentation Report: Short-Term Hydroelectric Generation Model,* DOE/EIA-M053 (96) (Washington, DC).

Archive Media and Installation Manual(s):

Archived on Energy Information Administration mainframe system.

Coverage:

- **Geographic:** National, Census Division
- **Time Unit/Frequency:** Monthly
- **Product(s):** Hydroelectric generation
- **Economic Sector(s):** Electric utilities.

Modeling Features:

- **Model Structure:** Autoregressive integrated moving average (ARIMA) time series model with an explanatory variable
- **Modeling Technique:** Time series analysis
- **Special Features:** None.

Non-DOE Input Sources:

- 1970-1987 and Average: National Climatic Data Center, *State, Regional, and National Monthly and Annual Precipitation Weighted by Area for the Contiguous United States, January 1931-December 1987* (Ashville, NC, August 1988), p.66. 1988-1992: *Monthly State, Regional and Nation Heating Degree Days Weighted by Population* (Ashville, NC, March 1989 through 1993), Table 3.3, “Regional and National Average Precipitation”
  - National precipitation data
- On the Internet: URL *ftp://ftp.ncdc.noaa.gov/pub/data/cirs/yymm.pcpst*
  - State level precipitation data used in pre-processing mode to obtain preliminary Census Division-level precipitation.

DOE Data Input Sources:

- Energy Information Administration, Data bases for Form EIA-759*, Monthly Power Plant Report*, and predecessors
  - Hydroelectric generation data.

Computing Environment:

- **Hardware Used:** Energy Information Administration Mainframe System
- **Operating System:** MVS
- **Language/Software Used:** SAS version 6.08
- **Memory Requirement:** 2000K
- **Storage Requirement:** 10 Mb
- **Estimated Run Time:** Approximately 15 seconds computer time on EIA Mainframe System
- **Special Features:** None.

Short-Term Integrated Forecasting System (STIFS)

Description:

STIFS is used to generate short-term (up to 8 quarters), monthly forecasts of U.S. supplies, demands, imports, stocks, and prices of various forms of energy. The STIFS model consists of over 300 equations (excluding equations used to convert standard units into energy equivalents such as British thermal units (Btu's)), of which just over 100 are estimated. The estimated equations are regression equations that together form a system of interrelated forecasting equations. The selection of functional form and the estimation technique is generally done on an equation-by-equation basis. The general method of estimation is ordinary least squares. Some equations incorporate a correction for autocorrelation of the error term.

Petroleum Products Supply Model Description:

The driving forces in the Petroleum Product Supply Model are estimated refinery inputs and refined product demands. Estimated refinery outputs of individual products yield share weights with which to disaggregate total refinery inputs. Net product imports and inventory change bear the burden of balancing product supply with product demand.

Petroleum Products Demand Model Description:

Nonutility petroleum products consist of the following: motor gasoline, jet fuel, nonutility distillate fuel oil, nonutility residual fuel oil, liquefied petroleum gases (LPGs), and other (minor) petroleum products. The major determinants of demand for these products are: transportation activity, economic activity (i.e., gross domestic product, transportation activity, manufacturing output, etc.), prices and weather. Most of the estimating relationships incorporate monthly seasonal dummies and dummy variables (Dxxxx) to capture one-time events or conditions.

Utility demand for distillate and residual fuel oil is derived separately through simulation of the electricity model (see Electricity Supply and Demand section).

"Other" Petroleum Products Demand Model Description:

Most discussion on petroleum product demand focuses on the five major products used in the transportation, residential, commercial, and utility sectors: motor gasoline, jet fuel, distillate fuel, residual fuel, and liquefied petroleum gas. However, the third largest category of product demand is "other" petroleum products, which is made up of 14 different products and represents about 14 percent of total petroleum product demand.

Energy Prices Model Description:

The prices are important in their own right, because they are widely used for budget planning and other purposes by Federal and local government agencies, as well as corporate planners. These prices are also used in the projections of energy supply and demand.

Electricity Model Description:

The STIFS model determines monthly aggregate U.S. electricity demand by four major sectors and provides a national-level supply balance. In STIFS, U.S. electricity supply is comprised of two major components: domestic net electricity generation (that is, electric power actually transmitted to the transportation grid by electric utility-owned and nonutility-owned power plants) and net electricity imports (principally from Canada). Generation sources (fuels used in power production) identified in STIFS are coal, petroleum, natural gas, nuclear power, hydroelectric and other renewables, including wind and solar, wood and waste, and geothermal. A catchall category representing the total of transportation and distribution losses of electricity and other items, including any pure statistical discrepancy between electricity supply and electricity demand, rounds out the demand/supply balance.

Coal Model Description:

The STIFS model determines total coal consumption as the total demand for four major sectors: electric utilities; coke plants; retail and general industry; and coal consumed by independent power producers.

Natural Gas Model Description:

Natural gas demand is calculated for six sectors, including four major consumption or end-use categories as well as estimated consumption of natural gas by pipelines and natural gas consumption by gas field and natural gas plan operations. In addition, a small amount of gas exports is accounted for. Weather (particularly in the residential and commercial sectors), household formation (residential sector), commercial employment (commercial sector), natural gas prices relative to competing fuel prices, and industrial output (industrial sector) are all important factors in the short-term determination of natural gas demand.

Last Model Update:

August 2000

Part of Another Model?

No

Sponsor:

- **Office:** Office of Energy Markets and End Use
- **Division:** Energy Markets and Contingency Information Division
- **Model Contact:** Dave Costello
- **Telephone:** (202) 586-1468
- **E-Mail Address:** Dave.Costello@eia.doe.gov

Documentation:

- Energy Information Administration, *Short-Term Energy Outlook, Model Documentation Statistical Overview* (Washington, DC, May 1998)
- Energy Information Administration, *Short-Term Energy Outlook, Petroleum Products Supply Model Description* (Washington, DC, August 2000)
- Energy Information Administration, *Short-Term Energy Outlook, Petroleum Products Demand Model Description* (Washington, DC, October 1998)
- Energy Information Administration, *Short-Term Energy Outlook, "Other" Petroleum Products Demand Model Description* (Washington, DC, June 1998)
- Energy Information Administration, *Short-Term Energy Outlook, Energy Prices Model Description* (Washington, DC, July 2000)
- Energy Information Administration, *Short-Term Energy Outlook, Electricity Model Description* (Washington, DC, August 1998)
- Energy Information Administration, *Short-Term Energy Outlook, Coal Model Description* (Washington, DC, October 1998)
- Energy Information Administration, *Short-Term Energy Outlook, Natural Gas Model Description* (Washington, DC, May 1999) *http://www.eia.doe.gov/emeu/steo/pub/contents2.html.*

Archive Media and Installation Manual(s):

STIFS0199-*STEO,* October 1999.

Coverage:

- **Geographic:** National
- **Time Unit/Frequency:** Monthly with forecasts up to 8 quarters
- **Product(s):**
  - Petroleum Products Supply Model
    - *Refinery Inputs*
      - Crude oil
      - Unfinished oils
      - Liquefied Petroleum Gas (LPGs)
      - Pentanes plus
      - "Other" petroleum products

- *Refinery Outputs*
  - Motor gasoline
  - Jet fuel
  - Distillate fuel oil
  - Residual fuel
  - Liquefied petroleum gases (LPGs)
  - "Other" petroleum products

– Petroleum Products Demand Model
  - *Motor gasoline*
  - *Jet fuel*
  - *Nonutility distillate fuel oil*
  - *Nonutility residual fuel oil*
  - *Liquefied petroleum gases (LPGs)*
  - *"Other" petroleum products*

– "Other" Petroleum Products Demand Model
  - *Crude oil*
  - *Pentanes plus*
  - *Unfinished oils*
  - *Aviation gasoline blend components*
  - *Petrochemical feedstocks*
  - *Petroleum coke*
  - *Asphalt and road oil*
  - *Still gas*
  - *Miscellaneous products*

– Energy Prices Model
  - *Refiner gasoline price*
  - *Retail motor gasoline*
  - *Diesel fuel oil*
  - *Refiner distillate fuel oil*
  - *Residential heating oil*
  - *Kerosene-jet fuel*
  - *Residual fuel oil*
  - *Propane*
  - *Petroleum products*
  - *Coal*
  - *Natural gas*
  - *Electricity*

– Electricity Model
  - *Electricity*

– Coal Model
  - *Coal*

  - Natural Gas
    - *Pipelines, gas field, natural gas plant operations*
    - *Exports*
    - *Residential, Commercial, and Industrial sectors*
    - *Electric utility sector*
- **Economic Sector(s):**
  - Residential
    - *Heating Oil Price, Electricity Price, Residential Natural Gas Price*
    - *Electric Utilities — Coal Price, Natural Gas Price, Residual Fuel Oil Price.*

Modeling Features:

- **Model Structure:** Accounting and algorithmic to balance supply and demand
- **Modeling Technique:** The estimated equations are regression equations that together form a system of interrelated forecasting equations. The general method of estimation is ordinary least squares
- **Special Features:** STIFS is updated monthly to produce new demand and supply forecast balances for the *Short-Term Energy Outlook.*

Non-DOE Input Sources:

- U.S. Department of Labor, Bureau of Labor Statistics
  - *Employment and Earnings*
- U.S. Federal Reserve System, Board of Governors
  - *Industrial Production*
- U.S. Department of Labor, Bureau of Labor Statistics
  - *Monthly Labor Review*
- U.S. Department of Commerce, National Oceanic and Atmospheric Administration
  - *Monthly State, Regional, and National Heating/Cooling Degree-Days Weighted by Population*
- U.S. Department of Commerce, Bureau of Economic Analysis
  - *National Income and Product Accounts of the United States*
- U.S. Department of Commerce, Bureau of Economic Analysis
  - *Survey of Current Business*

Most of the data sources provide monthly data and are used directly. Quarterly data are interpolated into monthly series.

DOE Data Input Sources:

The historical energy data used to estimate the model come primarily from the IMDS electronic database. IMDS merges data regularly reported in several EIA publications: *Quarterly Coal Report, Petroleum Supply Monthly*, *Petroleum Marketing Monthly*, *Electric Power Monthly*, *Natural Gas* Monthly, and *Monthly Energy Review.* Because of data limitations there are inconsistencies in the level of disaggregation of each type of fuel. For example, electricity and natural gas demands are represented by market sector, but petroleum products are generally represented only as national totals or for a combination of sectors (distillate and residual fuel oil are exceptions). Market-level data are available for the regulated industries (electricity and natural gas) while product-level data are available for the petroleum product markets, particularly for data frequencies higher than annual.

Computing Environment:

- **Hardware Used:** IBM MVS S390 Enterprise Server
- **Operating System:** OS/MVS2
- **Language/Software Used:** SAS, Version 6.08
- **Memory Requirement:** 2000K
- **Storage Requirement:** 3380 disk — Approximately 900 tracks to reload the files contained on the distribution tape, and a minimum of approximately 2,000 tracks to store and execute the entire system.

Short-Term Nuclear Annual Power Production Simulation (SNAPPS)

Description:

SNAPPS forecasts the short-term monthly and annual electric power generation by U.S. commercial nuclear power plants. SNAPPS is a relatively simple, straightforward accounting model programmed in FORTRAN. The model consists of codes that provide accounting for each nuclear reactor's generation for the projection period.

Last Model Update:

March 1991

Part of Another Model?

No

Sponsor:

- **Office:** Office of Coal, Nuclear, Electric and Alternate Fuels
- **Division:** Coal, Nuclear and Renewables Division
- **Model Contact:** Roger Diedrich
- **Telephone:** (202) 287-1757
- **E-Mail Address:** roger.diedrich@eia.doe.gov

Documentation:

- Energy Information Administration, *Short-Term Nuclear Annual Power Production Simulation Documentation,* Version 4 (Washington, DC, June 1990)
- Energy Information Administration, *Short-Term Nuclear Annual Power Production Simulation Documentation* (Washington, DC, November 1984) and Addendum (September 1986).

Archive Media and Installation Manual(s):

- SNAP893 — Archived for the *Short-Term Energy Outlook* (July 1989)
- SNAP9103 — Archived for the *Short-Term Energy Outlook* (January 1991)
- SNAP92Q4 — Archived for the *Short-Term Energy Outlook* (4th Quarter 1992)
- SNAP93Q1 — Archived for the *Short-Term Energy Outlook* (1st Quarter 1993)
- SNAP93Q2 — Archived for the *Short-Term Energy Outlook* (2nd Quarter 1993)
- SNAP93Q3 — Archived for the *Short-Term Energy Outlook* (3rd Quarter 1993).

Coverage:

- **Geographic:** Total United States, individual States, individual reactors, 10 Federal regions, or 4 Census regions
- **Time Unit/Frequency:** 18-month forecasts quarterly; 5-year forecasts annually, up to 10 years
- **Product(s):** Projections of electricity generation from nuclear power plants
- **Economic Sector(s):** Electric utilities which own or operate nuclear power plants.

Modeling Features:

- **Model Structure:** The model consists of codes that provide 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 capacity factor times the hours the reactor operates in that month. For the near term, about 6 months, the values are calculated in a preprocessor that estimates system-wide monthly capacity factors by applying time-series techniques to historical data. The relationship between the monthly capacity factor and the percent of capacity on-line is modeled by a Box-Jenkins transfer function. For the remainder of the projection period, SNAPPS uses average, full-cycle capacity factors, which are functions of reactor type (BWR or PWR) and fuel cycle (1st, 2nd, or equilibrium). 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.

- **Special Features:**
  - Allows the user to project either gross or net electricity generation. Reports aggregate operating capacity factors
  - May be run either in a reactor-specific or an aggregate mode.

Non-DOE Input Sources:

- Nuclear Regulatory Commission, *NRC Operations Center Plant Status Report* (updated weekly)
  - Scheduled outage data (start date and duration)
- Nuclear Regulatory Commission, *Operating Data Reports*
  - Historical generation data (reactor name, date, historical generation and type of generation)
- David Andress, Washington Consulting Group, *Analysis of Capacity Factors* (March 1990)
  - Cycle-specific data (cycle capacity factor)
  - Generic parameters (monthly capacity factor adjustment [seasonality] factors)
- David Andress, System Sciences, *Analysis of Capacity Factors* (September 1984)
  - Cycle-specific data (cycle capacity factor)
  - Generic parameters (monthly capacity factor adjustment (seasonality) factors).

DOE Data Input Sources:

Forms and Publications:

- Energy Information Administration, Form EIA-759, *Monthly Power Plant Report*
  - Historical generation data (1986 on: reactor name, date, historical generation and type of generation)
- Office of Civilian Radioactive Waste Management, Form RW-859, *Nuclear Fuel Data*
  - Cycle-specific data (cycle number, cycle start date, cycle generation time, cycle capacity factor, cycle full-power days, refueling start date and refueling time)
- Energy Information Administration, Form EIA-860A, *Annual Electric Generator Report — Utility*
  - Basic reactor characteristics (reactor capacities)

Models and Other:

- Energy Information Administration, International Nuclear Model (INM) maintained by the Office of Coal, Nuclear, Electric, and Alternate Fuels
  - Basic reactor characteristics (reactor type, reactor name, reactor capacities, DOE region, start dates [initial criticality, first electricity and commercial operation], State code and reactor retirement date)
- Energy Information Administration, Office of Coal, Nuclear, Electric and Alternate Fuels
  - Generic parameters
  - Default capacity factor
  - Default full power days
  - Default refueling time
  - Monthly capacity factor adjustment (seasonality) factors
  - Annual capacity factor adjustment (trend) factors.

Computing Environment:

- **Hardware Used:** IBM 3084QX
- **Operating System:** MVS/XA
- **Language/Software Used:** VS FORTRAN (Uses the G-1 compiler)
- **Memory Requirement:** 1600 Kb
- **Storage Requirement:** 3380 disk — 5 Mb for model and data
- **Estimated Run Time:** 7 CPU seconds
- **Special Features:** None.

Transportation Energy Model of the World Energy Projection System

Description:

The WEPS Transportation Energy Model is a structural accounting model for road, rail, air, domestic shipping, international shipping, and pipeline energy use. Estimates of growth in total energy use for each mode are built up from estimates of growth in travel (miles per year) and growth in energy intensity (energy use per mile). Projections of the mix of fuels used at the modal level are based on historical trends informed by country-specific analysis of potential shifts in the fuel mix. The transportation model generates mid-term (up to 2020) forecasts of transportation sector energy use as a component of WEPS. Utilizing the same regional macroeconomic and demographic projections as other WEPS components, it passes back to WEPS regional transportation sector energy use.

The model is designed to provide a flexible and accessible platform for energy analysis. Toward these ends it has been developed as an Excel spreadsheet. Defining a "model run" (for a given set of regional macroeconomic and demographic forecasts) consists of assigning values to key model parameters. The parameter values used for developing forecasts for the *International Energy Outlook* are archived as part of the WEPS model archival process.

Last Model Update:

August 1998

Part of Another Model?

World Energy Projection System (WEPS)

Sponsor:

- **Office**: Office of Integrated Analysis and Forecasting
- **Division:** International, Economic, and Greenhouse Gases Division
- **Model Contact:** Barry Cohen
- **Telephone:** (202) 586-5359
- **E-mail Address:** bcohen@eia.doe.gov

Documentation:

U.S. Department of Energy, Energy Information Administration, *Model Documentation Report: Transportation Energy Model of the World Energy Projection System,* (DOE/EIA-M072(99)) (Washington, DC, July 1999) *http://tonto.eia.doe.gov/FTPROOT/modeldoc/m07299.pdf.*

Archive Media and Installation Manual(s):

Archived as part of the World Energy Projection System (2001).

Coverage:

- **Geographic**: 22 Regions (United States, Canada, Mexico, Japan, United Kingdom, France, Germany, Italy, Netherlands, Other Europe, Australasia (the latter defined as Australia, New Zealand, and the U.S. Territories), Former Soviet Union, Eastern Europe, China, India, South Korea, Other Developing Asia, Middle East, Africa, Brazil, Rest of Central and South America, Turkey)
- **Time Unit/Frequency:** Annual 1996 through 2020
- **Product(s):** Worldwide transportation energy consumption
- **Economic Sector(s):** Road, air, rail, inland water, international water, pipeline.

Modeling Features:

- **Model Structure:** An accounting framework of relationships concerning transportation energy consumption, economic and population growth, and structural changes in transport systems
- **Modeling Technique:** Considers historical trends in travel and efficiency relative to population and economic growth as well as potential major changes in the transport systems of the developing regions of the world (which may account for a large portion of future increases in transportation energy).

Non-DOE Input Sources:

- International Energy Agency, *Balances and Statistics of OECD [Non-OECD] Countries* (Paris)
  - Consumption of energy by fuel and transport mode.

DOE Input Sources:

None, beyond those utilized within WEPS.

Computing Environment:

Consists of Excel97 spreadsheet files run on an IBM compatible computer using Windows 95.

Uranium Market Model (UMM-PC)

Description:

UMM-PC is a microeconomic simulation model in which uranium supplied by the mining and milling industry and from excess inventories is used to meet the demand for uranium by electric utilities with nuclear power plants. The input data includes every major power production center and utility on a worldwide basis. The model provides annual projections for each of the 16 major uranium consumption and production regions in the world, including Eastern Europe and the Republics of the Former Soviet Union. Presently, UMM-PC is being used by the Energy Information Administration (EIA) to generate projections of uranium prices, production, imports, inventories for the United States through 2010. EIA has used these projections to analyze the potential effects on the uranium market of commercializing U.S. and Russian surplus defense inventories. Projections from UMM-PC have been used by U.S. Department of Energy (DOE) program offices in their analyses of the potential economic impact of releasing DOE-held uranium into the market. Output from UMM-PC has also been used to support cooperative efforts between the United States and Organization for Economic Cooperation and Development's Nuclear Energy Agency and the International Atomic Energy Agency to assess long-term uranium supply and production capability.

Last Model Update:

July 1997

Part of Another Model?

None

Sponsor:

- **Office:** Office of Coal, Nuclear, Electric and Alternate Fuels
- **Division:** Coal, Nuclear and Renewables Division
- **Model Contact:** Luther Smith
- **Telephone:** (202) 586-9086
- **E-Mail Address:** luther.smith@eia.doe.gov

Documentation:

Energy Information Administration, *Model Documentation of the Uranium Market Model* (UMM-PC), DOE/OR-21400-H11 (Washington, DC, January 1993, revised December 1996).

Archive Media and Installation Manual(s):

- ORUMMPC — for the 1987 Viability Study
- ORUMM89 — Archived for *Domestic Uranium Mining and Milling Industry 1988: Viability Assessment*
- ORUMM90 — Archived for *Domestic Uranium Mining and Milling Industry 1989: Viability Assessment*
- ORUMM91 — Archived for the *Domestic Uranium Mining and Milling Industry 1990: Viability Assessment*
- ORUMM92 — Archived for *Domestic Uranium Mining and Milling Industry 1991*
- UMM93 — Archived for *Domestic Uranium Mining and Milling Industry 1992*
- UMM94 — Archived for *World Nuclear Capacity and Fuel Cycle Requirements*
- UMM95 — Archived for *World Nuclear Outlook 1995*
- UMM97 — Archived for *Nuclear Power Generation and Fuel Cycle Report 1997*.

Coverage:

- **Geographic:** World
- **Time Unit/Frequency:** Annually
- **Product(s):** Natural uranium
- **Economic Sector(s):** 16 buyer and producer regions worldwide.

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 Industry Status Report, A Fuel-Trac Product*, Volume 2 (U308), NAC International, February 1997
  - Country name
  - Supplier name
  - Utility name
  - Non-U.S. inventories
  - Unmet world demand
  - Production committed to utility in a simulation year and succeeding year
  - Country committed to sell to
- *Estimates of Behavior, Management and Market Data*, Nuclear Resources International (February 1984), for Oak Ridge National Laboratory
  - Years of desired uranium inventory
- Consulting reports on non-U.S. production centers by Energy Resources International, Inc.; NAC International; and Ux Consulting Company, LLC
  - Production center name
  - Country
  - Status
  - Initial production start year
  - Reserves
  - Production costs
  - Total capacity
  - Uncommitted capacity
  - Annual production
- *The Nuclear Review*, TradeTech, May 1997
  - Spot price
- Information provided by U.S. uranium producers to staff of the Energy Information Administration
  - Production center name
  - Current status
  - Production start year
  - Planned capacity expansions
- *Federal Register*, April and October, and as developments warrant
  - Department of Commerce's announcements related to import quotas.

DOE Data Input Sources:

Forms and Publications:

- Energy Information Administration, Form EIA-858, *Uranium Industry Annual Survey*
  - U.S. inventories
  - U.S. mill and plant capacities
  - U.S. production

Models and Other:

- Energy Information Administration, PC version of the International Nuclear Model
  - Reactor requirements worldwide
- Energy Information Administration, U.S. uranium reserve database (SOPE file)
  - Reserves
  - Production costs.

Computing Environment:

- **Hardware Used:** IBM-compatible personal computer
- **Operating System:** MS DOS Version 2.0 or greater
- **Language/Software Used:** Pascal (compiled and linked using Borland Turbo Pascal 4.0)
- **Memory Requirement:** 640K
- **Storage Requirement:** 630K
- **Estimated Run Time:** On a Dell Optiplex GX pro pentium 200 operating at 200 MHZ under Windows 95: 2 seconds
- **Special Features:** Model requires a math coprocessor and a hard disk plus a version of DOS that is 2.1 or greater.

Wellhead Gas Productive Capacity Model (GASCAP)

Description:

GASCAP estimates the historical wellhead productive capacity of natural gas for the lower 48 States and projects the productive capacity for 3 years. The *Short-Term Energy Outlook (STEO)* output for low, base and high cases is used to estimate the number of active rigs and oil and gas well completions. The projected oil production is used to estimate the oil-well gas production (which is assumed to be producing at capacity) using a constant gas-oil ratio. The gas demand is also taken from *STEO*. The difference between demand and oil-well gas production is assumed to be the gas-well gas demand and the production as long as capacity exceeds demand.

Last Model Update:

September 1995

Part of Another Model?

No

Sponsor:

- **Office:** Office of Oil and Gas
- **Division:** Reserves and Natural Gas Division
- **Model Contact:** Velton Funk
- **Telephone:** (214) 720-6171
- **E-Mail Address:** Velton.Funk@eia.doe.gov

Documentation:

Energy Information Administration, *Model Documentation for the Wellhead Gas Productive Capacity Model,* DOE/EIA-M052 (Washington, DC, March 1995).

Archive Media and Installation Manual(s):

Cartridge tape available from NEIC for GASCAP94, for the report *Natural Gas Productive Capacity for the Lower 48 States 1984 through 1997*, DOE/EIA-0542 (96R).

Coverage:

- **Geographic:** Lower-48 natural gas producing States
- **Time Unit/Frequency:** Evaluates 13 years of historical data and projects productive capacity for 3 years
- **Product(s):** Natural gas
- **Economic Sector(s):** Not applicable.

Modeling Features:

- **Model Structure:** The model consists of a series of Statistical Analysis System (SAS) procedures utilizing a modified rate of gas production versus cumulative gas production (Rate-cum) equation
- **Modeling Technique:** SAS, utilizing the least squares, nonlinear regression procedure (NLIN) with the Marquardt computational method, was used to fit hyperbolic equations to the data
- **Special Features:** Estimates conventional and coalbed gas-well productive capacity separately.

Non-DOE Input Sources:

- Dwight's Energy Data, Inc., Richardson, TX, Oil and Gas Reports
  - State monthly natural gas production by well
- Baker Hughes Incorporated
  - Number of active rotary rigs and number of active rotary gas rigs
- American Petroleum Institute
  - Drilling statistics monthly tapes.

DOE Data Input Sources:

- Energy Information Administration, *Natural Gas Annual*, DOE/EIA-0131 (Washington, DC, annually)
  - Marketed wet natural gas production by State
  - Gross gas production by State
  - Oil well gas production by State
- Energy Information Administration, *Natural Gas Monthly,* DOE/EIA-0130 (Washington, DC, monthly)
  - State marketed gas production
- Energy Information Administration, *Monthly Energy Review,* DOE/EIA-0035 (Washington, DC, monthly)
  - Crude oil production
  - World oil price (imported refiner acquisition cost)
  - Marketed gas production
  - Natural gas wellhead price
- Energy Information Administration, *Short-Term Energy Outlook,* DOE/EIA-0202 (Washington, DC, quarterly)
  - Marketed dry natural gas demand
  - Oil and gas price forecasts.

Computing Environment:

Mainframe

- **Hardware Used:** IBM 3090E Model 400
- **Operating System:** MVS/XA
- **Language/Software Used:** FORTRAN, SAS, and COBOL
- **Memory Requirement:** 1500 K
- **Storage Requirement:** 1200 tracks of 2280 disk space
- **Estimated Run Time:** 4 hours CPU time
- **Special Features:** None

Personal Computer

- **Hardware Used:** Compaq Diskpro 386/20
- **Operating System:** MS DOS
- **Language/Software Used:** Lotus 1-2-3; Excel; Arbiter; Harvard Graphics
- **Memory Requirement:** 2000K
- **Storage Requirement:** 10 Mb hard disk space
- **Estimated Run Time:** 1 hour
- **Special Features:** None.

World Energy Projection System (WEPS-PC)

Description:

WEPS is an integrated set of personal, computer-based spreadsheets containing data compilations, assumption specifications, descriptive analysis procedures, and projection models. Projections of the WEPS accounting framework incorporates projections from independently documented models and assumptions about the future energy intensity of economic activity (ratios of total energy consumption divided by gross domestic product [GDP]) and about the rate of incremental energy requirements met by natural gas, coal, and renewable energy sources (hydroelectricity, geothermal, solar, wind, and other renewable sources).

WEPS provides projections of total world primary energy consumption, as well as projections of energy consumption by primary energy type (oil, natural gas, coal, nuclear, and hydroelectric and other renewable sources) and projections of net electricity consumption. Carbon emissions resulting from fossil fuel use are derived from the energy consumption projections. All projections are computed in 5-year intervals through 2020. For both historical series and projections series, WEPS provides analytical computations of energy intensity and energy elasticity (the percentage change in energy consumption per percentage change in GDP).

Last Model Update:

April 2001

Part of Another Model?

No

Sponsor:

- **Office:** Office of Integrated Analysis and Forecasting
- **Division:** International, Economic, and Greenhouse Gases Division
- **Model Contact:** Linda Doman
- **Telephone:** (202) 586-1041
- **E-Mail Address:** Linda.Doman@eia.doe.gov

Documentation:

Energy Information Administration, *World Energy Projection System Model Documentation,* DOE/EIA-M050(97) (Washington, DC, 1997).
http://tonto.eia.doe.gov/FTPROOT/modeldoc/m05097.pdf

Archive Media and Installation Manual(s):

World Energy Projection System (WEPS) 2001, April 2001.

Coverage:

- **Geographic:** World by selected countries and major regions
- **Time Unit/Frequency:** Projections of consumption by 5-year intervals through the year 2020
- **Product(s):** Units include million barrels per day (oil), trillion cubic feet (natural gas), million short tons (coal), billion kilowatt hours (nuclear and net electricity), and quadrillion British thermal units (all energy sources).

Modeling Features:

- **Model Structure:** The model structure is an accounting framework of relationships concerning energy consumption, oil production, world oil prices, economic growth, and energy elasticities
- **Modeling Technique:** The major technique used in the WEPS is to project total energy by region based on an assumed relationship to economic growth as measured by gross domestic product (GDP). Projections of all other energy sources are made consistent with projected total energy. Econometric techniques are not used to determine changes in relationships over the projection period
- **Special Features:** None.

Non-DOE Input Sources:

- International Energy Agency (Paris), *Coal Information* (Paris)
  - Total final energy consumption by fuel
  - Energy consumed by end use sector by fuel
- International Energy Agency, *Electricity Information* (Paris)
  - Energy consumed by fuel by electric utilities
- International Energy Agency (Paris), *Energy Balances of OECD Countries* (Paris)
  - Consumption of energy source (oil, natural gas, coal, nuclear, other) by end-use sector (industrial, building, transportation, electric utility) for OECD countries.
- International Energy Agency, *Balances and Statistics of Non-OECD Countries* (Paris)
  - Consumption of energy source (oil, natural gas, coal, nuclear, other) by end-use sector (industrial, building, transportation, electric utility for Non-OECD Countries.
- American Automobile Manufacturers Association, World Motor Vehicle Data (Detroit, MI, 1997)
  - Vehicle population by country
- Standard & Poor's DRI, *World Economic Outlook: Volume I*, 3rd Quarter (Lexington, MA)
  - Historical (1970-1999) real GDP (in 1997 U.S. dollars)
  - GDP projections (1998-2020)
- WEFA Group, *World Economic Outlook: 20 Year Extension* (Eddystone, PA)
  - Historical (1977-1995) real Gross Domestic Product (in 1990 U.S. dollars)

DOE Data Input Sources:

- Energy Information Administration, *Annual Energy Outlook* (Washington, DC, annual)
  - U.S. consumption of energy source (oil, natural gas, coal, nuclear, other) by sector (industrial, transportation, building, and electric utility)
  - World oil price path
  - U.S. carbon emissions
  - U.S. net electricity consumption
- Energy Information Administration, *Annual Energy Review* (Washington, DC, annual)
  - GDP deflators
- Energy Information Administration, Office of Coal, Nuclear, Electric and Alternate Fuels; Coal, Nuclear, and Renewable Fuels Division
  - Nuclear power operating capacity
- Energy Information Administration, *International Energy Annual* (Washington, DC, annual)
  - Oil consumption in quadrillion Btu and million barrels per day
  - Natural gas consumption in quadrillion Btu and trillion cubic feet
  - Coal consumption in quadrillion Btu and million short tons
  - Nuclear energy consumption (equated to generation) in quadrillion Btu and billion kilowatthours
  - Hydroelectricity and other renewable energy consumption in quadrillion Btu
  - Net electricity consumption in billion kilowatthours
  - Carbon emissions in million metric tons.

Computing Environment:

Consists of spreadsheet files and directories run on an IBM compatible personal computer using Windows 95.The world energy consumption spreadsheet programs require about 17.4 MB of hard disk space. To run the world energy consumption reference case spreadsheet requires about 640K of random access memory (RAM).

World Integrated Nuclear Evaluation System (WINES-PC)

Description:

WINES-PC is an aggregate demand-based partial equilibrium model used by the Energy Information Administration (EIA) to project long-term domestic and international nuclear energy requirements. WINES-PC follows a top-down approach in which economic growth rates, delivered energy demand growth rates, and electricity demand are projected successively to ultimately forecast total nuclear generation and nuclear demand capacity. WINES-PC could potentially be used to produce forecasts for any country or region in the world. Presently, WINES-PC is being used to generate long-term forecasts for the United States and for all countries with commercial nuclear programs in the world, excluding countries located in centrally planned economic areas. Projections for the United States are developed for the period from 2010 through 2030, and for other countries for the period starting in 2000 or 2005 (depending on the country) through 2015.

WINES-PC serves as a flexible tool with which to assist the U.S. Department of Energy (DOE) 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 and the Nuclear Energy Agency (NEA) of the Organization for Economic Cooperation and Development (OECD), the International Energy Agency (IEA), and the International Atomic Energy Agency (IAEA). WINES-PC is used to develop long-term projections of nuclear capacity and generation published annually by EIA in *World Nuclear Outlook,* and in the *International Energy Outlook*. These projections are provided to the Office of Civilian Radioactive Waste Management (OCRWM) of DOE for use in estimating nuclear waste fund revenues, and to aid in planning the disposal of nuclear waste. In addition, the projections support other reports published annually by EIA, such as *Domestic Uranium Mining and Milling Industry: Viability Assessment,* and *World Nuclear Fuel Cycle Requirements*.

Last Model Update:

December 1991

Part of Another Model?

No

Sponsor:

- **Office:** Office of Integrated Analysis and Forecasting
- **Division:** Coal and Electric Power Division
- **Model Contact:** Laura Church
- **Telephone:** (202) 586-1494
- **E-Mail Address:** Laura.Church@eia.doe.gov

Documentation:

- Energy Information Administration, *Wines Model Documentation,* DOE/EIA-M049 (Washington, DC, December 31, 1991)
- Energy Information Administration, *Model Documentation of the World Integrated Nuclear 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).

Archive Media and Installation Manual(s):

- WINES90 — for the report, *Commercial Nuclear Power 1990*
- WINES91 — for the report, *Commercial Nuclear Power 1991*
- WINES91D — archived for purposes of documentation
- WINES92 — for the report, *World Nuclear Capacity and Fuel Cycle Requirements.*

Coverage:

- **Geographic:** Countries comprising the world outside of centrally planned economic areas with commercial nuclear programs
- **Time Unit/Frequency:** WINES-PC is designed to forecast in five-year intervals
- **Product(s):** Gross domestic product or gross national product growth rates, aggregate delivered energy demand growth rate, aggregate delivered energy demand, electricity generation, nuclear generation, and nuclear capacity
- **Economic Sector(s):** Country-specific aggregate demand.

Modeling Features:

- **Model Structure:** Basic four equations linked successively representing economic growth, aggregate energy demand growth, and electricity and nuclear generation requirements
- **Modeling Technique:** Simulation based on long-term growth relationships and logistic market penetration functions. Economic growth rates based on labor supply and productivity growth rates, energy demand growth defined by a Cobb-Douglas demand function based on economic growth and aggregate energy price growth, and electricity and nuclear generation determined with logistic market penetration functions
- **Special Features:** Long-term, highly aggregated model using logistic curves to estimate market penetration for electricity and nuclear generation.

Non-DOE Input Sources:

- Gregory Spencer, U.S. Department of Commerce, Bureau of the Census, *Projections of the Population of the United States, by Age, Sex and Race: 1988 to 2080,* Series P-25, No. 1018 (Washington, DC, January 1989)
  - Labor-age population growth rates (U.S.)
- M.T. Vu, World Bank, *Short-Term Population Projection, 1980-2000* and *Long-Term Projection, 2000 to Stationary Stage by Age and Sex for All Countries of the World* (Washington, DC, July 1984)
  - Labor-age population growth rates (foreign)
- World Bank, *World Development Report*
  - Classification of per capita income used to adjust price and income elasticities of energy demand over time (non-OECD nations)
- U.S. Department of Labor, Bureau of Labor Statistics, *Employment and Earnings* (Washington, DC, January 1991)
  - Labor force participation growth rate (U.S.)
- U.S. Department of Labor, Bureau of Labor Statistics, *Handbook of Labor Statistics* (Washington, D.C., various annual issues)
  - Historical productivity data used to estimate labor productivity growth rate (U.S.)
- Organization for Economic Cooperation and Development, Department of Economics and Statistics, *Labour Force Statistics* (Paris, 1990)
  - Labor force participation growth rate (OECD nations)
- Organization for Economic Cooperation and Development, *Historical Statistics — OECD Economic Outlook* (Paris, various annual issues)
  - Labor productivity growth rate (OECD nations)
  - Historical energy prices used to estimate delivered energy price growth rate (OECD) nations)
  - Historical energy consumption, price and growth data used to estimate price and income elasticities of energy demand (OECD nations)

- Organization for Economic Cooperation and Development, *Energy Prices and Taxes* (Paris)
  - Historical energy prices used to estimate delivered energy price growth rate (OECD nations)
  - Historical energy consumption, price and growth data used to estimate price and income elasticities of energy demand (OECD nations)
- Organization for Economic Cooperation and Development, International Energy Agency, *IEA Statistics: World Energy Statistics and Balances* (Paris, June 1991)
  - Historical energy consumption, price and growth data used to estimate price and income elasticities of energy demand (OECD nations)
  - Historical electrical and nuclear shares data used to estimate electrical and nuclear share asymptotic limits, and electrical and nuclear halving factors (foreign)
- Organization for Economic Cooperation and Development, International Energy Agency, *Energy Policies and Programs of IEA Countries: 1989 Review* (Paris, 1990)
  - Energy price forecasts used to estimate delivered energy price growth rate (OECD nations)
- Organization for Economic Cooperation and Development, *Nuclear Energy Data* (Paris, 1991)
  - Historical nuclear shares data and nuclear generation forecasts used to estimate nuclear share asymptotic limit and nuclear halving factor (foreign)
- Organization for Economic Cooperation and Development, Nuclear Energy Agency, *Summary of Nuclear Power and Fuel Cycle Data in OECD Member Countries* (Paris, March 1983)
  - Base year aggregate energy demand
- Organization for Economic Cooperation and Development, Nuclear Energy Agency, *Tabulation of WPNFCR Questionnaire Responses from OECD Member Countries* (Paris, December 1980)
  - Base year aggregate energy demand
- Organization for Economic Cooperation and Development, Nuclear Energy Agency, *Tabulation of WPNFCR Questionnaire Responses from Non-OECD States* (Paris, July 1980)
  - Base year aggregate energy demand
- International Labour Office, *Labour Force Estimates* (Geneva, Switzerland, 1977)
  - Labor force participation growth rate (non-OECD nations)
  - Labor productivity growth rate (non-OECD nations)
- United Nations, *1981 Statistical Yearbook of the United Nations* (New York, 1983)
  - Base year aggregate energy demand
- United Nations, *1980 Yearbook of World Energy Statistics* (New York, 1982)
  - Base year aggregate energy demand.

DOE Data Input Sources:

- Energy Information Administration, *Annual Energy Outlook*, DOE/EIA-0383 (Washington, DC, annual)
  - Energy price forecasts used to estimate delivered energy price growth rate (U.S.)
  - Historical energy consumption, price and growth data used to estimate price and income elasticities of energy demand (U.S.)
  - Base year aggregate energy demand
  - Historical electrical and nuclear shares data used to estimate electrical and nuclear share asymptotic limits, and electrical and nuclear halving factors (U.S.)

- Energy Information Administration, *Annual Energy Review,* DOE/EIA-0384 (Washington, DC, annual)
  - Historical energy prices used to estimate delivered energy price growth rate (U.S.)
  - Historical energy consumption, price and growth data used to estimate price and income elasticities of energy demand (U.S.)
  - Base year aggregate energy demand
  - Historical electrical and nuclear shares data used to estimate electrical and nuclear share asymptotic limits, and electrical and nuclear halving factors (U.S.)
- Energy Information Administration, *Commercial Nuclear Power: Prospects for the United States and the World*, DOE/EIA-0438 (Washington, DC, 1990 and 1991 issues)
  - Historical nuclear shares data and nuclear generation forecasts used to estimate nuclear share asymptotic limit and nuclear halving factor (U.S.) Nuclear generation capacity factor
- Energy Information Administration, *Improving Technology: Modeling Energy Futures for the National Energy Strategy*, Service Report SR/NES/90-01, January 1991
  - Energy price forecasts used to estimate delivered energy price growth rate (U.S.).

Computing Environment:

- **Hardware Used:** IBM-compatible personal computer
- **Operating System:** MS DOS
- **Language/Software Used:** FORTRAN, Version 3.31
- **Memory Requirement:** 640 Kb RAM
- **Storage Requirement:** 600 Kb
- **Estimated Run Time:** No longer than 5 minutes
- **Special Features:** None.