NEMS Integrating Module Documentation Report

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Contents

Tables

Figures

1. Introduction

The National Energy Modeling System (NEMS) is a computer modeling system that produces a general equilibrium solution for energy supply and demand in the U.S. energy markets. 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 such 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.

NEMS is structured as a modular system. The modules include the Integrating Module documented herein and a series of relatively independent analytical modules that represent the domestic energy system, the international energy market, and the economy. The domestic energy system is decomposed into fuel supply markets, conversion activities, and end-use consumption sectors.

In order to compute an integrated energy forecast, it is necessary for the modules of NEMS to exchange data, both with the outside world and with each other. This is accomplished in NEMS by a set of global variables arranged into an efficient, manageable data structure, although each module also has its own local variables and local files used only by that particular module. Most of the data reside in main memory, rapidly accessible by any module during execution.

Scope of This Document

The NEMS Integrating Module is the central integrating component of a complex modeling system. As such, a thorough understanding of its role in the modeling process can only be achieved by placing it in the proper context with respect to the other modules. To that end, this document provides an overview of the complete NEMS model, and includes brief descriptions of the modules with which the Integrating Module interacts. The emphasis and focus, however, is on the structure and function of the Integrating Module of NEMS.

This document is intended to be read by analytical personnel having in-depth experience with modeling systems, who desire a comprehensive, detailed explanation of overall NEMS methodologies and approaches. As the NEMS approaches completion, additional chapters will analyze the quality of NEMS solutions.

Publication of this document 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.*

Model Archival Citation

The first model archival of NEMS will be done for the version used for the *Annual Energy Outlook 1994*. This will be available in early 1994.

Report Organization

Later chapters of this document explain NEMS purpose and scope, rationale and structure, focusing on the Integrating Module, but describing important features of the analytical modules as necessary. The properties of the solution process are also covered in detail.

Because the Integrating Module stands at the center of NEMS operations, controlling the solution process, this documentation describes NEMS as a whole, as well as the details of the operation of the solution algorithm. The first chapter is therefore devoted to a description of NEMS.

The **Solution Methodology** chapter discusses the details of the Integrating Module's activities.

Chapters on properties, performance, calibration, and validation are reserved for future editions of this document that will be completed later.

Appendices contain supporting information for the NEMS model: history, bibliography, Model Abstract, and detailed listings of model variables.

2. Overview of the Structure of NEMS

The purpose of the National Energy Modeling System (NEMS) is:

> To illustrate the energy, economic, environmental, and energy security consequences on the United States of various energy policies and assumptions by providing forecasts of alternative energy futures in the mid-, and long-term periods, using a unified modeling system.

The primary use of NEMS is the development of baseline forecasts, such as those presented in the *Annual Energy Outlook* and special studies requested by clients, including Congress. The Short-Term Integrated Forecasting System (STIFS) is currently used in developing the quarterly *Short-Term Energy Outlook*. NEMS is planned to have both a midterm and a long-term modeling capability. The midterm horizon, to 2015, is the focus of this report and of the initial development effort. Most policy questions or alternative analyses have their greatest impact during the midterm.

In that vein, NEMS represents a rethinking and enhancement of past modeling efforts, with particular sensitivity to current policy-related issues. Some of the areas given enhanced representation by NEMS include:

- Environmental issues;
- Regulatory changes;
- New technologies;
- Renewable sources of energy;
- Alternative fuels and reformulated products;
- Extension of the endogenous macroeconomic and microeconomic analysis capability; and
- World energy trade endogenous to the system.

Regional capabilities critical to appropriate representation of issues, such as energy flows, environmental impacts, industry infrastructure, and resource depletion, have also been implemented.

NEMS Objectives

NEMS' design was formulated in response to three objectives:

- The incorporation of sufficient detail to support a broad range of policy analysis;

- The representation of energy markets in a manner that captures the important interrelationships so that actual energy market conditions can be accurately simulated; and

- The choice of a modeling system design which facilitates maintenance and use.

NEMS is a model of domestic energy markets. As such, the decisions to produce, convert, or consume energy products are presumed to serve the economic self-interest of those making the decisions. Many NEMS modules explicitly reproduce the economic decisionmaking involved in the portion of the energy system being modeled. In order to represent these decisions, NEMS is constructed in a reasonably fine detail of energy product categories and the regional locations of the sites of energy production and use. This detail is necessary since the economics of allocating energy products is strongly influenced by the product category at issue and regional differences in costs and other factors. Table 1 provides a summary of NEMS product and regional detail.

Table 1. Summary of NEMS Modeling Detail

Energy System Activity	Categories	Regions
Primary Supply		
Oil	conventional enhanced heavy oil shale oil	six lower 48 onshore three lower 48 offshore three Alaska
Gas	conventional nonassociated conventional associated coalbed methane deep tight sands Devonian shale	six lower 48 onshore three lower 48 offshore three Alaska
Natural Gas Transmission and Distribution	residential, commercial, industrial, utility firm *vs.* interruptible peak *vs.* offpeak	twelve transshipment regions
Coal	four sulfur categories four thermal categories deep and surface mining types	sixteen supply regions
Renewables	hydropower, wind, geothermal, solar thermal, photovoltaic, municipal solid waste, biomass	NERC regions for variables to conversion modules; Census divisions for variables to demand modules
Conversion		
Electricity (including uranium for Nuclear)	utilities, independent power cogeneration	thirteen supply regions nine census demand regions
Refining	five crude categories seven product categories	five PADDs
Energy Demand		
Residential	eight end-use services three housing types	nine census divisions
Commercial	eight end-use services eleven building types	nine census divisions
Transportation	six vehicle size categories ten vehicle age categories	nine census divisions
Industrial	thirty-five industries nine primary industries	four census regions shared to nine census divisions

Regional Detail

The Integrating Module of NEMS processes energy information at the level of Census Divisions, which subdivide the nation as shown in Figure 1. NEMS imposes no requirements upon the component analytical modules as to the regional breakout they are to use, beyond the requirement that all data obtained from, or contributed to, the Integrating Module must be by Census Division. In fact, many of the modules use other regional structures as appropriate for their market segments. These modules convert their solutions to the Census Division structure for processing by the Integrating Module and by the reporting programs. Details of the conversion processes embedded in the modules are given in the individual *Model Documentation Reports*. These are listed below, in the bibliography given in Appendix C, pages 104 through 106.

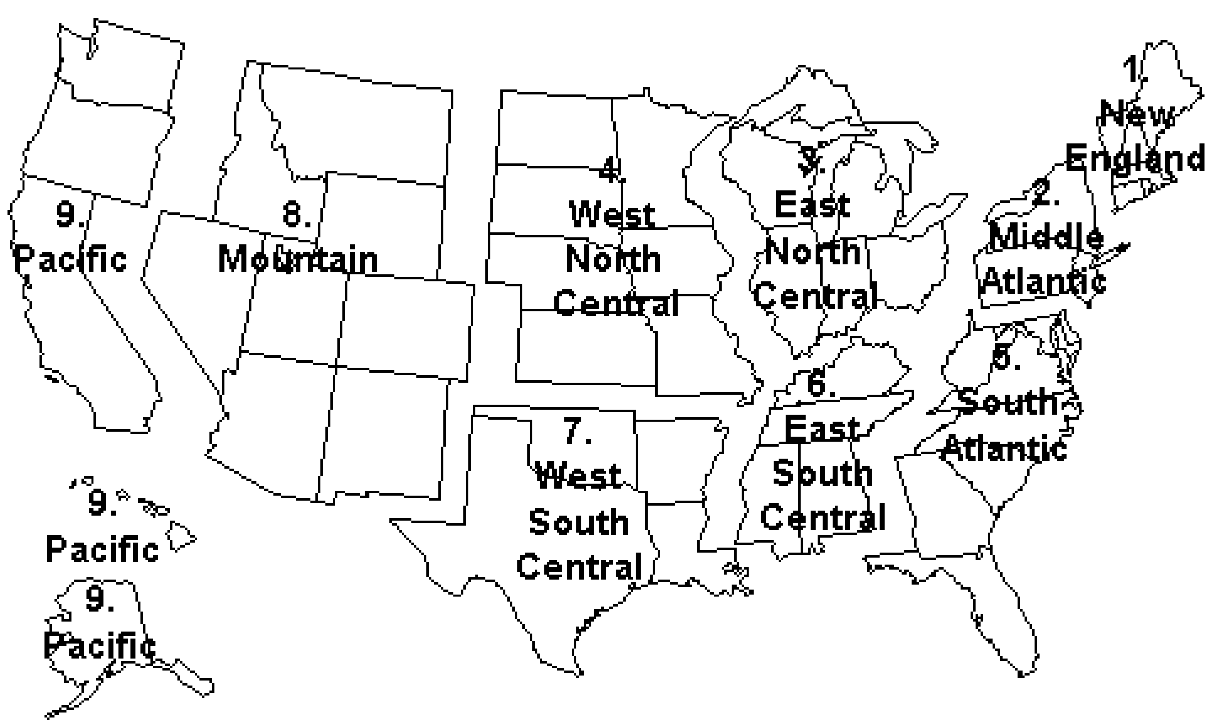
Time Horizon

The horizon for the midterm model is 2015, covering that time period in which the structure of the economy, the nature of energy markets, and regional demographics are sufficiently well understood in structural and regional detail. The majority of policies proposed today can be expected to have their greatest impacts during the midterm years.

Rather than trying to attain some planned state of energy markets, NEMS attempts to simulate where the present state of energy markets and planned policies would take us. Therefore it solves forward in time year-by-year.

Major Assumptions

Figure 1. Census Divisions

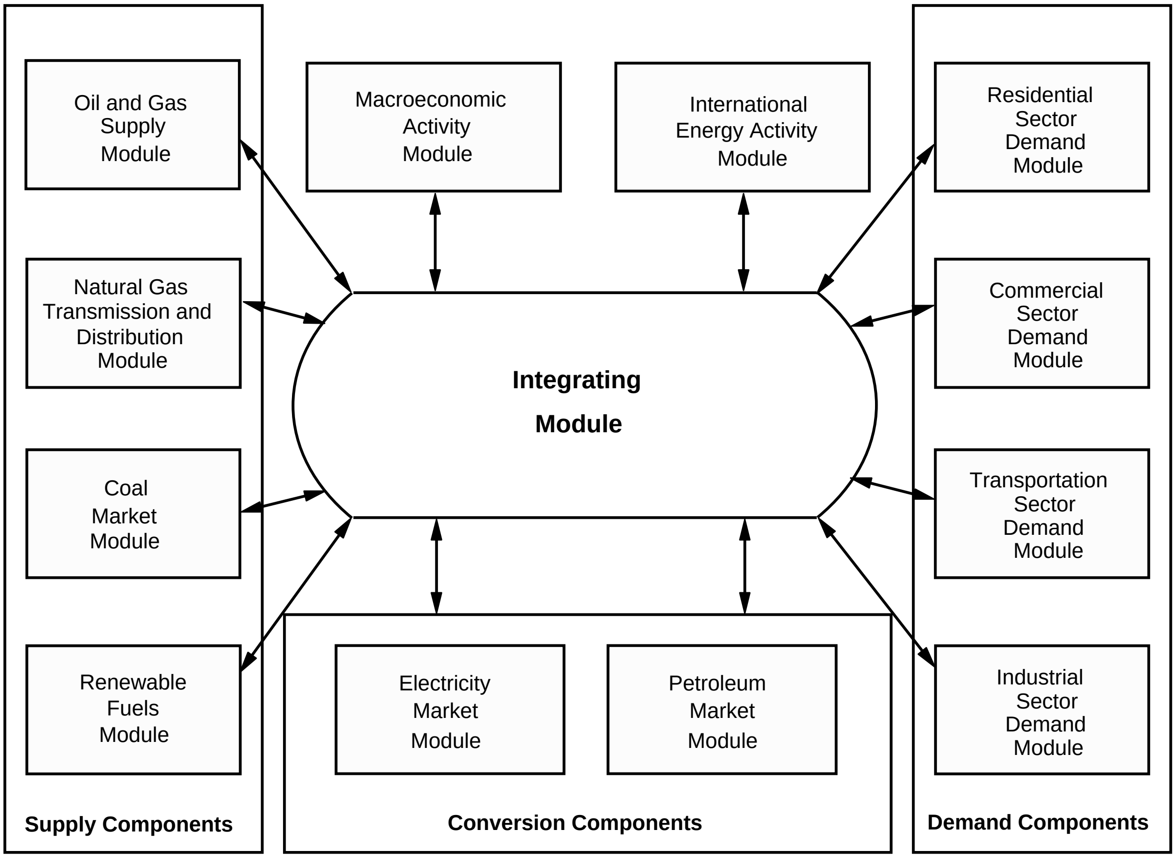


Each module within NEMS embodies the many assumptions necessary to characterize the future production, conversion, and consumption of energy products in the U.S. There are no specific data-oriented assumptions, in the Integrating Module, such as there are for the other modules. NEMS' Integrating Module assumes that the individual modules can be integrated to provide a convergent process for the system as a whole. It makes use of the Gauss-Seidel algorithm for blocked non-linear simultaneous equations, interpreted for the characteristics of the national energy marketplace simulated here. Chapter 4 describes this approach in detail.

The NEMS algorithm and modeling approach worked successfully in the predecessor IFFS/GAMS modeling system. Although the models differ, NEMS has not added obstacles to finding solutions and has retained the older model's overall structure. Experience has shown that this approach occasionally has difficulty converging on a final solution, due to two broad classes of discontinuities in the component modules: the linear programming solution methods used by some modules jump from one vertex to another of their polygonal solution space; and other modules use tabulated functions evaluated either as step functions or by linear interpolation. These issues are handled in NEMS by ensuring that the spacings between the modules' steps are reasonably small. Convergence issues are discussed in more detail in Chapter 5.

NEMS Modular Structure

Figure 2. Basic NEMS Structure



As shown in Figure 2, NEMS consists of four supply modules (oil and gas, natural gas transmission and distribution, coal, and renewable fuels), two conversion modules (electricity and petroleum refineries), four demand modules (residential, commercial, transportation and industrial sectors), one module to simulate energy/economy interactions (macroeconomic activity), one to simulate world energy/domestic energy interactions (international energy activity), and one module to provide the mechanism that achieves a general market equilibrium among all the modules (the Integrating Module). The last of these is the focus of this document. Figure 2 depicts the high level of modularity of NEMS.

Modularity

Model modularity implies a system of self-contained units, each performing a specific, well-defined function. This concept is generally consistent with the economic structure of energy markets, which can be represented by various supply, conversion, and demand components that are largely separable. Due to the heterogenous nature of energy markets, a single methodology cannot adequately represent all fuel supply, energy conversion, and end-use demand sectors. Modularity allows the flexibility to use the methodology and coverage that is most appropriate for each module. Furthermore, modularity provides the capability to execute the modules individually or to easily substitute alternative modules to represent a specific function, so long as the required interfaces are satisfied. The interactions among these modules are controlled by the integrating mechanism.

Coordination of Modules and Data

Required linkages among modules are passed through common interfaces via the Integrating Module. The primary data flows among the major modules are the delivered prices of energy and the quantities consumed by product, region, and sector. As shown in

Table 2. NEMS Module Information Flows

Module	Inputs from Other NEMS Modules	Inputs from Exogenous Sources	Important Outputs
Oil and Gas Supply	Oil and Gas Production by Fuel Type Interest Rates/Price Deflators Oil, Gas, Electricity Prices	Resource Levels Finding Rate Parameters Costs Production Profiles Tax Rates	Supply Curve Parameters Oil and Gas Financial Data Pipeline Gas and LNG Imports (Exports) Reserves and Reserve Additions
Natural Gas Transmission and Distribution	End-Use Gas Demands Natural Gas Supply Parameters Interest Rates Labor Costs Productivity	Existing Pipeline and Storage Facilities Historical Consumption Patterns Historical Flow Patterns	End-Use Natural Gas Prices Natural Gas Wellhead Prices Investment for Facilities Pipeline Emissions Storage and Pipeline Capacity Expansion
Coal Market	Coal Demand Natural Gas Prices Refined Product Prices Interest Rates Price Deflators	Base Year Production Contract Quantities Labor Productivity, Costs Transportation Costs Excess Capacity	Coal Production and Distribution Minemouth and End-Use Coal Prices Coal Feedstock Demand and Prices Coal Liquids Production and Prices Synfuel Plant Investment
Renewable Fuels	Installed Capacities Interest Rates, GDP	Technological Parameters Applicable Agricultural Factors Dispersed Geothermal Data	Available Production Capacities Capital Costs Operating Costs Thermal Contents and Heat Rates Biomass (Wood) Prices Supply Curves for Ethanol Load Duration Curves for Solar and Wind Emissions rates for Wood, MSW, Geothermal
Residential	Energy Product Prices Housing Starts	Current Housing Stocks Retirement Rates Current Appliance Stocks & Life Expectancy New Appliance Types, Efficiencies, Costs Housing Shell Retrofit Indices Unit Energy Consumptions	Energy Product Demand Emissions Changes in Housing and Appliance Stocks
Commercial	Energy Product Prices Rates of Interest, GDP	Existing Commercial Floorspace Floorspace Survival Rates Appliance Stocks Appliance Survival Rates New Appliance Types, Efficiencies, Costs Service Demand Intensities	Energy Product Demand Emissions Changes in Floorspace Changes in Appliance Stocks
Transportation	Energy Product Prices GDP Disposable Personal Income Industrial Output New Car and Light Truck Sales	Current and Projected Demographics Existing Vehicle Stocks Vehicle Survival Rates New Vehicle Technologies, Efficiencies, Costs Vehicle Safety and Emissions Regulations Vehicle Miles-per-Gallon Degradation Rates	Energy Product Demand Emissions Stocks and Characteristics of Vehicle Types
Industrial	Energy Product Prices Sectoral Trends of Economic Activity	Production Stages in Energy-Intensive Industries Technology Possibility Curves	Energy Product Demand Sectoral Detail of Future Energy Use

Table 2. NEMS Module Information Flows (Continued)

Module	Inputs from Other NEMS Modules	Inputs from Exogenous Sources	Important Outputs
Petroleum Market	Current World Oil Price Supply Curves for Imported Crudes and Products Petroleum Product Demands Electricity and Natural Gas Prices	Costs of Refining and Capacity Expansion Processing Unit Parameters Existing Refining and Distribution Facilities	Petroleum Product Prices Capital Expenditure for Refineries Crude and Product Imports (Exports) Refinery Fuel Use
International Energy Activity	U.S. Oil Supply/Demand U.S. Net Product Imports	OPEC Production Capacity Path Reference Non-U.S. Oil Supply and Demand	World Oil Price Crude Oil Imports Product Import Prices MTBE and Methanol Prices
Macroeconomic Activity	Wholesale Electricity Prices Retail Electricity Prices For Oil, Gas and Coal: Wholesale Prices Retail Prices Production Rates Rate of Refinery Activity Incremental Energy Investment	Labor Force Productivity	GDP and Other Economic Activity Measures Price Indices and Deflators U.S. Imports/Exports Production Rates by Industry

Table 2, the information flows are not limited to prices and quantities, but include other information such as economic activity, capital expenditures, and load curves. The delivered prices for a fuel include the costs of all the activities necessary to produce, import, and transport the fuel to the end user.

The NEMS user can modify input values and key assumptions for the modules through the user interface, thus facilitating analyses using individual modules. For example, the Electricity Market

Module normally receives delivered prices of fuels from the fuel supply modules; however the user can specify those prices externally to allow greater flexibility in using individual modules of the system.

Data Structure

The concept of the NEMS Global Data Structure is central to the modular structure. The NEMS Global Data Structure is defined as the set of data communicated among any of the thirteen NEMS modules. The Global Data Structure includes the energy market prices and consumption, macroeconomic variables, energy production, transportation, and conversion information, as well as centralized model control variables, parameters, and assumptions. The Global Data Structure excludes variables that are defined locally within modules and not communicated to other modules.

An important subset of the Global Data Structure is the Energy Market Data, the energy market end-use-sector prices and quantities of fuels used for equilibration and the NEMS energy balance. The Energy Market Data are the principal variables used directly by the Integrating Module in its convergence algorithm. Additional macroeconomic and international trade variables are tested for convergence as well in the solution algorithm.

Environment

Recognizing the importance of environmental issues associated with the use of energy, NEMS includes an environmental impact capability. Six emissions are accounted for in NEMS: carbon, CO, CO_2, SO_x, NO_x, and volatile organic compounds. These emissions are computed only for fuel combustion. In addition, NEMS represents all current environmental regulations, such as the Clean Air Act Amendments of 1990.

Alternative Approaches

This section on alternative approaches to the integrating methodology for NEMS provides background on the research that preceded the overall system design.[1] The discussion of methodologies is limited to those with which EIA has some familiarity and is intended to focus on the fundamental principles of the design rather than on the specifics of individual fuel or sector methodologies. This topic was also considered by the National Research Council Committee on NEMS.

Two primary requirements form the basis for discussion of the integrating framework of NEMS. First, NEMS is a tool for performing market-based integrated energy market analysis, but on a sector- and fuel-specific basis. Second, the NEMS design allows a high degree of modularity. The

[1] A full discussion of the issues relating to the integrating methodology can be found in the NEMS Issue Paper, *Integrating Methodology of the National Energy Modeling System*, June 28,1991.

first goal implies that NEMS should be able to balance the supply of and demand for energy, taking into account the economic competition among energy sources. Economic principles for energy supply, consumption, and competition are the foundation of most EIA analysis. Although valuable insights can be derived from the analysis of a narrow sector-specific option, very often the policy discussions center on broad energy market impacts, such as energy security or economic impacts. This is not to imply that all analyses need be done in an integrated framework, but rather that the capability should be in place.

A fixed-shares approach to fuel competition or a system in which the energy sectors do not balance would add little information to the policy debates. A market-based approach, in which supplies and demands for energy respond to the costs and prices of energy, predominates as the underlying principle of the required energy policy analysis. Thus, NEMS must provide a framework in which the market-clearing prices and quantities of energy supply and demand can be derived, subject to other factors, such as regulatory and legislative conditions.

The second goal for NEMS development that directly affects the design of the integrating methodology is the requirement for modularity. Model modularity implies that the modules of NEMS that represent the various supply, conversion, and consumption components are separable in both their methodology and their implementation. Functionally, modularity allows the component modules to be tested and developed without running the entire system, which is necessarily faster, and allows problems to be isolated to particular sectors. In addition, individual fuel or sector studies can be conducted with all other components held constant. Finally, modularity readily allows for the inclusion of alternative modules that meet minimum interface requirements. This desired modularity or segmentation of the modeling system leads to the necessity for a methodology by which the various modules can interact—the integrating methodology. A discussion of various approaches used in earlier models follows.

Approaches to an Integrating Methodology

Project Independence Evaluation System

The Project Independence Evaluation System (PIES), later named the Midterm Energy Forecasting System (MEFS), is one example of a large-scale integrated energy modeling system. It was developed in 1974 by the Federal Energy Administration, a predecessor organization to the EIA. The core model of PIES/MEFS was a single linear program of fuel supply, transportation, conversion, and fixed demand activities, which optimized by solving for the least-cost combination of supply and transportation of fuel to meet end-use demand.

PIES/MEFS solved for a supply/demand equilibrium in one future period by iterating between the linear program and a reduced-form representation of demand models. After the linear program optimized the supply/conversion problem, the marginal, or shadow, prices for each fuel delivered to the end-users were taken from the linear program. The reduced-form demand models were evaluated at these marginal prices, giving revised demands for fuels that were entered into the linear program, which was then re-solved. This process of iterating between the linear program and demand models continued until the marginal prices and end-use demands between subsequent iterations were close within a convergence tolerance. Over the years, many special features were added to PIES/MEFS to reflect regulatory policies or to ensure that certain end-use prices from the linear program were average or regulated prices, rather than strict marginal prices. These features were incorporated in either the linear program or in the program that controlled the equilibration and determined convergence.

As a modeling system, PIES/MEFS encompassed a host of satellite models—coal, oil, natural gas, synthetic fuels, refinery, electric utility, end-use demand, and macroeconomic. Each of these satellite models produced the necessary coefficients and objective function costs for the linear program and incorporated sector-specific features as required. This limited modular structure served to organize the data and allocate responsibilities for the modeling activities; however, there were several significant problems with PIES/MEFS as an integrating methodology.

First, the structure of the system required the entire linear program to be executed together without any means of decomposing the model. This was a serious problem in a testing and debugging mode since PIES/MEFS required several hours to execute, and the simplest changes could only be tested through an entire run of the model. The satellite models and preprocessor programs produced data for the linear program, but did not produce results that could be readily used for analysis or testing of the individual sector. Yet another difficulty with PIES/MEFS was the overarching optimization methodology, which was not suitable for all portions of all the supply sectors. Several special features were incorporated into the system to appropriately represent some regulatory or institutional features of various sectors; however, this became increasingly burdensome.

Intermediate Future Forecasting System

The immediate predecessor to NEMS was the Intermediate Future Forecasting System (IFFS), an annual model that forecasted to a specified time horizon, the maximum finally set at 2010. IFFS partitioned the energy system into fuel supply, conversion, and end-use demand sectors, then solved for a supply/demand equilibrium by successively and repeatedly invoking these modules. This equilibration was performed one forecast year at a time, stepping forward to the next forecast year when the equilibrium for one year was complete.

The fuel supply modules in IFFS encompassed all the activities necessary to produce, import, and transport the fuel to the end user, thus computing the domestic production and the regional end-use prices necessary to meet end-use demand. Each of the end-use demand modules computed fuel requirements for the sector by region, based upon the regional end-use prices of all competing fuels, and other factors. The electricity module, as a conversion module, consumed fuel based on relative prices and then generated and priced electricity. The refinery module was also viewed as a conversion module, except that it used only a single primary input, crude oil, whose price was invariant, and its fuel use was represented in the industrial demand module with no direct linkage to refinery activity.

Within the IFFS framework, the primary interfaces among the modules were the regional end-use prices and demands for each fuel, although other information was passed among modules. Each fuel supply or end-use sector demand module was called in sequence, and each module solved assuming all other variables in the energy markets were held constant. That is, the coal module solved for the production and end-use prices of coal, assuming a slate of demands for coal and assuming that all other sectors were fixed. Any module that used the coal prices would then use these new prices to compute demand the next time the module was executed. This process was equivalent to a Gauss-Seidel algorithm for solving a set of simultaneous equations.

The equilibration module of IFFS called the various modules in sequence and checked for convergence of the system by computing percentage differences between iterations for all end-use prices and demands in each region. When differences were within the user-specified tolerance, convergence was declared and the equilibrating module began solving the next forecast year. Some attempt was made in IFFS to speed convergence by using characteristics of particular modules. For example, the sensitivity of the natural gas price to the level of demand, and the concomitant sensitivity of gas demand in certain sectors to the price, was well recognized. To handle this, the electricity module computed a derived demand curve for natural gas, explicitly representing the demand for gas at a variety of prices, for both the electricity and gas modules to deal more effectively with convergence. This demand curve was part of the information passed from the electricity module to the gas module.

Due to the partitioning of the energy markets and the specific implementation of the modules and integrating methodology in IFFS, any subset of the modules could be executed, or any module that met a minimum interface requirement could be substituted. A key feature that was necessary to achieve the modularization was the means by which the modules passed information to each other. Within IFFS, none of the modules passed information directly to another module, but rather through a central data storage file. If a particular module was not included in a particular run of the system, the information it normally provided was located in the central data file. Thus, any other module could read that information and was oblivious to whether the module was included.

The modular nature of IFFS allowed for single-fuel studies, if desired. Such studies were conducted on the electricity and natural gas sectors. However, it was not easy to execute, for example, the electricity model with a specified demand or with fuel prices that were different from another instance of the model execution. These functions required explicit programming by someone familiar with IFFS, or adjusted assumptions in other modules to produce the desired input.

In addition, the modular nature of IFFS readily allowed each sector of the energy market to be represented with the methodology deemed most suitable to that sector, allowing for a more natural representation of each market. IFFS contained a mix of simulation, process, econometric, and optimization methods within the various sectors. It also allowed each module to vary the depth and breadth of its coverage of the sector. For example, the coal supply module of IFFS represented 32 coal production regions and a detailed transportation network delivering the coal to the end-use demand regions. By contrast, the petroleum product module computed the refinery gate prices of products at the national level and used regional, sectoral markups to derive end-use prices without an explicit transportation component.

The flexibility of IFFS came at some cost, however. A linear program, for example, is a highly structured approach to modeling. There is an ever-increasing set of software available to generate, debug, analyze, and report linear programs. In a less structured system with more diverse methodologies, many of these features are not available or must be programmed into individual modules.

The basic IFFS methodology was also employed in the PC-AEO, a simplified spreadsheet representation of the modeling system used by EIA for three years. PC-AEO decomposed the energy system into the same supply, conversion, and demand modules, representing each module in a separate spreadsheet. The interface variables among the modules upon which the system iterated were also the end-use prices and quantities by fuel. For easier file handling, each module of PC-AEO solved all years in the forecast horizon each time it was invoked. Thus, the order of looping over modules and forecast years was reversed from IFFS.

Long-term Energy Analysis Package

For three years, EIA used the Long-term Energy Analysis Package (LEAP) for long-range forecasting. LEAP was EIA's configuration of the Generalized Equilibrium Modeling System (GEMS), originally developed by the Stanford Research Institute and now with Decision Focus, Inc. Many organizations use GEMS, configured to suit their particular purposes.

LEAP segments the energy system by separating all supply, transportation, conversion, and end-use processes. Each of these activities is defined as a node, and a network describing the flows of all information between nodes must be explicitly drawn. Each regional activity, such as coal supply by region, would also be a separate node. At all decision points in the system, there are allocation nodes. Several examples of such allocations are:

- The coal transportation network might contain a centroid in the upper Great Plains that can be served by several production regions. An allocation node at that centroid determines how much production comes from each region.

- The decisions on how much natural gas goes to each of the gas technologies in the electricity generation sector or in any end-use sector would be allocation nodes.

- The amount of each competing technology used to satisfy residential heating needs would be an allocation node.

- The entrance of Alaskan North Slope gas into the supply system would be an allocation node.

Each allocation node is a market share algorithm that uses market share coefficients, price premium, behavioral lag coefficients, and initial year market shares. These data, though fundamental to the solution, are very difficult to derive empirically for each node in the system.

LEAP solved for a supply/demand equilibrium in a way fundamentally similar to IFFS, with prices and quantities of the various types of energy being computed by modules that represented production, raw material transportation, conversion, final product transportation, and end-use energy consumption. As a representation of the overall system, the order of solution was directional, prices flowing from supply to end-use demand and quantities flowing in reverse. Thus, it solved for an equilibrium by iteratively computing the network flows.

Like PC-AEO and unlike IFFS, each module of LEAP/GEMS solved for all forecast years at a time, coming to an equilibrium for all years simultaneously.

One feature of the GEMS system is a library of generic models, from which one can choose in building a representation of the energy system. These generic models include a simple and a complex conversion process, an allocation process, a primary resource process, an end-use demand process, and a transportation process. In building a model using GEMS, a user draws the network by selecting a generic model for each node, defining all the input and output links to other nodes, and specifying all necessary data. It is the data specification and the flows that distinguish, for example, a node representing the industrial sector demand for electricity for machine drive from a node for residential natural gas space heating demand. The value of the generic models depends on the view of the model builder. If the model builders think, for example, that the coal transportation system and the natural gas transportation system differ in their physical or economic characteristics, then a generic model cannot be used for both and separate models must be developed. One model builder might require only a simple energy market representation and therefore be comfortable with the generic models. Someone interested in more sophisticated representations of the different energy sectors for specific issues might be less comfortable with the generic model concept. As the model builder moves away from the generic model concept, the value of the GEMS system and its data structure diminishes.

A potential difficulty in using the GEMS-type approach is the application of methodologies that encompass several nodes. A model builder using GEMS would represent oil and gas production by a separate node for each region and each technology type, differentiated by oil and gas. This was done in LEAP, which made the model large and cumbersome. However, if EIA wished to incorporate a methodology such as an oil and gas industry-wide cash flow or other activity, this would become difficult. EIA has tended to take a wider market view of the various sectors, for example, representing coal supply and transportation in a unified way or natural gas production and transportation. GEMS could incorporate these market views if the model builder programmed larger, more specialized nodes, encompassing a larger number of individual activities, but diminishing the value of the generic module library.

Optimization Methodologies

Optimization models are often appropriate for simulating the behavior of a homogeneous industry or sector of the economy that typically has a single objective function. For example, the electric industry's plant dispatching decisions or the movements in the coal transportation sector can be represented appropriately as an optimization model. In such models, the objective is typically a cost minimization.

Optimization approaches can also be used to solve a market equilibrium problem for a competitive market. The mathematical equivalence between the competitive solution and the cost minimizing solution allows the use of optimization techniques to solve for the market equilibrium. For a competitive model, an equivalent supply side optimization problem is to provide customers with prespecified quantities of end-use fuels at minimum cost. Such a model ignores the fact that real-world markets are always suboptimal, as they are constantly in the process of optimizing to constantly changing conditions. The integrating framework of the PIES model mentioned earlier was structured as an optimization problem.

While optimization methods could be used to determine a generalized market clearing solution, such an approach might prove too difficult or inflexible to apply to the complex U.S. energy economy. As discussed above, the experience with the PIES model cautions against using an overarching optimization approach as an integrating framework for NEMS. Model implementation and management are relatively difficult, as is the simulation of a diverse group of industries with a single modeling approach. A preferred approach combines a flexible integrating framework with a solution algorithm that yields equilibrium energy market forecasts.

Other Methodologies

All the above methodologies inherently assume a complex representation of the feedbacks and interrelationships of the energy system, as well as an ability to represent a system that evolves over time. Other methodologies that do not incorporate such features are possible.

EIA's *Short-Term Energy Outlook* is a 2-year, quarterly forecast of national energy supply and demand, produced using the Short-Term Integrated Forecasting System (STIFS). Given assumed crude oil and natural gas wellhead prices, STIFS computes delivered energy prices and the consumption of energy based upon relative prices and recent trends. Domestic crude oil and coal production are both projected based on the fuel prices. It achieves an energy balance using a simultaneous non-linear equations approach that adjusts production and import trends and stock levels, with limited feedback of energy prices and consumption on production. Being a short-term system, STIFS does not account for capital stock changes and investment decisions.

STIFS performs credibly for its intended purpose of providing short-term, non-equilibrium forecasts, although its limited structural representation and the lack of certain feedback effects restrict the types of scenarios it can address. In general, the STIFS integrating methodology, which does not allow for equilibration or market transition, would not be appropriate for a longer-term modeling system.

Conclusions

Because of these considerations, NEMS adopted a system design and solution algorithm similar to that of the Intermediate Future Forecasting System (IFFS). The key features of this design are:

- The energy system is decomposed into fuel supply markets, conversion activities, and end-use consumption sectors, with explicitly defined flows among the components. The primary information flows among these major components are the delivered prices of energy and the quantities consumed by product, region, and sector. Other information such as economic activity, capital expenditures, and load curves is passed among the modules as well.

- To allow operational independence, the components do not pass information to each other directly but communicate through a database while executing.

- Solution is achieved by equilibrating on the delivered prices of energy and quantities demanded, which assures an economic equilibrium of supply and demand in each of the consuming sectors.

- Equilibration is achieved annually at least through the midterm. Eventually, longer-term components of NEMS may function with longer time intervals.

Enhancements or improvements to the IFFS approaches implemented in NEMS are as follows:

- The convergence algorithm allows the use of relaxation techniques to ensure that the system achieves convergence as rapidly as possible.

- The integrating framework accounts for global system values, such as emissions and other toxics, capital requirements, and foreign trade, to allow for the representation of feedback effects of such values on the energy system.

- The structure of the integrating framework and data storage incorporate alternative assumptions about decision makers' foresight in the system. The integrating algorithm allows the system to cycle through the years to reach convergence, rather than stepping forward progressively through the years.

3. Summary of NEMS Modules

This chapter gives capsule summaries of the major software components introduced in the previous chapter. for more detailed descriptions of the NEMS modules, the reader is referred to the *NEMS Methodology Summary*, forthcoming in January 1994, and to the documentation packages for the individual modules, which are listed in Appendix C. Inputs for and outputs from the modules are summarized in Table 2.

System Integration Module

Figure 2 depicts the relationship of the Integrating Module of NEMS with each of the component modules. The Integrating Module interacts with all of the NEMS submodels, generally referred to as *modules*. The term module is used because each NEMS submodel is designed to be invoked selectively by the NEMS Integrating Module so that all or some of the NEMS model can be executed in a truly modular way.

The integrating mechanism of NEMS balances the supply of and demand for energy, taking into account the economic competition among energy sources. This competition is the foundation for most of the analysis performed by EIA. Although valuable insights can be derived from a single-sector analysis, very often policy discussions revolve around overall energy market impacts that cannot be understood from the narrow perspective of a single market segment. This does not imply that all analyses must be done in an integrated framework, but rather that the capability be in place. The individual modules of NEMS are designed to account for sector-specific or fuel-specific market characteristics and regulations, while the Integrating Module ensures that the interaction among consuming sectors, energy sources, and the economy is reflected.

The NEMS Integrating Module possesses the following features:

- Solutions are achieved by equilibrating on the delivered prices of energy and the quantities demanded, thus assuring an economic (market-clearing) equilibrium of supply and demand at agreed prices in the consuming and producing sectors. Each fuel supply, conversion, or end-use demand module is called in sequence and solves assuming all other variables in the energy markets are fixed. The modules are called iteratively until the end-use prices and quantities remain constant within a specified tolerance, a state defined as convergence. In NEMS, quantities supplied are not accounted for separately from quantities demanded; a single set of quantities both supplied and demanded ensures that they are in balance with one another.

- Equilibration is achieved annually through the midterm period to 2015.

- The integrating framework incorporates interfaces to macroeconomic and international modules that exchange information with the domestic energy modules. The solution algorithm incorporates iterative calls for the NEMS macroeconomic and international modules and performs convergence tests on a set of key macroeconomic and international trade variables.

- The integrating framework accounts for global system values, such as emissions and capital requirements.

The Integrating Module controls execution of the component modules in an iterative, convergence algorithm. The objective is to equilibrate on the delivered prices of energy and quantities demanded, to ensure an economic equilibrium of supply and demand in the domestic energy markets, with feedbacks from the international market and the economy as whole.

The concept of modularity requires that output variables from each NEMS module be available, even if the module is switched off for a particular run. In support of this requirement, the Integrating Module is capable of replacing a module's output data when that module is omitted from a run. The Integrating Module manages and has access to all data communicated among modules. The Integrating Module also loads initial energy market solutions, assesses market equilibrium, and stores the final solutions for future restart purposes and centralized reporting. In addition, the Integrating Module has access to user-defined model control variables, parameters and centrally defined assumptions.

Supply Modules

Supply sectors are generally characterized by their function of converting raw energy resources into forms that can be consumed by the consumption sectors. In NEMS, supply modules have the responsibility for accepting quantities of energy products demanded by the demand modules, and returning the prices that would be required to produce supplies in matching amounts. In addition, they provide descriptions of the technical characteristics of energy products.

Oil and Gas Supply Module

The Oil and Gas Supply Module represents domestic crude oil, natural gas liquids, and natural gas production within an integrated framework that captures the interrelationships among the various sources of supply: onshore, offshore, Alaska, conventional, and unconventional production. This framework analyzes cash flow and profitability to compute investment in each of the supply sources. Oil and gas market equilibration for production is computed at a regional level. The crude oil and natural gas liquids produced are input to the Petroleum Market Module, a separate conversion module in NEMS, for conversion and blending into refined petroleum products.

The OGSM is solved as a classical process model.

Natural Gas Transmission and Distribution Module

This module represents the transmission, distribution, and pricing of natural gas, subject to end-use demand for natural gas, the production of domestic natural gas, and the availability and price of natural gas traded on the international market. The module tracks the flows of natural gas in an aggregate, domestic pipeline network. This capability allows the analysis of impacts of regional capacity constraints in the interstate natural gas pipeline network and the identification of pipeline capacity expansion requirements. There is an explicit representation of firm and interruptible markets for natural gas transmission services, and the key components of pipeline and distributor tariffs for transmission services are included for the pricing algorithms.

The NGTDM is formulated as a linear program.

Coal Market Module

The Coal Market Module represents the mining, transportation, and pricing of coal, subject to the end-use demand for coal differentiated by physical characteristics, such as the heat and sulfur content. The coal supply curves include a response to capacity utilization and fuel costs. Transportation by various modes, such as trucks or rail, and the effects of coal contracts are represented.

The Coal Market Module incorporates an international submodule that calculates U.S. coal exports as part of the worldwide market for coal. The Coal Synthetics Submodule projects the production of synthetic fuels from coal, to be used as substitutes for conventional petroleum liquids and pipeline-quality natural gas.

The module combines linear programming optimizations with deterministic calculations.

Renewable Fuels Module

The Renewable Fuels Module includes several submodules that represent the supply of wood, municipal solid waste, wind, solar, hydropower, and geothermal technologies. The market penetration of renewable technologies used for centralized electricity generation is represented in the Electricity Market Module. The market penetration of dispersed renewables such as rooftop solar collectors and geothermal heat pumps is incorporated within the end-use demand modules. Renewable supply curves from the renewable supply module provide costs and performance criteria to these other modules. The Renewable Fuels Module also interacts with the refining module to represent the production and pricing of alcohol fuels.

Each of the submodules in the Renewable Fuels Module uses its own techniques for arriving at a solution. All, except for Geothermal, are relatively deterministic formulations. The Geothermal Submodule uses a process modeling technique that accounts for all known potential geothermal sites.

Demand Modules

Demand sectors in the energy marketplace are the end users of energy products, converting them into usable work. In NEMS, the demand modules examine prices for energy products to determine the amounts of the products that would be purchased at those prices. They are responsible also for calculating purchases of additional energy consuming equipment, on the basis of expectations about future energy requirements and prices.

The demand modules are deterministic models, characterized as structural, economic/engineering representations, as opposed to econometric modules.

Residential Sector Demand Module

The Residential Sector Demand Module forecasts the consumption of residential sector fuels and electricity by housing type and end use, subject to delivered energy prices, the availability of renewable sources of energy, and macroeconomic variables representing disposable personal income, interest rates, and housing starts.

The module distinguishes consumption by type of housing unit (single-family, multi-family, mobile home) and end use (heating, air conditioning, water heating, types of appliances, etc.). Because certain end uses and conservation measures interact (e.g., a conversion from incandescent to fluorescent lighting changes demand for other fuels, by increases in heating equipment loads and decreases in cooling loads) the model keeps track of overall, as well as individual, impacts of conservation measures and new technologies.

Commercial Sector Demand Module

The Commercial Sector Demand Module forecasts the consumption of commercial sector fuels and electricity by building type and non-building uses of energy and by category of end use, subject to delivered prices of energy, the availability of renewable sources of energy, and macroeconomic variables representing gross domestic product, employment, interest rates, and floor space construction.

Transportation Sector Demand Module

The Transportation Sector Demand Module forecasts the consumption of transportation sector fuels and electricity by transportation mode, including the use of renewables and synthetic fuels, subject to delivered prices of energy fuels and macroeconomic variables representing disposable personal income, gross domestic product, population, interest rates, and the value of output for industries in the freight sector. Analysis is disaggregated by vehicle age and size class.

Industrial Sector Demand Module

The Industrial Sector Demand Module forecasts the consumption of fuels and electricity for heat and power and for feedstocks and raw materials at a process or end-use level for the energy-intensive industries, including the direct use of renewable energy and the use of synthetic fuels, subject to delivered prices of energy and macroeconomic variables representing gross domestic product, interest rates and cost of capital, employment and labor cost, and the value of output for each industry. It includes simplified process models for 35 industries, with uses broken out to boilers/steam generation, buildings, and process/assembly. This module includes the nonutility generation of electricity that is either used in the sector or sold to electric utilities.

Conversion Modules

Conversion sectors in the energy marketplace convert energy products that could be consumed directly into other forms that can be consumed more easily by the demand sectors. In NEMS, the conversion modules act both like demand modules, in that they demand energy products, and like supply modules, in that they produce energy products for the demand sectors. They also act in a dual capacity in that they calculate the quantities of primary fuels they would consume at specified prices, and calculate the prices necessary to supply quantities of output fuels demanded by the demand modules.

Electricity Market Module

The Electricity Market Module represents the generation, transmission, and pricing of electricity, subject to the delivered prices for coal, petroleum products, natural gas, and synthetic fuels, the costs of generation by centralized renewables, macroeconomic variables for costs of capital and domestic investment, and electricity load shapes and demand. The submodules include capacity planning, fuel dispatch, nonutility generation, finance and electricity pricing, transmission and trade, and demand side management (DSM) in conjunction with the demand models.

DSM programs and all Clean Air Act compliance options are explicitly represented in the capacity expansion and dispatch decisions. Both new generating technologies and some renewable technologies compete directly in these decisions. Several options for wholesale pricing and the competition between utility and nonutility generation are included in the module.

The capacity planning portion of EMM employs a linear programming formulation; the other parts are process models.

Petroleum Market Module

The Petroleum Market Module includes the pricing of petroleum products, crude oil and product import activity in conjunction with the International Energy Activity Module, and domestic refinery operations, subject to the demand for petroleum products, the availability and price of imported petroleum, and the domestic production of crude oil, natural gas liquids, and alcohol fuels. The module represents the same five crude oil types in the refining activities as does the International Energy Activity Module. It explicitly models the requirements of the Clean Air Act Amendments of 1990 and the costs of new automotive fuels, such as oxygenated and reformulated gasoline, and includes oxygenated production and blending for reformulated gasoline. Costs include required capacity expansion for refinery processing units.

The Petroleum Market Module consists of a set of regional linear programs.

International and Economic Modules

International Energy Activity Module

The International Energy Activity Module represents the world oil markets and projects world oil prices within NEMS. International petroleum product supply curves, including curves for oxygenates, are incorporated, and an international refinery model is being added. This module defines crude oil categories that are consistent with those in the domestic refinery model.

The module is purely deterministic.

Macroeconomic Activity Module

The Macroeconomic Activity Module provides a set of essential macroeconomic drivers to the energy modules, provides a macroeconomic feedback mechanism within NEMS, and evaluates detailed macroeconomic and interindustry impacts associated with energy events. Industrial drivers are calculated for 35 industrial sectors. A capability to analyze the impacts of energy investment is included, as well as regional macroeconomic projections. This module is a response surface representation of the Data Resources, Inc., (DRI) Quarterly Model of the U.S. Economy.

4. Global Data Structure

As a distinct component of NEMS, the Integrating Module operates on a subset of the Global Data Structure that consists primarily of the model control information and the end-use sector prices and quantities of fuels. Some model control information is input to the Integrating Module from the NEMS user interface. Other control information, such as the current model year, is updated during model execution. All of this control information is accessible to NEMS modules, and can be viewed as an output of the Integrating Module.

The end-use prices and quantities are both inputs and outputs for the Integrating Module. The Integrating Module stores these values from one iteration to the next to check on NEMS convergence. At user request, the Integrating Module can change the prices and quantities from the component modules, to speed convergence (see **Acceleration Techniques**, on page 44). Thus, the updated values are considered an output.

Because of the flexible year-looping algorithm in the Integrating Module, all variables in the Global Data Structure are explicitly dimensioned with a NEMS year subscript. As a result, the memory requirements for the NEMS Global Data Structure are significant.

Inter-Module Communications

Four categories of variables provide input and output for each module. Some variables fall into more than one category:

- Variables needed by the module, which pertain to and are specific only to that module, including initial values, parameters, coefficients, and assumptions for that individual module, ordinarily read in from the module's private input files;

- Variables that are outputs of the individual module, derived only from that module, including specialized and/or debug reports, that ordinarily are output to the module's private output files;

- Variables that are critical to the proper functioning of the integrating system, providing the information links that allow the modules to communicate with each other and/or the system to solve for an equilibrium solution, including prices, consumption, and macroeconomic information that are input to and output from the various modules; and

- Variables that are of sufficiently general interest to most of the model users that they are printed in the modeling system reports, cover a wide range of variables, and are a substantial superset of the variables that are necessary for integration.

Only the last two categories in this list are included in the NEMS Global Data Structure.

All data in the NEMS Global Data Structure is defined in FORTRAN COMMON blocks that designate groups of global variables. Only some of the COMMON blocks used by NEMS modules are considered part of the Global Data Structure. During NEMS execution, each module accesses its input and output variables through these NEMS COMMON blocks. The NEMS COMMON block structure designed to store the Global Data Structure is displayed in Table 3. The specific elements of the COMMON block structure can be found in Appendix A. Generally, three COMMON blocks can be found in the Global Data Structure for each NEMS module, to hold three categories of information:

- The module's outputs (moduleOUT) used by other NEMS modules, (exclusive of end-use consumption and prices);

- The module's outputs (moduleREP) used only for reports (for some modules only); and

Table 3. COMMON Blocks for the NEMS Global Data Structure

Module Creator	COMMON block Names	Description
Integrating/all	QBLK	End-Use Sector Quantities (See Table 3)
Integrating/all	MPBLK	End-Use Sector Prices (See Table 4)
Integrating/all	MXQBLK	Expected Quantities for foresight
Integrating/all	MXPBLK	Expected Prices for foresight
Integrating/all	QSBLK	SEDS Historical data corresponding to QBLK
Integrating/all	NCNTRL	Control Variables
All	EMISSION	Emissions data
All	CAPEXP	Capital Expenditures for Energy Equipment
All	COGEN	Cogeneration
All	DSM	Demand-Side Management
Exogenous	CONVFACT	Global conversion factors
Refinery	PMMOUT	Module outputs to other modules
Oil & Gas Supply	OGSMOUT	"
Natural Gas T & D	NGTDMOUT	"
Electricity		"
Coal	EMMOUT	"
Renewable/all	COALOUT	"
Commercial	WRENEW	"
Industrial	COMOUT	"
Macroeconomic	INDOUT	"
International	MACOUT	"
Uranium	INTOUT	"
	UMMOUT	
Refinery		Key input parameters and assumptions
Commercial	PMMPARAM	"
Macroeconomic	COMPARAM	"
	MACPARMS	
Nat. Gas T&D		Module outputs to report writer only
Industrial	NGTDMREP	"
Macroeconomic	INDREP	"
Commercial	MACREP	"
Refinery	COMREP	"
Transportation	PMMRPT	"
Residential	TRANREP	"
	RESDREP	

- The module's input variables (modulePARAM) for its key parameters and assumptions.

In addition, a group of general-purpose COMMON blocks, called the Energy Market Data, hold data that are created by various modules. These are:

QBLK	Sectoral End-Use quantities
MPBLK	Sectoral End-Use prices
MXQBLK	Expectations for End-Use quantities
MXPBLK	Expectations for End-Use prices
CAPEXP	Capital Expenditures on Energy Equipment

Energy Market Data Representation

The Energy Market Data define the energy consumption product and price details that are used for market definition in NEMS. These variables are the principal values necessary for convergence testing in the integrating algorithm. The Energy Market Data are just part of the NEMS Global Data Structure. The quantity and price structure does not attempt to represent all energy flows, but instead focuses on the primary variables necessary for the design of the NEMS equilibrating methodology. In addition, the Energy Market Data structure defines the end-use energy classification for the NEMS energy balance.

Table 4. Energy Market Data Consumption Product Arrays

Description	Prod Code	End-Uses Resid RS	Comm CM	Trans TR	Indus IN	Conversions Refin RF	Elect EL	Synth SN	All AS
Purchased Electricity, Peak	EP	QEPRS	QEPCM	QEPTR	QEPIN	QEPRF			QEPAS
Purchased Electricity, Off-Peak	EN	QENRS	QENCM	QENTR	QENIN	QENRF			QENAS
Purchased Electricity (total) *	EL	QELRS	QELCM	QELTR	QELIN	QELRF			QELAS
Natural Gas, Core (Firm)	GF	QGFRS	QGFCM	QGFTR	QGFIN	QGFRF	QGFEL		QGFAS
Natural Gas, Noncore (Interrupt.)	GI	QGIRS	QGICM	QGITR	QGIIN	QGIRF	QGIEL		QGIAS
Natural Gas (total) *	NG	QNGRS	QNGCM	QNGTR	QNGIN	QNGRF	QNGEL		QNGAS
Natural Gas, Pipeline Fuel	GP			QGPTR					
Lease and Plant Fuel	LP				QLPIN				
Steam Coal	CL	QCLRS	QCLCM		QCLIN	QCLRF	QCLEL	QCLSN	QCLAS
Metallurgical Coal	MC				QMCIN				
Motor Gasoline	MG		QMGCM	QMGTR	QMGIN				QMGAS
Jet Fuel	JF			QJFTR					
Distillate	DS	QDSRS	QDSCM	QDSTR	QDSIN	QDSRF	QDSEL		QDSAS
Kerosene	KS	QKSRS	QKSCM		QKSIN				QKSAS
Liquid Petroleum Gas	LG	QLGRS	QLGCM	QLGTR	QLGIN	QLGRF			QLGAS
Residual Fuel, Low Sulfur	RL		QRLCM	QRLTR	QRLIN	QRLRF	QRLEL		QRLAS
Residual Fuel, High Sulfur	RH			QRHTR			QRHEL		QRHAS
Residual Fuel (total) *	RS		QRSCM	QRSTR	QRSIN	QRSRF	QRSEL		QRSAS
Petrochemical Feedstocks	PF				QPFIN				
Still Gas	SG				QSGIN	QSGRF			
Petroleum Coke	PC				QPCIN	QPCRF	QPCEL		QPCAS
Asphalt and Road Oil	AS				QASIN				
Other Petroleum	OT			QOTTR	QOTIN	QOTRF			QOTAS
Total Petroleum *	TP	QTPRS	QTPCM	QTPTR	QTPIN	QTPRF	QTPEL		QTPAS
Methanol	ME			QMETR					
Ethanol	ET			QETTR					
Liquid Hydrogen	HY			QHYTR					
Uranium	UR						QUREL		
Hydroelectric	HO				QHOIN		QHOEL		QHOAS
Geothermal	GE				QGEIN		QGEEL		QGEAS
Biomass	BM	QBMRS	QBMCM		QBMIN	QBMRF	QBMEL	QBMSN	QBMAS
Municipal Solid Waste	MS				QMSIN		QMSEL		QMSAS
Solar Thermal	ST	QSTRS	QSTCM		QSTIN		QSTEL		QSTAS
Photovoltaic	PV	QPVRS	QPVCM		QPVIN		QPVEL		QPVAS
Wind	WI				QWIIN		QWIEL		QWIAS
Total Renewable *	TR	QTRRS	QTRCM	QTRTR	QTRIN		QTREL	QTRSN	QTRAS
Net Electricity Imports	EI						QEIEL		
Net Coal Coke Imports	CI				QCIIN				
Total Sectoral Consumption *	TS	QTSRS	QTSCM	QTSTR	QTSIN	QTSRF	QTSEL	QTSSN	QTSAS

* aggregation of other variables

Table 4 presents a list of the consumption products in a grid depicting the sectoral detail. Each item in the grid represents the named variable in NEMS. The sectoral definitions include the four end-use sectors and three conversion sectors. The reader may note the inclusion of Synthetics as a conversion sector. This sector is implemented in NEMS as a submodule of the Coal Market Module. The sectoral and fuel consumption detail is defined to meet several objectives, including energy accounting coverage and consistency, the structure of component modules, and the requirements for inter-module communications. Elements of this design requiring clarification are as follows:

- The electricity sector includes fuel used by electric utilities and independent power producers to generate electricity supplied to the grid. The industrial and commercial sectors

Table 5. Energy Market Data Price Arrays

		End Uses				Conversions			
Description	Prod Code	Resid RS	Comm CM	Trans TR	Indus IN	Refin RF	Elect EL	Synth SN	All AS
Purchased Electricity, Peak	EP	PEPRS	PEPCM	PEPTR	PEPIN				PEPAS
Purchased Electricity, Off-Peak	EN	PENRS	PENCM	PENTR	PENIN				PENAS
Purchased Electricity (average)*	EL	PELRS	PELCM	PELTR	PELIN				PELAS
Natural Gas, Core (Firm)	GF	PGFRS	PGFCM	PGFTR	PGFIN		PGFEL		PGFAS
Natural Gas, Noncore (Interrupt.)	GI	PGIRS	PGICM	PGITR	PGIIN		PGIEL		PGIAS
Natural Gas (average)*	NG	PNGRS	PNGCM	PNGTR	PNGIN		PNGEL		PNGAS
Natural Gas, Pipeline Fuel	GP			PGPTR					
Lease and Plant Fuel	LP				PLPIN				
Steam Coal	CL	PCLRS	PCLCM		PCLIN		PCLEL	PCLSN	PCLAS
Metallurgical Coal	MC				PMCIN				
Motor Gasoline	MG		PMGCM	PMGTR	PMGIN				PMGAS
Jet Fuel	JF			PJFTR					
Distillate	DS	PDSRS	PDSCM	PDSTR	PDSIN		PDSEL		PDSAS
Kerosene	KS	PKSRS	PKSCM		PKSIN				PKSAS
Liquid Petroleum Gas	LG	PLGRS	PLGCM	PLGTR	PLGIN				PLGAS
Residual Fuel, Low Sulfur	RL		PRLCM	PRLTR	PRLIN		PRLEL		PRLAS
Residual Fuel, High Sulfur	RH			PRHTR			PRHEL		PRHAS
Residual Fuel (average)*	RS		PRSCM	PRSTR	PRSIN		PRSEL		PRSAS
Petrochemical Feedstocks	PF				PPFIN				
Asphalt and Road Oil	AS				PASIN				
Other Petroleum	OT			POTTR	POTIN				POTAS
Petroleum (average)*	TP	PTPRS	PTPCM	PTPTR	PTPIN	PTPRF	PTPEL		PTPAS
Methanol	ME			PMETR					
Ethanol	ET			PETTR					
Liquid Hydrogen	HY			PHYTR					
Uranium	UR						PUREL		

* averaged from other variables

include fuel used for on-site electricity generation, primarily in cogeneration applications. This breakout is consistent with the coverage of the Electricity Market Module and the demand modules.

- Fuel consumption in the refinery sector is broken out from the industrial sector for inter-module communication requirements. The Petroleum Market Module determines fuel use by the refinery sector. This information is passed to Industrial Demand Module, where fuel consumption for refining is added to other industrial fuel use. Thus, the industrial energy consumption product demands as defined in Table 4 *include* refinery consumption.
- The synthetic sector includes fuel consumed for conversion and omits energy products used solely as feedstocks in the synthesis itself.

Table 5 presents the prices in the Energy Market Data structure. In general, the energy prices match the corresponding consumption quantities. The exceptions are as follows:

- Detailed refinery sector prices are omitted even though refinery fuel consumption products are defined. This is because there is no corresponding need to break out refinery sector prices from the rest of the industrial sector. The industrial fuel prices are the delivered prices to industrial fuel consumers, including refineries. As a result, the industrial sector prices match the coverage of the corresponding industrial consumption products.

- Prices for some industrial petroleum categories are combined in the industrial other petroleum category to eliminate unnecessary detail. That is, the industrial other petroleum price is defined as the average price of three consumption categories: still gas, petroleum coke, and other petroleum. The other petroleum price is not needed by any NEMS module but is required for reporting purposes to determine the average price of all petroleum products.

- Delivered prices for renewable energy categories are left undefined because there are no meaningful market prices for them. For example, there are no delivered prices associated with hydroelectric, geothermal, wind, solar thermal, and photovoltaic energy sources. In the case of biomass, the diverse nature of the product and the lack of organized market structures preclude the definition of a delivered price. Thus, there is no need to define end-use prices for renewables.

Table 4 and Table 5 define the variable names for the NEMS consumption products and end-use prices along with the two-character product code mnemonic for each product. Each array is a two-dimensional, floating point array. The first dimension represents the nine Census Divisions, with a 10th position reserved for possible breakout of California and the 11th position reserved for the National total. The second dimension represents 26 years from 1990 to 2015, plus 3 additional positions reserved for future storage of 2020, 2025, and 2030 results. The space for the latter 3 years is reserved as a possible way of supporting the NEMS long-term modeling capability. Quantities are stored in trillions of Btu. Prices are stored in 1987 dollars per million Btu, as deflated by the implicit GDP price deflator.

A related part of the Energy Market Data structure comprises the variables to hold energy market expectations. The Integrating Module maintains a separate set of arrays to store consumption and price expectations. The expectations arrays are updated according to the foresight options under consideration. The expectations arrays are defined like the standard energy market arrays, each with an additional leading character, X. Not all energy product detail is duplicated.

Other Variables in the Global Data Structure

In addition to Energy Market Data, the Global Data Structure includes the following information:

Model Control Variables
Key parameters and Assumptions for each of the NEMS modules
Macroeconomic variables, including energy demand drivers such as population
Energy demand characteristics, including demand side management savings
Energy production, conversion, and transportation activities

International energy flows
Emissions
Renewable energy information
Other data for inclusion in central report writing programs

These categories of data are those items necessary for inter-module communications and centralized report writing. COMMON blocks intended for communicating data among the subroutines of a module, but not among modules, are stored in a series of FORTRAN COMMON blocks that are not included in the NEMS data structure.

The details of the contents of the Global Data Structure can be found in Appendix A, where the variables in each COMMON block are described. Appendix A is a partial listing of the contents of the NEMS Data Dictionary, a current version of which can be found in a dataset named CN6005.PRJ.NEMS.DICT.AEO.datekey. Appendix B contains a listing of the same variables in alphabetical order, with references to the COMMON block names shown in Appendix A.

Variable Naming Convention

The naming convention used for the variables in the NEMS Global Data Structure involves up to four components, with 1- to 3-character mnemonics: a sector, an action or classification, a fuel, and miscellaneous, as follows:

[Action] [Fuel] [Sector] [Miscellaneous]

Action	**Fuel**	**Sector**	**Miscellaneous**
Price	**CR**ude	**R**e**F**inery	**N**orth Slope **A**laska
Quantity	**D**ry **NG**	**O**il & **G**as	**S**outh **A**laska
Cost	**S**ynthetic **NG**	**N**G**T**DM	**IN**dustrial **N**oncore
Discount(max)	**NG P**ipeline	**EL**ectricity	**T**on **M**iles
IMport	**NG W**ellhead	**CO**al	**N**on **U**tility
PRoduction	**C**oa**L** Li**Q**uid	**R**e**S**idential	**DSM**
Transportatio**N**	**C**oa**L G**ases	**C**o**M**mercial	**AV**oided
Capacity **A**dditions		**IN**dustrial	**R**e**N**ewables
Ge**N**eration		**TR**ansportation	
Sales to **G**rid		**I**n**T**ernational	

For instance, the NEMS variable IMCRRF represents crude oil net imports as defined by the refinery sector. This naming convention is neither exhaustive nor required.

RESTART File

At the beginning of a run, the Integrating Module reads initial values for all data in the Global Data Structure from a user-specifiable version of a special file, called the RESTART file. The RESTART file contains a starting point for the scenario currently under consideration, that consists of results from a prior simulation. During the run, much of this data is updated and changed. For example, alternative values for key module parameters and input assumptions, read separately from the user interface file or other sources, override the values stored in the RESTART file. At the end of the run, a new RESTART file is created with all the data from the run. The file is available for future runs, as well as to link with reporting and database management routines.

This feature promotes modularity by supplying values for all shared variables, regardless of whether the module that creates them is active in the run. Prices, quantities demanded or supplied, and other variables normally generated by a module that is switched off for the current run, are provided instead by the RESTART file.

Report Data

NEMS contains several varieties of reporting functionality. While each module generates detailed, module-specific reports, there is also a central reporting feature that prepares reports that combine output from all of the modules and inputs to the models. A simple post-processing user interface is available to prepare standard reports and compose special reports.

A user interface also allows extraction of data and conversion to input for other types of analytic software, and facilitates transfer of output data between platforms. For example, selected output from several NEMS runs may be extracted from the total results on the mainframe, reformatted into Lotus 1-2-3 format, and transferred to the PC for subsequent spreadsheet analysis.

Database Loading

The primary NEMS data management objectives are met with a FORTRAN-callable procedure, FILER, that standardizes and automates storage and retrieval of the NEMS Global Data Structure. In addition, the routine provides a file-based data interchange capability to allow communication among NEMS modules, where necessary, and supports standalone module development and testing.

FILER provides a simple, reliable, and fast mechanism for moving data between COMMON blocks of the Global Data Structure and files. The COMMON blocks used to store the NEMS Global Data Structure and are accessed by most modules. The basic capabilities of FILER are:

- To load data from a file into a standard NEMS COMMON block; and
- To write data from a standard NEMS COMMON block to a file.

This capability is constructed such that files created by FILER can also be read by FILER. Beyond these basic capabilities, FILER simplifies operation of modules in standalone mode by allowing users to create simple, sequential files containing the subset of the data they need, and the software necessary to read these data. This allows a user to use FILER to prepare sequential files containing all the data needed by a program in a simple format that can be transferred to a PC or another platform for independent operation and development, without need for access to the FILER routines. User access to the FILER program is available outside NEMS through the NEMS macro command, TFILER.

5. Integrating Module Solution Methodology

The Integrating Module controls the overall flow of the NEMS solution algorithm, and provides the interface and control logic for scenario implementation and execution. In addition, it tests for convergence of the system during each year, as it controls the iteration process.

Using the Energy Market Data portions of the NEMS Global Data Structure as inputs, the Integrating Module measures whether convergence has occurred, and optionally adjusts the Energy Market Data values to accelerate the convergence process. By means of calls to the FILER and File Manager routines, the Integrating Module manages the flow of overall system data; however, beyond reading the user's parameter requests, it has no important input nor output functions of its own.

Relationship of the Integrating Module to Other NEMS Modules

The modular structure of NEMS implies that little model structure resides within the Integrating Module. The component modules represent energy sectors and markets; the Integrating Module oversees the interactions among the various energy sectors, calling upon the component modules as needed. In a very real sense, the structure of the Integrating Module is therefore synonymous with the structure of NEMS, insofar as the Integrating Module defines a structure within which the analytical modules function.

The Integrating Module controls the execution of the other component modules as part of an iterative convergence algorithm. The objective is to equilibrate iteratively on the delivered prices and quantities of energy, thus assuring an economic equilibrium of supply and demand in the domestic energy markets, with feedbacks from the international markets and the U.S. economy as a whole.

The Integrating Module also coordinates communication among the other modules. The primary information flows among these major modules are the delivered prices and quantities of energy by product, region, and sector. However, the data flows are not limited to prices and quantities and include other information such as economic activity, capital expenditures, and impacts of demand side management programs.

Integrating Module Inputs

Given its mediating role in the NEMS system, the Integrating Module has little input data of its own; the major model inputs are processed by each of the component modules. The Integrating

Module reads user run description parameters and invokes a data base portion that reads the NEMS Global Data Structure.

As a body, all data used, either read or written, by more than one of the NEMS component modules are referred to as the *NEMS Global Data Structure*. For convenient sharing among the modules, all such variables are stored internally in FORTRAN COMMON blocks. At the end of each NEMS iteration, the Integrating Module invokes a process, called *FILER*, which stores the contents of the COMMON blocks that constitute the NEMS Global Data Structure into a single large file, called the *RESTART* file. At the start of each NEMS run, the Integrating Module makes use of FILER to read an entire RESTART file to initialize the COMMON blocks. Thus, the NEMS Global Data Structure includes both the external file and its internal representation in COMMON.

Because all NEMS shared data are initialized from the RESTART file at the start of each run, it is not strictly necessary for the Integrating Module to invoke all of the component modules; if any module is omitted, its normal output variables can be found by the other modules in exactly the same places they would otherwise occupy, filled with values from the end of an earlier NEMS run. An important function of the Integrating Module is to ascertain which of the component modules are to be used in the current run, and to skip the others at times when they would otherwise be called.

General Modeling Approach

EIA has taken the approach of developing models that characterize the natural decision making of each sector of the energy market, linking or integrating the models together in a simulation framework to represent the aggregate U.S. energy market response to basic assumptions and alternative policies. Optimization models are appropriate to simulate the behavior of a homogeneous industry or sector of the economy, and their use is a standard practice in economic policy analysis. For example, the electric industry's plant dispatch decisions or the movements in the coal transportation sector can be appropriately represented as an optimization model. Other sectors are better represented using simulations of the outcome of decision rather than modeling the decisions directly.

The fundamental integrating methodology used by NEMS involves a control program, the Integrating Module, that commences the solution process with an initial set of estimates of energy prices and quantities. It calls each of the modules in turn to generate new end-use demands for energy in the demand modules, and new end-use prices at which the demands can be satisfied in the supply and conversion modules. This new set of prices and quantities is then used for another round of calling the modules and so on, until the model has computed price estimates at which supply and demand are in balance.

NEMS design criteria do not specify the modeling approaches to be taken by the individual analytical modules. A variety of approaches can be found among the existing modules, ranging in complexity from simple accounting models through detailed mathematical optimization algorithms. Some sectors have implemented multiple approaches that the user can select by choosing alternative complete modules.

Figure 2 in Chapter 2 depicts the relationship of the Integrating Module of NEMS with each of the component modules. Generally, the component modules of NEMS do not interact with one another directly, but instead communicate through the Integrating Module. The organization has a number of benefits. It allows each module to be executed or omitted independently. More importantly, it provides centralized control over such Integrating Module functions as execution sequence, convergence checks, equilibration procedures, and data access. Finally, the organization promotes a division of labor for the development and maintenance of NEMS, as each module is the responsibility of a single team.

The approach followed by NEMS is comparable to that followed by the predecessor Intermediate Future Forecasting System (IFFS). The model is entirely new, with additional features such as the implementation of foresight throughout the model and the Global Data Structure. Improvements in the NEMS approach can be found more in the analytical modules than in the Integrating Module.

The following section provides a more explicit, detailed formulation of the Integrating Module solution algorithm. It includes a complete mathematical specification as well as a detailed flow chart of the algorithm.

Mathematical Specification

In many ways, NEMS follows the standard structure of energy models. It has separate models for determining the supply of each fuel. These models are incorporated in the Oil and Gas Supply Module (OGSM), the Renewable Fuels Module, and the Coal Production Submodule. These modules produce supply curves. The supply curves consist of estimates of reserve additions that take account of the longer run effects of prices and the quality of the resource base followed by short-run supply curves that capture the short-run utilization of the reserves in clearing markets annually. The short-run supply curves are inserted into the fuel market models that determine the market clearing prices and quantities and distribution patterns. These models are contained in the Natural Gas Transmission and Distribution Module (NGTDM), the Coal Distribution submodule (CDS), and Coal Export submodule (CES). The transformation components model the conversion of fuel from one form to another. These include the Petroleum Marketing Module (PMM), which converts crude oil to refined products, and the Electricity Marketing Module (EMM), which converts natural gas, petroleum products, and other fuels to electricity. These modules consist of capacity expansion models and short-run capacity-utilization models. Finally, the demand models, including the Commercial, Residential, Industrial, and Transportation modules include short-run and long-run demand responses to price changes in fuels. The short-run response measures the effect of equipment utilization and the long-run response measures the change in energy-consuming capital stock.

The supply curves from the supply models provide prices for fuel quantity used. Although the demand models do not directly provide demand curves, their response to different input prices defines the inherent demand curves. These demand curves or demand model responses provide the quantities of fuels demanded for given fuel prices. The NEMS solution algorithm attempts to determine a vector of prices and quantities so that supply and demand are matched. Thus, the NEMS integrating algorithm must solve the set of simultaneous equations implied by the supply, demand, and conversion models.

Equation Solving Techniques

The standard equation solving techniques are Jacobi and Gauss-Seidel algorithms. Suppose that a set of equations is defined

$$f_i(x_1, \ldots, x_n) = 0 \text{ for } i = 1,\ldots n. \tag{1}$$

If one has a trial solution $x_1^t,\ldots,x_n^t$, in a Jacobi iteration t, for each x_i one solves for x_i^{t+1} in

$$f_i(x_1^t, \ldots, x_{i-1}^t, x_i^{t+1}, x_{i+1}^t, \ldots, x_n^t) = 0. \tag{2}$$

That is, one fixes all variables other than x_i at the previous trial solution and solves for a new x_i^{t+1} as a single dimensional line search. For example, if in iteration three of NEMS, the coal model is called to determine the price of coal, the coal demand and all other inputs to the model would be obtained from iteration two of NEMS using the Jacobi method. This is the case even if, for example, the industrial model has already been called during the third NEMS iteration, and therefore, updated information on demand for coal from the industrial sector is available.

On the other hand, with the Gauss-Seidel algorithm one iterates sequentially through *i* and uses the most recent values for the *x*'s at each step. The equation solved at each step i looks as follows:

$$f_i(x_1^{t+1}, \ldots, x_{i-1}^{t+1}, x_i^{t+1}, x_{i+1}^t, \ldots, x_n^t) = 0. \tag{3}$$

Continuing the example introduced above with the Gauss-Seidel algorithm, when the coal model is called in iteration three of NEMS the results of any other models already run during iteration three are used. If inputs are required from other models that come after the coal model in the NEMS calling sequence, the results from iteration two of these models must be used.

Under certain conditions, it can be shown that the Jacobi iteration can never be faster than Gauss-Seidel and of course, could be considerably slower. It is intuitively more appealing to use the most recent information, which is why the NEMS uses the Gauss-Seidel algorithm.

Convergence Properties of the Jacobi and Gauss-Seidel Algorithms

It is worth reviewing some of the general convergence properties of the Jacobi and Gauss-Seidel algorithms, especially their relationship to the convergence in NEMS. The matrix of first partial derivatives of equation (1), hereafter denoted J, is a square matrix known as the Jacobian. The spectral radius of a matrix is the largest absolute value of the eigenvalues associated with a matrix.[2]

[2]Let $Ax=\lambda x$ be a linear system of equations, with *A* a matrix, *x* a vector, and λ a scalar. The values of λ satisfying this equation are the eigenvalues of the matrix *A*.

If the spectral radius of the iteration matrix derived from J is less than one, these algorithms converge to a solution. If not, then these algorithms do not necessarily converge. One can think of the spectral radius as the measure of the contractor in a contraction map, since the rate of convergence is inversely proportional to the spectral radius.

In situations where the spectral radius is greater than one, convergence can still be achieved by using relaxation techniques. That is, when the solution is oscillating and diverging, one can take a convex combination of the old and new solutions to dampen the oscillation. This technique, known as successive over relaxation, modifies the iteration matrix so that it has a spectral radius less than one. It can be shown that there is a sufficiently small $w > 0$ such that when one uses $(1-w)x_t + wx_{t+1}$ as the trial solution, a solution to the equations will be achieved. In complex models such as NEMS the parameter w must be determined empirically, and could impede convergence if the solution is monotonically converging and w is chosen less than one. The application of relaxation to the NEMS solution process is discussed in the section **Acceleration Techniques**.

With NEMS, however, there are solution points which are either nondifferentiable or for which there are no Jacobians because of the discontinuities caused by incorporating linear programs in the system. The presence of such points greatly complicates the solution procedure of the NEMS system.

Discontinuities and Convergence in NEMS

The existence of supply and demand curves in NEMS was discussed in the previous section. Though the supply and demand curves are generally treated as continuous functions, various models contain linear programs or their analogues that can only incorporate step functions. Any such continuous functions must be approximated by a series of discrete steps. The inclusion of such discrete functions leads to discontinuities in the representation of the supply and demand curves in NEMS. Such discontinuities cause significant problems in the solution process.

Several modules incorporate algorithms that yield these discontinuous results. For example, the petroleum refining and distribution model is a linear program that represents crude oil supply curves as discrete step functions. Similarly, the distribution model for natural gas is also a linear program that uses step-function approximations of the supply and demand curves. These step-function approximations are updated during each solution iteration, so that the model can be considered to be a nonlinear program which is solved by successive linear approximations. The electricity fuel dispatch (EFD) model, although not a linear program, contains discontinuities due to the discrete nature of the merit-order plant dispatch algorithm which determines the fuel mix required to produce electricity. The coal distribution model is a nonlinear program where the nonlinear supply curves are incorporated directly; however, discontinuities are introduced due to the discrete nature of the heuristic supply distribution algorithm. Thus, each of these models introduces discontinuities into the NEMS solution process.

The effect on the solution process of having discontinuities can be seen by using step function demand curves with continuous supply curves. The same conclusions may be drawn as long as either or both of the supply and demand curves are step functions. Figures 3a and 3b depict the two ways in which the continuous supply curve and step demand curves can intersect:

In these figures the supply curve determines the price used in the demand curves, which then feed back a quantity. The solution path resulting from application of the Gauss-Seidel algorithm is delineated by arrows: a horizontal arrow shows the quantity response from the demand curve and a vertical arrow shows the price response from the supply curve.

When the supply curve intersects the horizontal portion of the demand curve, there is an oscillation in the solution between quantities Q_0 and Q_1 and prices P_0 and P_1 (Figure 3a). When the intersection of the supply and demand curves is on the vertical portion of the demand curve, one can achieve the equilibrium with the Gauss-Seidel algorithm using relaxation, even if the unrelaxed algorithm yields an oscillation in the solution (Figure 3b). In Figure 3a there is no *w* for which convergence will occur. However, a value for *w* can always be found so that the oscillation occurs around no more than one (or possible two) steps. This is useful because if one can specify sufficiently small steps so that the entire step falls within the convergence tolerance, this oscillation is no longer a convergence problem.

Application of Gauss-Seidel to NEMS

The NEMS integrating algorithm, similar to the approach used for the predecessor Intermediate Future Forecasting System (IFFS), is an application of the Gauss-Seidel algorithm designed to solve a set of simultaneous nonlinear equations.[3] The approach partitions the equations and variables into subsets. For NEMS, the subsets consist of predefined fuel supply, energy conversion, and sectoral demand modules. Each subset of equations is solved keeping the other variables constant at their trial values and ignoring the effects of current variables on equations in other subsets. The process is repeated for each subset, updating the trial values for each variable from the prior solution.

More formally, for a stylized NEMS, the nonlinear system of equations could be represented by

$$x_i = g_i(x) \quad \text{for} \quad i = 1, ..., n \tag{4}$$

[3]Murphy, F., J. Conti, S. Shaw, and R. Sanders, "Modeling and Forecasting Energy Markets with the Intermediate Future Forecasting System," *Operations Research*, Vol. 36, No. 3, May-June 1988.

Figure 3A. The Supply Curve Cuts Across the Horizontal Portion of the Demand Curve

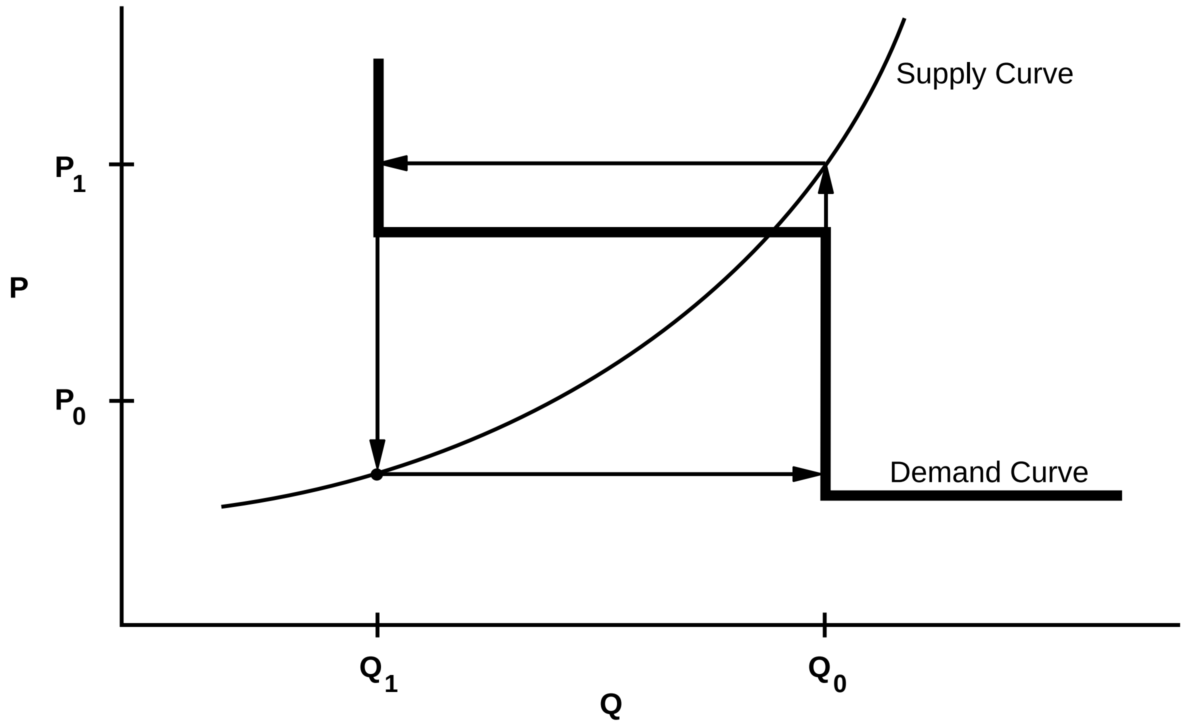
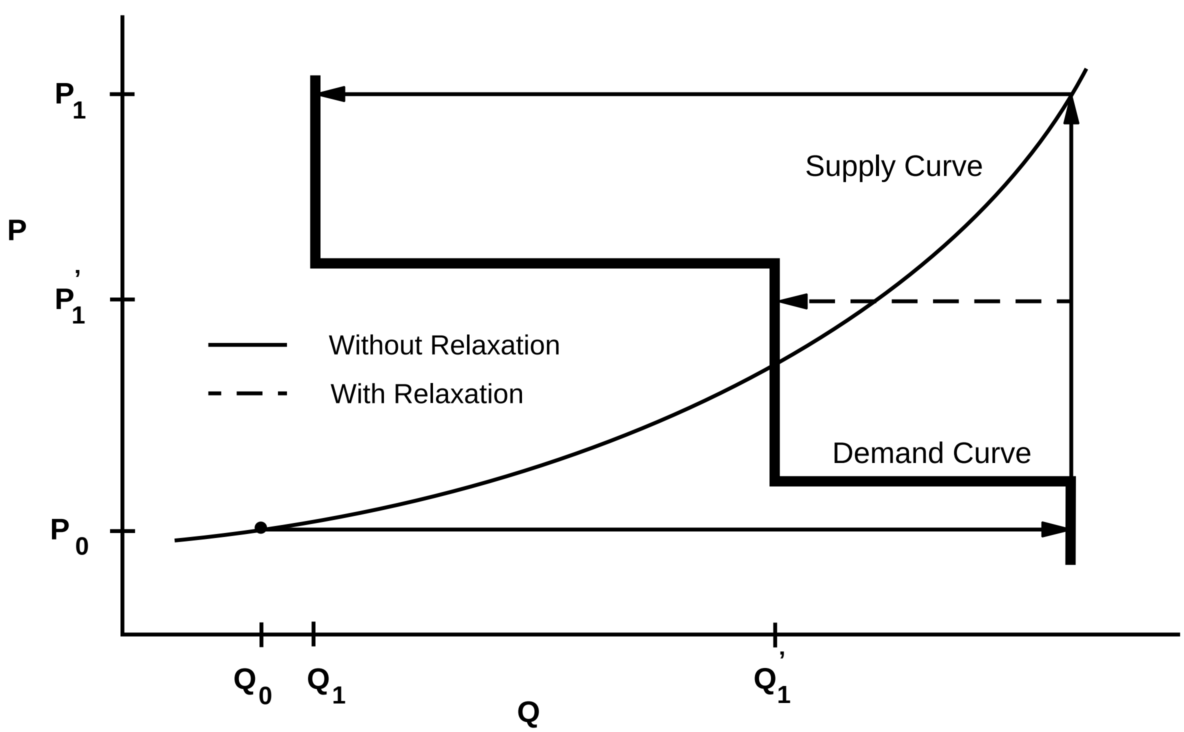


Figure 3B. The Supply Curve Cuts Across the Vertical Portion of the Demand Curve



having the market clearing or equilibrium solution vector

$$x = (x_1, ..., x_n).$$

Here, each x_i is a single variable. A trial solution for iteration k for a certain year is denoted by x^k, where

$$x^k = (x_1^k, ..., x_n^k).$$

Each $g_i(x)$ uses one or more of the elements of the trial solution vector x^k, excluding its own solution, x_i^k.

Further, we define a series of nonlinear equations $f_i(x^k)$ that represent the amount by which any trial solution $g_i(x^k)$ deviates from an equilibrium solution:

$$f_i(x^k) = x^k_i - g_i(x^k).$$

To reiterate, the solution vector x represents the set of solutions to the model: prices of energy products, quantities of energy products demanded, and certain key economic quantities. The functions $g_i(x)$ represent the formulas by which the x are calculated, and $f_i(x)$ represent the discrepancies between the calculated values for the solution vector and the solution vector itself. The $g_i(x)$ represent the relationships in the modules between prices and demands: for those i that correspond to supply modules and conversion markets the $g_i(x)$ are prices, for demand modules the $g_i(x)$ are quantities.

At the end of iteration k for a certain year, the discrepancy $f_i(x^k)$ from the equilibrium solution can be estimated as follows:

$$f_i(x^k) = x_i^{k-1} - g_i(x^{k-1}), \tag{5}$$

$$f_i(x^k) = x_i^{k-1} - x_i^k. \tag{6}$$

where x^{k-1} is the trial solution vector from the previous iteration for the same year.

In the block Gauss-Seidel scheme, unknowns are grouped together in such a way that a subsystem (e.g., a NEMS module) must be solved before any of the unknowns can be determined. The NEMS equations are divided into n groups (modules) and the subsystem of equations belonging to a given group is solved for the corresponding unknowns using approximate values for the other unknowns. For example, suppose the unknowns are divided into groups ($x_1..x_n$) such that X_1, X_2, ..., X_{m1} belong to group x_1; X_{m1+1}, X_{m1+2}, ..., X_{m2} belong to group x_2; $X_{m(k-1)+1}$, $X_{m(k-1)+2}$, ..., X_{mk} belong to group x_k etc. In our case, n corresponds to the number of separate modules in NEMS (residential demand, commercial, industrial, transportation, petroleum markets, electric generation, oil and gas supply, etc.) In the NEMS context each x_i represents the set of *outputs* from the module ($g_i(x)$), given approximate values for the other unknowns in the remaining NEMS modules. Consequently, there are n blocks of variables to be solved for as groups using each of the n model blocks, $g_i(x)$. At iteration k+1, the solution can be represented by

$x_1^{k+1}, x_2^{k+1}, ..., x_{i-1}^{k+1}, x_i^k, ..., x_n^k$

In the above representation of the solution, the first i-1 groups of unknowns (x's) have been solved for in iteration k+1 and the other groups remain to be determined. The i-th group will be solved for next in the scheme. To solve for the next estimate of x_i, we determine $_ix$ in the functional relationship

$$(g_i(x_1^{k+1}, x_2^{k+1}, ..., x_{i-1}^{k+1}, x_i^k, x_{i+1}^k, ..., x_n^k)) = (x_1^{k+1}, x_2^{k+1}, ..., x_{i-1}^{k+1}, x_i^{k+1}, x_{i+1}^k, ..., x_n^k)$$

Notice that x_i^k is usually not used to solve module i but is included here for completeness. Starting at the beginning of iteration (k+1), the algorithm proceeds as follows:

Step 0: Start with $x = (x_1^k, x_2^k, ..., x_n^k)$.

Step 1: Solve the first module in iteration (k+1)

Solve for x_1^{k+1} by solving for x_1 in the nonlinear system

$$g_1(x_1^{k+1}, x_2^k, ..., x_n^k) = (x_1^{k+1}, x_2^k, ..., x_n^k).$$

The solution yields a new estimate of the unknowns $x = (x_1^{k+1}, x_2^k, ..., x_n^k)$.

Step 2: Solve the second module in iteration (k+1).

Solve for x_2^{k+1} by solving for x_2 in the nonlinear system

$$g_2(x_1^{k+1}, x_2, x_3^k, ..., x_n^k) = (x_1^{k+1}, x_2^{k+1}, x_3^k, ..., x_n^k).$$

The solution yields a new estimate of the unknowns $x = (x_1^{k+1}, x_2^{k+1}, x_3^k, ..., x_n^k)$.

In general, when solving for the i-th group of variables,

Step i: Solve the i-th module in iteration (k+1).

Solve for x_i^{k+1} by solving for x_i in the nonlinear system

$$g_i(x_1^{k+1}, x_2^{k+1}, x_{i-1}^{k+1}, x_i, x_{i+1}^k, ..., x_n^k) = (x_1^{k+1}, x_2^{k+1}, ..., x_{i-1}^{k+1}, x_i^{k+1}, x_{i+1}^k, ..., x_n^k).$$

The solution for x_i above in g_i updates the solution estimate to

$$x = (x_1^{k+1}, x_2^{k+1}, ..., x_{i-1}^{k+1}, x_i^{k+1}, x_{i+1}^k, ..., x_n^k).$$

The process continues until a k+1 iteration estimate is derived for all groups of x_j.

At the end of the k+1 iteration, we compare, pointwise, every component of every group of variables in the k+1 iteration versus the k-th iteration values. A final solution, x^{k+1}, has been achieved if, after all modules have been executed, the absolute values of the proportional changes in the x_i remain smaller than a specified tolerance, ϵ:

$$2\left|\frac{x_i^{k+1} - x_i^k}{x_i^{k+1} + x_i^k}\right| < \epsilon$$

for $i = 1, ..., n$. Values of ϵ can be chosen on a variable-specific basis. Defaults are in the range of 5 percent for the Census Division variables, less for the national macroeconomic variables.

After the convergence criterion has been met, another iteration is performed to test whether a true equilibrium has been reached, and to allow the modules to perform final processing for the year; so that the final converged solution vector for the year is x^{k+1}.

To handle cases where the procedure does not converge on a solution or does not achieve the specified tolerance, a limit on the number of iterations terminates the algorithm for the current year. In such cases, the model performs the additional iteration mentioned in the previous paragraph, reports the convergence status with a list of the variables failing to converge, and then proceeds to the next projection year. The final solution for the year is therefore the result of one iteration beyond the non-converged trial solution.

The equations are partitioned in the fuel supply and sectoral demand modules, with the x_i consisting primarily of quantities and prices of fuels by region and consuming sector. These variables are defined as

$P^{k}_{f,s,r,y}$ = Energy product price (current iteration)

$P^{k-1}_{f,s,r,y}$ = Energy product price (previous iteration)

$Q^{k}_{f,s,r,y}$ = Energy product quantity consumed (current iteration)

$Q^{k-1}_{f,s,r,y}$ = Energy product quantity consumed (previous iteration)

indices:

f fuel/energy product (natural gas, coal, petroleum products, electricity, etc)

s consuming sector (residential, commercial, industrial, transportation, electric utility, refinery, synthetic)

r region (census divisions)

y year

In several modules, planning decisions must be made to acquire additional capacity which will be required in future years. These include the Electricity Capacity Expansion (ECP) submodule, the Capacity Expansion Module for natural gas, the Oil and Gas Supply module.

In order to make such decisions, information on future demands, prices, and macroeconomic variables such as interest rates must be provided. While each module solves one year at a time, their simulations of planning activities involve an extrapolation of energy market conditions. Those modules making new capacity construction decisions apply an assumption about foresight in their expectations of future energy prices and quantities. In NEMS, a set of price and quantity variables is defined to store expectations:

$XP_{f,s,r,\hat{y}}$ = Expected prices of energy products beyond the current forecast year (for $\hat{y} > y$)

$XQ_{f,s,r,\hat{y}}$ = Expected consumption of energy products beyond the current forecast year

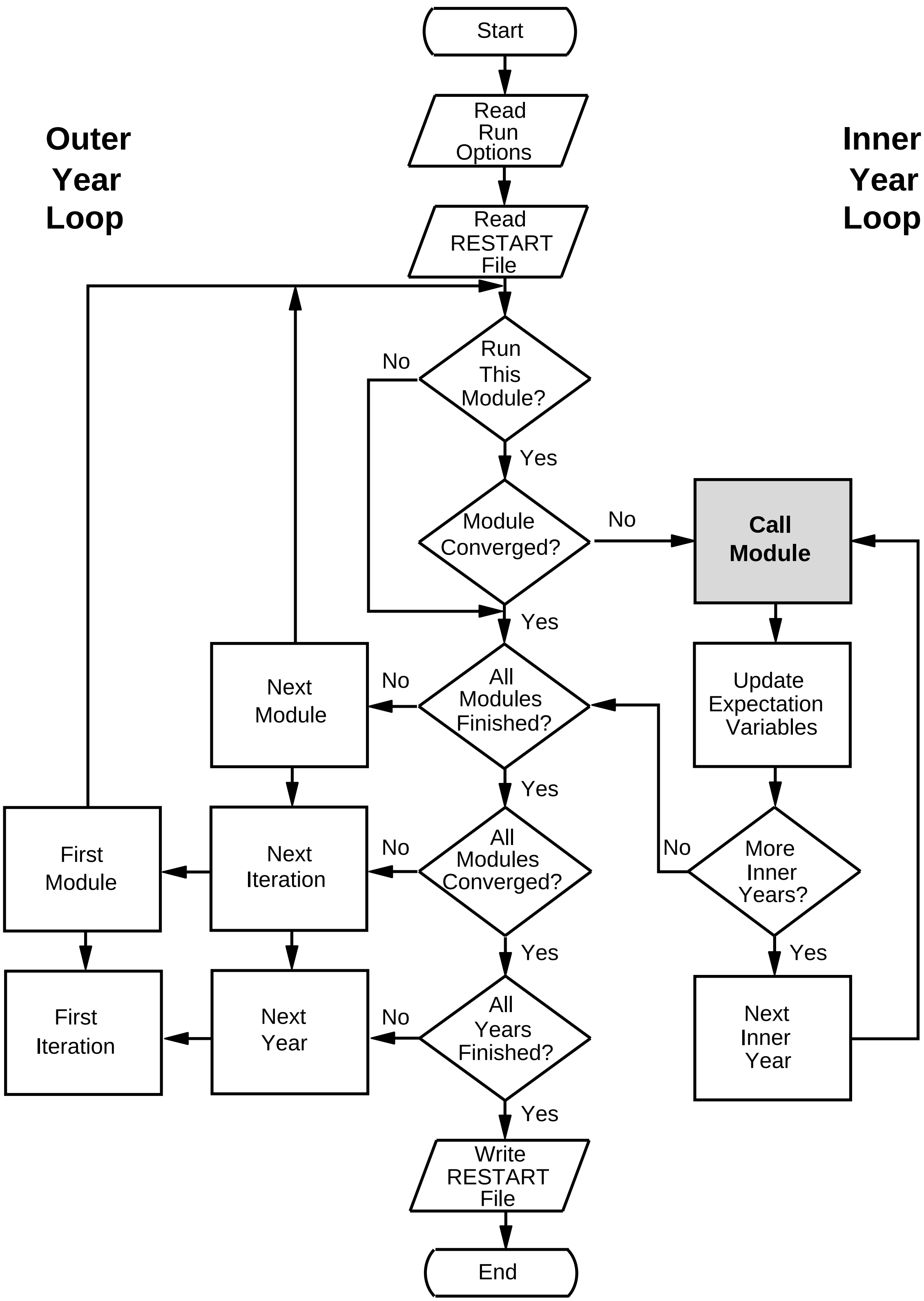
The foresight mode determines how the expectation variables are to be calculated: under perfect foresight, the various NEMS modules are invoked for years beyond the current iteration year; otherwise, the Integrating Module calculates minor extrapolations of present-year conditions. Foresight is therefore always calculated by looking forward to the consequences of conditions in the present iteration year, not by attempting to reach some end state determined *a priori*. The treatment of expectations is discussed in greater detail under **Expected Value Foresight**, on page 54.

Additional variables, representing such values as macroeconomic activity, world oil prices and trade, and emissions, may be added to the convergence algorithm, but are omitted here for clarity. In terms of the energy market interactions, the sectoral demand models estimate current-year energy demands $Q_{f,s,r,y}$ and energy-related capital stock additions as functions of current and expected energy prices. The supply models estimate end-use prices $P_{f,s,r,y}$ and capacity additions as functions of current and expected energy demands. The conversion modules (electricity, refinery, and synthetics) are viewed primarily as supply components, but they are both consumers of primary energy and suppliers of energy products.

Solution Algorithm Flow Chart

Figure 4 presents a detailed flow of the Integrating Module solution algorithm. The objective of the algorithm is to execute the system of component modules repeatedly until convergence is reached. The solution procedure for one iterative cycle involves execution of the component modules, as well as updating expectation variables. The component modules include the International Energy Activity Module, the Macroeconomic Activity Module, the sectoral demand models, the conversion models, and the supply models.

Figure 4. Integrating Module Flow Chart



Through program control options, the looping over years takes place either within an iterative cycle (Inner Year Loop) or outside the iterative cycle (Outer Year Loop). That is, component modules may either be called repeatedly to execute for all years in a given iteration, or may be executed one year at a time. The flexible year looping is designed to support different approaches for foresight, as discussed in detail under **Expected Value Foresight**, on page 54, below. Generally, looping for all years at a time is used only for the perfect foresight approach. The solution of each module one year at a time has been found to be more efficient than solving all years each time.

In Figure 4, the *Outer Year Loop* is executed once for each year in the forecast horizon when all modules are being executed for one year during each iteration. In that case, the *Inner Year Loop* executes for a single year as well. When modules execute for all years during each iteration, the *Inner Year Loop* controls the year indexing, and the *Outer Year Loop* is entered only once.

To accommodate flexible year looping, the solution procedure for a given iteration begins with the establishment of starting and ending year index ranges for the inner year loop. The next step is to update the expectation variables over the specified inner year range (either a single year or all years):

$$XP^{k}_{f,s,r,\hat{y}} = f(P^{k-1}_{f,s,r,y}) \qquad \text{(update price expectations from previous iteration prices)}$$
$$XQ^{k}_{f,s,r,\hat{y}} = f(Q^{k-1}_{f,s,r,y}) \qquad \text{(update quantity expectations from previous iteration quantities)}$$

Next, each of the modules is executed in turn. Normally, for each year in the inner year range, the International Energy Module and the Macroeconomic Module are called first, followed by the sectoral demand models.

$$Q^{k}_{f,s,r,y} = f(P^{k-1}_{f,s,r,y}, XP^{k}_{f,s,r,\hat{y}}, \textit{macroeconomic, other variables})$$

The conversion and supply models are then called, using updated demand quantities, to return prices:

$$P^{k}_{f,s,r,y} = f(Q^{k}_{f,s,r,y}, XQ^{k}_{f,s,r,\hat{y}}, \textit{macroeconomic, other variables})$$

After all modules have been executed for an inner year, the next inner year is begun. The order of calling the modules is flexible.

Convergence

After a module has been called, a check for convergence for that specific module is made, and the storage of previous iteration values is performed. Modules that had converged on an earlier iteration in the current year are bypassed. These intervening convergence checks isolate the specific modules that are not converging. An additional global convergence check requires all submodules to have converged. A separate convergence check is made for prices and quantities, consisting of a comparison of the absolute value of the percent changes to an assumed tolerance, ϵ , as follows:

$$\left| \frac{Q^{k}_{f,s,r,y} - Q^{k-1}_{f,s,r,y}}{(Q^{k}_{f,s,r,y} + Q^{k-1}_{f,s,r,y}) / 2} \right| < \epsilon$$

$$\left| \frac{P^{k}_{f,s,r,y} - P^{k-1}_{f,s,r,y}}{(P^{k}_{f,s,r,y} + P^{k-1}_{f,s,r,y}) / 2} \right| < \epsilon$$

Here, the denominators use an average to avoid convergence difficulties if either the starting value or a trial solution value is equal to zero. To avoid unnecessary iterations for changes in insignificant values, the quantity convergence check is omitted for changes less than a user-specified minimum level.

The last step is to store the current quantities and prices for the next iteration's convergence check:

$$Q^{k+1}_{f,s,r,y} = Q^{k}_{f,s,r,y}$$
$$P^{k+1}_{f,s,r,y} = P^{k}_{f,s,r,y}$$

The cycle is repeated until convergence is achieved for all submodules over the specified inner year range or until the maximum number of iterations is reached. When one of these two conditions occurs, an additional iteration, referred to as the ‘‘Final Convergence and Reporting Loop’’ is executed. This has several purposes. First, it is used to test whether a solution meeting the convergence criteria is maintained on two successive iterations. If so, there is a greater likelihood that the solution is an equilibrium solution. Second, it provides a signal for each module to write any reporting data out to disk, thus saving resources on intermediate iterations. Third, it provides a signal to the Integrating Module that all modules are to be executed, even if they had already converged on prior iterations. If the modules fail to converge on the Final Convergence and Reporting Loop, the convergence algorithm is repeated. In such cases, the model may converge on a subsequent iteration, thus triggering the Final Convergence and Reporting Loop a second time.

Once the model completes the Final Convergence and Reporting Loop, or when the maximum number of iterations is reached, the cycle for the current inner year range is completed. If the specified inner year range is only one year, the outer year index is incremented and the algorithm is repeated for the next year.

Whenever a year fails to converge within the user-specified number of iterations, the model completes the Final Convergence and Reporting Loop, accepts the resulting solution as the final solution, and proceeds to the next model year. The unconverged final solution should be examined in detail by the user, to verify its validity. Furthermore, later years' solutions in modules that refer to earlier years' solutions in their formulations can be affected adversely by the data in the unconverged final solution.

A model ‘‘execution log’’ is generated to record the progress of the model as it proceeds from one iteration to the next. The convergence status after execution of each module is reported in the log. Also reported are the names of any variables failing to converge, along with their values on the current and previous iterations, and their fractional changes. If the values of any tested variables fail to converge within the specified number of iterations, a message is written to the execution log, and execution continues with the next year. During or after a model run, the user may review the execution log to examine the convergence status.

When a nonconvergent situation arises, the results of the run must be viewed with caution. An assessment should be made as to the type of convergence problem and its effect on the results. A failure to converge may indicate a programming error, or it may be an accurate reflection of the modeling configuration. Generally, convergence problems must be evaluated on a case-by-case basis.

Other than specifying the run options through the run submission user interface, and substituting modified files containing data upon which the NEMS modules depend, there is no intervention required of the user to ensure a successful model run. The user should examine the execution run log and other output reports to ensure that convergence has been achieved, and that the results are credible. In the case of a problem with convergence, appropriate modules may be ‘‘switched off,’’ the allowable number of iterations may be increased, or other such parameters may be adjusted through the user interface and the simulation resubmitted.

Summary of Convergence Problems and Resolution

Integrated developmental testing of NEMS revealed a number of convergence problems. Factors leading to convergence problems were assessed and changes were made as needed to the individual NEMS modules. In a few cases, provisions to pass additional information between modules were required to develop stable convergence properties. Many of the convergence problems involved interactions between the Electricity Market Module (EMM) and the three supply modules providing it with fuel prices: the Natural Gas Transmission and Distribution Module (NGTDM), the Petroleum Market Module (PMM), and the Coal Market Module (CMM). The primary convergence problems and their resolutions are summarized below.

Merit Order Switching

The major function of the Electricity Fuel Dispatch (EFD), a submodule of the EMM, is to determine what generating capacity should be running at a particular time to meet the demand for electricity. The type of capacity used (fossil fuel, nuclear, renewables) and the manner in which it is deployed (base load, intermediate load, or peak) determines the fuel demands for the EFD. The objective of the EFD is to provide a least cost solution while meeting environmental requirements. In the merit order dispatching methodology, the marginal source of electricity is selected to react to each load change. One effect of this methodology is that step changes in the quantity of fuels required occur; the resulting discontinuities occasionally yielded nonconvergence.

Merit order switching in the utility market commonly occurred between natural gas and other fuels, between types of coal (graded by sulfur content), and sometimes between types of natural gas (competitive versus firm). Several techniques were used to reduce this effect, depending on the specific cause of the switch. These included incorporating demand curves in the PMM and NGTDM modules, price relaxation, and other modifications discussed later in this section.

NGTDM/EMM Interactions

Since NEMS is an extension and elaboration of IFFS, the experience gained with achieving convergence while incorporating step functions in IFFS was relevant. Consequently, the first step towards convergence in NEMS was to extend the IFFS approach to addressing the natural gas/utility interactions. As described above, the step functions for utility demand for natural gas come from merit order switches in the utilities model. When gas is cheaper than oil, the gas plants are dispatched with a higher capacity factor than the oil plants, and dual-fired plants switch to gas. When gas is more expensive, the reverse occurs and the gas plants operate with a lower capacity factor and consume less gas even though total electricity demand has not changed. If, when in the gas model, one were to take the utility gas demand as fixed, one would have an oscillation as in Figure 3a. This was known from the beginning of the design of IFFS.

Because of the similarity in the structures of NEMS and IFFS, the first step in achieving convergence was to focus on gas/utility interactions. Using a derived demand curve to encompass all the natural gas consumed by the utilities was not possible due to the greater complexity of the models in NEMS than the ones in IFFS. For example, allowing electricity trade meant that the utility model in each region was no longer an isolated consumer of natural gas and the full derived demand curve could not be constructed in each region without considering the interregional interactions. Consequently, the curve constructed in NEMS looks at fuel switching in dual-fired plants only.

In the EMM, the fuel choice decision is made for each capacity subunit based on a gas/oil sharing function. This function relates the ratio of prices of competitive gas to residual fuel oil to the quantity of gas required by the utilities. The vertical portions of the curve represent minimum and maximum quantities of gas needed by the utility respectively. An aggregate curve for each region is generated in the NGTDM. In order to use the information from the gas/oil sharing function, the oil price provided by the PMM is used as the denominator for the gas/oil price ratio, and a portion of the demand curve is created around the average of the trial prices from the last two iterations. Since a continuous demand curve cannot be implemented in a linear program, the three line segments constructed with the four points shown in the figure are approximated by a step function for inclusion in the NGTDM. This approach operated with relatively few problems and stabilized the fuel switching in the dual-fired plants.[4]

[4]There are two ways of interpreting the use of this step function. One is to view this approach as a partition in which the natural gas demand in utilities is determined in the natural gas model. The alternative is to view the utility gas demand as being determined in both the gas and utilities model. This is a departure from traditional equation solving, for in the traditional approach one constructs a partition of the equations, where each equation appears in only one grouping.

Additional merit order switching between categories of gas also occurred for which the gas/oil sharing function did not compensate. Gas is categorized as firm, interruptible, and competitive. Firm gas delivery is guaranteed in that the pipeline capacity is allocated to these customers first. These customers pay a reservation charge to reserve the capacity. Interruptible customers pay a lower price, essentially the marginal cost of delivery plus purchase costs, and face the risk of having gas supplies curtailed if delivery capacity is insufficient. Competitive customers have the ability to switch between gas and oil. Their gas is assumed to be priced as the maximum of either the residual oil price or the city gate price plus $.10 per MMBtu, with a ceiling at the interruptible price.

Because of the differences in the three gas prices, it was thought that the merit order would not change between iterations. However, this was not the case. Firm gas in utilities is burned in combined cycle plants that are more efficient than steam plants. Although the firm price remained above the competitive price, given the heat rate advantages, in some iterations the usual merit order switched. That is, instead of the steam plants being dispatched ahead of the combined cycle plants, the reverse occurred. With the higher operating rates for the combined cycle plants and the correspondingly lower operating rates for the steam plants, less gas was consumed overall, reflecting the greater efficiencies of the combined cycle plants over the steam plants in electricity production. The effect was to lower the wellhead price of gas. The economics of steam versus combined cycle depend more on the ratio of prices. Given the wellhead price drop and a constant difference between the different gas prices, the merit order switched back and forth because the percentage differences in the prices increased.

The solution to this problem involves changing the representation in the model. Firm gas to utilities needs to be marginally priced at the competitive price for dispatching purposes and priced at the full firm rate (including reservation rates) for calculating electricity rates and capacity expansion planning. The rationale is that the reservation charge is a sunk cost; that is, the charge must be paid whether gas is purchased or not. In general, this puts combined-cycle plants ahead of steam plants in the merit order, thus reducing the potential for these merit order switches. However, in Texas certain steam plants had better heat rates than combined cycle plants, though they had higher operating costs. Consequently, when the price of gas reached a threshold merit order switches still occurred. This was resolved by equalizing the operating costs of the two types of plants.

Other Natural Gas Convergence Issues

An aspect of the solution procedure that never caused a problem on its own, but did aggravate other problems, was the way the linear program approximations to the supply curves are constructed in the NGTDM. The underlying supply curve is a continuous function, which is approximated with a step function by constructing steps around the trial solution. The same increment to the price was used in all regions. In the solution to successive transportation linear programs, given the basis did not change, all prices changed the same amount for supply and demand nodes connected by any path of basic variables.[5]

[5]Murphy, F.H., and H. Greenberg, "Computing Regulated Equilibria with Mathematical Programming," *Operations Research*, Vol. 33, No. 5, 1985, pp 935-955.

In the case of the natural gas model transmission and distribution problem, almost all the supply and demand nodes and their associated prices are connected in this way. The only demand region not usually connected is the Northwest, because this region is supplied by Canadian gas. Consequently, when the equilibrium price changes, the gas prices in almost all regions change the same amount. Since all of the supply curve steps were based on the same price differences, they coincided with each other for changes in the equilibrium price. Essentially, the gas model had only six national steps because of this property of the solution. The solution was to ensure that step sizes were not absolute but based on a fraction of each regional price. This approach operated with relatively few problems and stabilized the fuel switching in the dual-fired plants. In addition, an oscillation in gas prices occurred because the price used to construct the supply curve was not relaxed, but the demand curve starting price was. The solution was to apply the same relaxation to the supply price as was used for the demand price.

Another natural gas convergence problem occurred when the short run supply curves hit the maximum production-to-reserves ratio at a low price. In this situation, the NGTDM had vertical supply curves. The resulting oscillations in the trial solutions were quite large in price with little quantity movement. The oscillations were aggravated because there were demand curves only for competitive gas to the utilities and not for the other gas demands. Since much of the response to the perturbations in price occurred with other types of gas and by other sectors, these demand curves did not sufficiently reflect the total demand response. This problem was resolved by including the demand response of end-use consumption of natural gas in the NGTDM.

The final convergence problems of note with natural gas involved the linear program defining the end-use prices and flow patterns for movements of natural gas through the regional interstate network. Because of the nature of the linear program, as the full capacity of a pipeline or storage facility would be reached, the price response would be disproportionate, leading to a drop in demand and an oscillation on the price. The solution to this problem also required the incorporation of an approximation of end-use demands within the natural gas distribution model.

Coal/EMM Interactions

The 1990 amendments to the Clean Air Act (CAAA) require reductions of emissions of sulfur dioxides and nitrogen oxides from electric utilities. In particular, after 1994 a national ceiling is placed on the total amount of sulfur dioxide that may be emitted by utilities. To represent the CAAA in the EMM, fuels are classified by the fraction of sulfur they contain. For instance, residual fuel oil is categorized as low or high-sulfur, and coal is divided into 12 sulfur grades, four for each coal rank.

The introduction of the CAAA restrictions, and the resulting disaggregation of coal demand by sulfur type made the convergence issues with coal more complex than encountered with IFFS. In IFFS, the shares of each coal type categorized by rank and sulfur content in electric utility consumption were fixed, and the merit order of the coal plants never changed. In NEMS, the types of coal used by a given plant are determined endogenously, based on the cost of competing coals and the cost of sulfur dioxide allowances. Coal-burning plants are grouped and dispatched by the type of coal they may use. This allows merit order changes even among plants using different coals, which happens regularly in the model.The fundamental problem is that the different coals can be substituted for each other in the coal plants. Consequently, when there is no single dominant sulphur grade in a region and a mix of coals is available, there can be an oscillation among grades of coal with essentially the same cost.

The convergence problems with coal have to be separated into two periods in the forecast horizon: before 1995, and 1995 and beyond. Prior to 1995 utilities can burn any coal they wish in their plants and the oscillations occur as follows: when the utilities model demands large quantities of high sulfur coal and the price rises above low sulfur, the utilities model switches to low sulfur coal and the relative order of the prices switch as well after the coal model is re-solved. The solution to this problem is to allow lower sulfur coals to flow into high-sulfur coal in the coal model. The effect of this is to cap the high-sulfur price at the low-sulfur price. When these prices are equal, any slight perturbation in price will cause a change in relative order of prices of the coal grades and consequently a large switch in demand. To compensate for this, an additional cost is assessed to change from a higher sulfur coal to one with a lower sulfur content. The effect of this structure is to fix the merit order of the coal plants from the perspective of the utility model.

An additional solution is to add relaxation to the coal prices. Relaxation is accomplished using the formulation

$$x_{i+1} = .80\ x_i + .20 x_{i+1}$$

where x_i is the previous relaxed price and x_{i+1} the new price. This algorithm also serves to reduce the fluctuation in coal prices between iterations.

After 1994 the Clean Air Act Amendments relating to sulfur dioxide pollution apply. The amendments establish a cap on the amount of sulfur dioxide emitted by the electric utilities nation-wide, and also establishes a system for trading sulfur dioxide emission rights, or allowances. The utilities can reduce their emissions by burning lower sulfur fuel, adding scrubbers, or reducing plant output and fuel consumption and sell the allowances to defray their costs. Alternatively, they can buy allowances to cover their costs of emissions. The market clearing price for the pollution rights functions as a tax on sulfur, since the marginal cost of emissions is equal to the cost of the allowances.

The preliminary approach to modeling the sulfur permit market led to oscillations in coal prices and quantities. To achieve convergence, additional information was passed between the utility and coal modules as follows. Given a set of coal prices, the dispatching order is resolved and the coal demands are calculated in the utility module. Using the emission cap as an additional constraint, a bisection algorithm is used to determine the sulfur penalty such that the least-cost coal dispatch reduces sulfur emissions below the cap. Given these demands, the coal module must determine new prices for each coal rank and sulfur type.

As before, lower-sulfur coals are allowed to replace high-sulfur coal in the coal module. However, a credit must be added to the price of low-sulfur coal in the objective function of the coal module to account for the value of the sulfur emission rights gained by using the low-sulfur coal to meet the demand for high-sulfur coal. Originally, this was set as the sulfur penalty multiplied by the difference in sulfur contents of the coals. Unfortunately, coal demands by region incorporate both scrubbed and unscrubbed plants, and the economics are different for each. Thus the equilibrium value of the credit is not so easily determined. After the demand for each coal grade is determined in the utility module, the ratio of each coal type is compared to that produced in the previous iteration of the coal module, and the credit adjusted accordingly until the shares of each coal grade are identical between models. At this point the sulfur penalty, coal prices and quantities are constant and market equilibrium has been reached.

Convergence Issues and the PMM

Since refineries in the Texas/Louisiana area can burn both natural gas and residual oil for heat, the linear program in the PMM allows both fuels to be consumed. This caused an oscillation between gas and residual fuel oil in the Southwest. This problem was resolved by taking the slope of the Texas supply curve for natural gas and using it to generate a step function supply curve for natural gas in the PMM. Since this supply curve is less elastic than the derived supply curve from NGTDM, it has the property that the model would converge monotonically if there were no other adjustments made. Both the base price and quantity are derived from the trial price and quantity determined in the previous iteration.

Demand curves were added for the following imported products: liquid propane gas (LPG), heating oil, high and low sulfur residual fuel, petrochemical feedstocks and other petroleum products. The purpose of these curves is to reduce the oscillation in prices caused by imports. These curves are implemented with three steps in the linear program used by the PMM. All curves except residual have three steps; high and low-sulfur residual were modeled with a nine step curve. This was required because of a convergence problem that occurred in the Northern Great Plains. In this case the high and low-sulfur residual oil prices oscillated to such an extreme that the high-sulfur residual was more expensive than the low-sulfur residual, the opposite of what should occur. With only three steps, the representation of the import supply curve is necessarily crude. In this case this representation was sufficient to cause slight changes in demand to shift the solution from one step to another and back, causing an oscillation. This was resolved by taking the import points and connecting them with line segments. That is, the curves were made continuous, which better matched the underlying economics. These line segments were then dynamically approximated by the nine steps. This eliminated any major price moves unaccompanied by quantity moves.

Summary of Convergence Issues

Three basic techniques were used to enhance convergence in NEMS. The first was to incorporate a representation of the demand response in the supply and pricing modules, as was done in the NGTDM to capture the behavior of dual-fired power plants. Secondly, when the slope of the supply curve for natural gas was incorporated in the PMM, an approximation was created of the first order effects of a change in gas consumption caused by a change in the demands by the PMM. To some extent, these two techniques are reflections of the same principle: a particular set of price-quantity relationships are incorporated in two distinct modules. The final convergence technique involved passing additional information besides just price and quantity signals between the coal and utility modules to compensate for the convergence problems caused by the CAAA requirements.

Acceleration Techniques

The NEMS Integrating Module incorporates a number of features that provide the user some amount of control over the speed with which the equilibration process converges on a final solution. Foremost among such features in terms of accelerating convergence while at the same time increasing the overall robustness of the solution process is a user-controllable feature known as *relaxation*.

As the Integrating Module iteratively directs the energy supply, demand, and other modules to recalculate the energy market data, the calculated prices and quantities can be expected to oscillate about the equilibrium solution as they converge on the supply and demand equilibrium for the current year. If the relaxation option is selected for the run by the user, then these swings from iteration to iteration are dampened by a user-specified factor, which may accelerate convergence and lead to a more stable and robust solution process. Using the notation developed above,

$$x^{k+1} = x^{k} + r\,(x^{k-1} - x^{k})$$

where r = relaxation factor.

Another acceleration technique is the selection of the appropriate initial solution. As many runs are simulations of alternative scenarios to a prior run, an appropriate choice of initial solution will speed convergence significantly.

Initial Solution Selection

At the start of a NEMS run, initial values for all years for all variables in the Global Data Structure, including the energy market data, are read from a user-specified version of the RESTART file. In turn, the final solution for all years at the end of the NEMS run is stored and becomes available for use as the initial solution for subsequent runs.

The choice of restart files may have an affect on the speed of convergence. A restart file provides an initial set of demands and prices for the modules to use as input. In addition, for those modules employing linear programs, the restart file is associated with a set of initial bases. The restart file based on the last iteration of the same year of another run provided the most efficient initial point for the starting iteration.

Expected Value Foresight

Approaches to foresight ($XP_{f,s,r,\hat{y}}$ and $XQ_{f,s,r,\hat{y}}$) are important for theoretical and practical reasons. Mid- and long-term energy forecasting involves assessing changes in energy-using capital stocks and choices among energy supply alternatives. This analysis requires simulation of such decisions as the selection of durable appliances, planning electricity-generating capacity additions, and building gas pipelines. The economic evaluation of these decisions requires energy demand and price expectations for life-cycle cost and capacity addition calculations. An objective in this aspect of the modeling is to simulate such decision making in the aggregate for predictive and analytical purposes, representing how players in the energy marketplace make long term planning decisions, rather than by deriving the theoretically optimal long-term expansion path. As a result, the formulation of foresight assumptions is open to alternative approaches based on observed industry practices.

NEMS could, in principle, approach the issue of foresight by prescribing a desirable end state for the energy marketplace, and calculating backwards in time to prescribe how best to arrive there. However, as a simulation, NEMS calculates foresight as an extrapolation of the present state of energy markets, subject to announced policies. Rather than determining how to arrive at the planned future, NEMS can evaluate whether present plans could result in the desired end state.

In reality, different methodologies for treating foresight are used in different sectors and supply areas, and alternate approaches to representing expectations may yield significantly different planning decisions. Consequently, treatment of foresight becomes an important modeling decision.

There is no one best approach to treating foresight. The National Research Council Committee on NEMS recommended that several options for modeling foresight be developed.[6] As a result, an objective in NEMS was to build the flexibility to support different approaches to foresight to allow for experimentation and future modeling changes. In addition, it is desirable to have the option to treat foresight consistently throughout the modeling system.

The purpose of dealing with foresight and expectations in the Integrating Module is to be able to represent different types of foresight consistently. At the same time the Integrating Module allows individual modules to handle foresight independently, should industry practice require different approaches. To achieve this flexibility, each NEMS module is intended to be constructed so that an on-off switch is examined to determine whether the module uses the system-generated expectations or not. If this central-control switch is turned on, the module uses system expectations; otherwise, the module uses expectations it generates for itself.

The system-generated expectations include several types:

- The ‘‘myopic expectations’’ option is one in which expected prices for any forecast period are assumed to be constant in real dollar terms relative to the current period in which decisions are being made. Generally, this case applies only to expected prices because an assumption of constant energy demands would rarely be assumed.

- ‘‘Adaptive expectations,’’ also known as ‘‘extrapolative expectations,’’ is an approach that assumes planners extrapolate recent trends when making long-term decisions. For the system-generated expectations, this assumption about foresight is implemented by extrapolating the current projection year prices and quantities using the average annual growth over the previous few projection years. For example, the expectations generated in model year 2000 for use in 2001 would be determined from the growth over the last few model years (e.g., 1998 to 2000), with the number of years being a model option. For

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[6]National Research Council, *The National Energy Modeling System*, Washington D.C.: National Academy Press, 1992.

expectations generated within individual modules, more elaborate behavioral models, or adaptive expectations, are used.

- The ‘‘perfect foresight’’ approach is based on rational expectations theory. The approach generates an internally consistent scenario for which the formation of expectations is consistent with the projections realized in the model. In practice, perfect foresight describes the configuration and solution algorithm that achieves the convergence of expected values and realized values. A variation in the integrating algorithm is required to implement perfect foresight. Instead of solving for an equilibrium for each year, the Integrating Module calls each model for all years of the forecast horizon during each iteration. The objective is to converge across all years simultaneously rather than solving one year at a time. Expectations of variables beyond the standard forecast horizon, required for long-term decisions made late in the forecast period, are, however, still extrapolated under the perfect foresight approach.

While these approaches are implemented in full in the Integrating Module, they cannot as yet be used in NEMS runs. Some of the analytical modules have not yet been programmed for the approaches other than myopic foresight, and others have not been tested. The foresight options have therefore not been tested in the full NEMS system and will not be available until later editions of the system.

Among those modules using alternative expectations is the Electricity Market Module (EMM). The EMM requires fuel price expectations for natural gas, oil, and coal for use in its capacity planning submodule. For the 1994 *Annual Energy Outlook* (AEO), separate approaches for generating oil, gas and coal prices for this module were developed and are summarized below:

- Coal price expectation equations were developed using a regression approach on a NERC region basis. This methodology is implemented directly in the EMM.

- Oil product price expectations are generated in the Integrating Module. The prices are calculated from an external forecast of world oil prices, assuming a constant markup between the regional product price and the world oil price. In each forecast year, the assumed markup is derived from the prior forecast year:

  $$P_{c+k} = (P_c - W_c) + W_{c+k} \quad \text{for } k=1,...,40$$

  where P_c and W_c are the product price and the exogenous world oil price from the previous forecast year, and P_{c+k} and W_{c+k} are the prices in the expectation years.

- Delivered natural gas prices are derived from expected wellhead prices, assuming a constant markup between the delivered prices and the wellhead price. The wellhead price expectations are based on a simple, nonlinear function which relates the expected wellhead gas price to cumulative domestic gas production. The equation is of the following form:

  $$P_k = A * Q_k^{1.5} + B \quad ,$$

where P is the wellhead price, Q is the cumulative production from 1991 to year k, and A and B are determined each year, as explained below.

The approach was developed to have the following properties:

— Prices should be upward sloping as a function of cumulative gas production.

— The rate of change in wellhead prices should increase as fewer economical reserves remain to be discovered and produced.

The approach assumes that at some point in the future a given target price, PF, results when cumulative gas production reaches a given level, QF. Thus, the target values PF and QF are assumed inputs to the approach. For simplicity, the annual production is assumed to be constant at the prior year's level. The parameters of the price equation, A and B, are determined each projection year such that the price equation will intersect the future target point. That is:

let D = Last year's gas production
let PS = Last year's wellhead gas price
let QS = Last year's cumulative gas production since 1991

$$A = (PF - PS) / (QF^{1.5} - QS^{1.5})$$

$$B = PF - A*QF^{1.5}$$

Extrapolate cumulative production for future years k= 1,...40:

$$Q_k = Q_{k-1} + D$$

Generate expected well-head prices:

$$P_k = A*Q_k^{1.5} + B$$

Appendix A

Variable, Data and Parameter Listing

Appendix A. Variable, Data and Parameter Listing

This appendix gives the details of the NEMS Global Data Structure. The bulk of the appendix is a modified listing of the NEMS Data Dictionary, where the modifications are intended to make the somewhat terse content of the Data Dictionary more intelligible to the less-technical reader. Full details of the content of the Global Data Structure are contained herein.

The version of the NEMS Data Dictionary printed here was that created on February 18, 1993. For the most current data, the reader should refer to a dataset on the EIA Service Facility mainframe computer named CN6005.PRJ.NEMS.DICT.AEO.datekey, where *datekey* is the most recent date found. The dataset listed herein was CN6005.PRJ.NEMS.DICT.AEO.D0218931.

In the ordinary format of the Data Dictionary, a series of header records give detailed information about some of the fields in the body of the Data Dictionary. This information is given instead in the tables that follow.

On most of the pages of this appendix, there is a header that describes the content of the columns below. The headings in this row are described in the sections that follow.

COMMON Block Name

Appears at the beginning of the COMMON block, preceded by some delimiters and a verbal description of the purpose for the COMMON. Followed by a row for each variable in the COMMON block; the descriptions that follow describe the content of the rows for variables.

Variable Name

Variable names that appear in this column are the actual FORTRAN names by which the variables are used in the program.

Variable Dimensions

In the Variable Dimensions column are up to five dimensions for each variable. NEMS conventions limit Global Data Structure variables to five dimensions. There is no convention that limits variables that are not part of the Global Data Structure from assuming the full seven dimensions allowed by the FORTRAN syntax.

Names are used as variable dimensions, so as to distinguish the meanings of the values of the sizes of the variables. Table A1 defines the meanings of the names:

Table A1. Dimension Names

Dimension Name	Value	Description
NOGCAT	12	Oil Catagories (Regions)
NOGCRO	5	Gas Catagories (Regions)
NOGRGN	10	OGSM Reporting Regions
NOGDTP	4	OGSM Drilling Regions
NFNGSS	4	OGSM Import/export Regions
GRADCR	5	Grades of Crude Oil
MNPOLL	8	No. Air Emissions+Particulates
MNETOH	5	No. of Ethanol Vol steps
MNCROP	2	No. of Crops(Corn,Biomass)
WNTECH	10	Renewables
MNUMCL	3	Renewables
MNUMSO	9	Renewables
MNUMWI	20	Renewables
MNUMPR	6	PADD Regions
DSMPCM	10	No. of DSM Progs. Commer.
DSMPRS	10	No. of DSM Progs. Residen.
MNUMCR	11	Census Regions
MNUMXR	11	Coal Export Regions
MODELS	12	Number of Modules
NSICNM	12	Non-Mfg: No. of SIC's
MNUMOR	13	Oil & Gas Regions
MNUMBX	18	NG Border Crossings
MNUMGR	15	NGTDM Regions
CLTYPE	16	Coal Type
MNUMNR	16	'NERC' Electric Supply Regions
MNUMLR	17	Coal Supply Regions
NDREGN	23	Coal Demand Regions
MFTYPE	29	No. of Mfg Types
MNUMYR	29	Years=1990-2015,'20,'25,'30
MECPYR	39	MNUMYR + 10 yrs (horizon)
MSEDYR	2	# Historical SEDS years
MNSICM	40	Mfg: Number of SIC's
MNXYRS	66	No. of Expectation Years
FLTYPE	6	Fuel Type-Oil,NG,MCL,SCL,Ren,Al

Variable Descriptors

Table A2. Data Dictionary Variable Descriptors

TYPE	
CNTROL	
HISTOR	SED/Other Historical Data
PARAM	Parameter
PRICE	Price
QUNTY	Quantity
XPRICE	Expected Price 87$BTU
XQUNTY	Expected Quantity tBTU
RATE	
LEVEL	
INDEX	
CONFAC	
GENCAP	Generation Capacity
CAPFAC	Capacity Factor
CAPCOS	Capital Cost
OPCOST	Operating Cost
LIFE	Plant Lifetime
HEATRT	Heat Rate
FUECOS	Fuel Cost

UNITS	
87$BTU	87$ per million BTU
87$BBL	87$ per Barrel
87$MCF	87$ per million cu ft
BARREL	
MMBBL	
BBL/DA	
tBBL/D	thousand Barrels per day
MPG	
mBTU/B	Million BTU / Barrel
tBTU/C	Thousand btu / Cubic Ft
MWATT	Megawatts
tMWATT	Thousand Megawatts
GWATT	Gigawatts
GWTHRS	Gigawatt hours
SCALAR	
BLANK	
DEC_4	
INT_2	
INT_3	
INT_4	
MCF	
MKWH	
ON_OFF	
RADS	
tBTU	Trillion BTU
THREE	
TONS	
tMTONS	thousand Metric Tons
mMTONS	Million Metric Tons
mSTONS	Million Short Tons
bLBS	Billion Pounds
$/TON	
TON_ML	Ton Miles
TWO	
UNIT1	
UNIT2	
UNIT3	
UNIT4	
UNIT5	
UNIT6	
BCF	Billion Cu Ft
b87$	Billion 87$
m87$	Million 87$
m82$	Million 82$
PERCNT	Percent
MILL	Million (units)
1000s	Thousand (units)
89=1.0	1989=1.0
87=1.0	1987=1.0
82=1.0	1982=1.0
bSQFT	Billion Sq Ft
$/HR	$ per Hour
$/GAL	$ per Gallon
FCUR/$	Foreign Currency/$
87$MW	87$ per Megawatt
87$KWH	87$ per Kilowatt-hour
87mKWH	87$ per Kilowatt-hour
BTUKWH	Trillion Btu per Kilowatt-hour
YR	Years
FRACT	Fraction
BTUCOR	Btu per Cord
BTUGAL	Btu per Gallon
BTUMSF	Btu per Thousand Square Feet
BTUTON	Btu per Short Ton
BTUBBL	Btu per Barrel

FUEL	
AS	Asphalt and Road Oil
BM	Biomass
CI	Net Coal Coke Imports
CL	Coal
DS	Distillate
EI	Net Electricity Imports
EL	Purchased Electricity
EN	Purchased Electricity, Non-Peak
EP	Purchased Electricity, Peak
ET	Ethanol
GE	Geothermal
GF	Natural Gas, Core
GI	Natural Gas, Non-Core
GP	Natural Gas, Pipeline
HO	HydroPower
HY	Liquid Hydrogen
WO	World Oil Price
JF	Jet Fuel
KS	Kerosene
LG	Liquid Petroleum Gases
LP	Lease and Plant Fuel
MC	Metallurgical Coal
ME	Methanol
MG	Motor Gasoline
MS	Municipal Solid Waste
NG	Natural Gas
OT	Other Petroleum
PC	Petroleum Coke
PF	Petrochemical Feedstocks
PV	Photovoltaic
RH	Residual Fuel, High Sulfur
RL	Residual Fuel, Low Sulfur
RS	Residual Fuel
SG	Still Gas
ST	Solar Thermal
TP	Total Petroleum
TR	Total Renewables
TS	Total Sectorial Energy Consumption
UR	Uranium
WI	Wind
COALGS	
COALIQ	
COALST	
ETBE	
FUEL4	
GASOLN	
LNG	
OTHER	
WOOD	
ALL	All Fuels

SECTOR	
RESIDN	Residential
COMMER	Commercial
TRANSP	Transportation
INDUST	Industrial
REFINE	Refinery
ALLSEC	All Sectors
ELECTR	Electricity
SYNTHE	Synthetics
PIPELN	
INTERN	International
PLANT	

MODELS
INTERN
MACRO
ELECTR
RESID
COMMER
INDUST
TRANS
UTIL
COAL
OIL&GS
NATGAS
PETROL
RENEW
ALL

In the Data Dictionary, the Variable Descriptors are columns provided to allow one-word categorization of each variable in a COMMON block. Within each COMMON block, the variety of categorization can be customized to the purpose of the COMMON block, as shown by the titles at the top of each of the four columns. In fact, the Data Dictionary allows five columns of descriptors, although no COMMON block uses more than four.

Table A2 on the next page gives the names of the legal values for each of the categorizations, and, where the programmers have provided them, the meanings of the categories.

Brief variable descriptions are provided in the dictionary.

COMMON Block Name	Variable Name	Variable Dimensions	Variable Descriptors				Variable Descriptio
*========	================	====== ====== ====== ====== ======	======	======	======	======	================================
* Quantities Common Block							
*========	================	====== ====== ====== ====== ======	======	======	======	======	================================
QBLK			TYPE	UNITS	FUEL	SECTOR	QUANTITIES
	QEPRS	(MNUMCR,MNUMYR)	QUNTY	tBTU	EP	RESIDN	Purchased Electricity, Peak. Resi
	QEPCM	(MNUMCR,MNUMYR)	QUNTY	tBTU	EP	COMMER	Purchased Electricity, Peak. Comm
	QEPTR	(MNUMCR,MNUMYR)	QUNTY	tBTU	EP	TRANSP	Purchased Electricity, Peak. Tran
	QEPIN	(MNUMCR,MNUMYR)	QUNTY	tBTU	EP	INDUST	Purchased Electricity, Peak. Indu
	QEPRF	(MNUMCR,MNUMYR)	QUNTY	tBTU	EP	REFINE	Purchased Electricity, Peak. Refi
	QEPAS	(MNUMCR,MNUMYR)	QUNTY	tBTU	EP	ALLSEC	Purchased Electricity, Peak. All
	QENRS	(MNUMCR,MNUMYR)	QUNTY	tBTU	EN	RESIDN	Purchased Electricity, Nonpeak. R
	QENCM	(MNUMCR,MNUMYR)	QUNTY	tBTU	EN	COMMER	Purchased Electricity, Nonpeak. C
	QENTR	(MNUMCR,MNUMYR)	QUNTY	tBTU	EN	TRANSP	Purchased Electricity, Nonpeak. T
	QENIN	(MNUMCR,MNUMYR)	QUNTY	tBTU	EN	INDUST	Purchased Electricity, Nonpeak. I
	QENRF	(MNUMCR,MNUMYR)	QUNTY	tBTU	EN	REFINE	Purchased Electricity, Nonpeak. R
	QENAS	(MNUMCR,MNUMYR)	QUNTY	tBTU	EN	ALLSEC	Purchased Electricity, Nonpeak. A
	QELRS	(MNUMCR,MNUMYR)	QUNTY	tBTU	EL	RESIDN	Purchased Electricity. Residentia
	QELCM	(MNUMCR,MNUMYR)	QUNTY	tBTU	EL	COMMER	Purchased Electricity. Commercial
	QELTR	(MNUMCR,MNUMYR)	QUNTY	tBTU	EL	TRANSP	Purchased Electricity. Transporta
	QELIN	(MNUMCR,MNUMYR)	QUNTY	tBTU	EL	INDUST	Purchased Electricity. Industrial
	QELRF	(MNUMCR,MNUMYR)	QUNTY	tBTU	EL	REFINE	Purchased Electricity. Refinery
	QELAS	(MNUMCR,MNUMYR)	QUNTY	tBTU	EL	ALLSEC	Purchased Electricity. All Sector
	QGFRS	(MNUMCR,MNUMYR)	QUNTY	tBTU	GF	RESIDN	Natural Gas, Core. Residential
	QGFCM	(MNUMCR,MNUMYR)	QUNTY	tBTU	GF	COMMER	Natural Gas, Core. Commercial
	QGFTR	(MNUMCR,MNUMYR)	QUNTY	tBTU	GF	TRANSP	Natural Gas, Core. Transportation
	QGFIN	(MNUMCR,MNUMYR)	QUNTY	tBTU	GF	INDUST	Natural Gas, Core. Industrial
	QGFRF	(MNUMCR,MNUMYR)	QUNTY	tBTU	GF	REFINE	Natural Gas, Core. Refinery
	QGFEL	(MNUMCR,MNUMYR)	QUNTY	tBTU	GF	ELECTR	Natural Gas, Core. Electricity
	QGFAS	(MNUMCR,MNUMYR)	QUNTY	tBTU	GF	ALLSEC	Natural Gas, Core. All Sectors
	QGIRS	(MNUMCR,MNUMYR)	QUNTY	tBTU	GI	RESIDN	Natural Gas, Noncore. Residential
	QGICM	(MNUMCR,MNUMYR)	QUNTY	tBTU	GI	COMMER	Natural Gas, Noncore. Commercial
	QGITR	(MNUMCR,MNUMYR)	QUNTY	tBTU	GI	TRANSP	Natural Gas, Noncore. Transportat
	QGIIN	(MNUMCR,MNUMYR)	QUNTY	tBTU	GI	INDUST	Natural Gas, Noncore. Industrial
	QGIRF	(MNUMCR,MNUMYR)	QUNTY	tBTU	GI	REFINE	Natural Gas, Noncore. Refinery
	QGIEL	(MNUMCR,MNUMYR)	QUNTY	tBTU	GI	ELECTR	Natural Gas, Noncore. Electricity
	QGIAS	(MNUMCR,MNUMYR)	QUNTY	tBTU	GI	ALLSEC	Natural Gas, Noncore. All Sectors
	QNGRS	(MNUMCR,MNUMYR)	QUNTY	tBTU	NG	RESIDN	Natural Gas. Residential
	QNGCM	(MNUMCR,MNUMYR)	QUNTY	tBTU	NG	COMMER	Natural Gas. Commercial
	QNGTR	(MNUMCR,MNUMYR)	QUNTY	tBTU	NG	TRANSP	Natural Gas. Transportation
	QNGIN	(MNUMCR,MNUMYR)	QUNTY	tBTU	NG	INDUST	Natural Gas. Industrial
	QNGRF	(MNUMCR,MNUMYR)	QUNTY	tBTU	NG	REFINE	Natural Gas. Refinery
	QNGEL	(MNUMCR,MNUMYR)	QUNTY	tBTU	NG	ELECTR	Natural Gas. Electricity
	QNGAS	(MNUMCR,MNUMYR)	QUNTY	tBTU	NG	ALLSEC	Natural Gas. All Sectors
	QGPTR	(MNUMCR,MNUMYR)	QUNTY	tBTU	GP	TRANSP	Natural Gas. Pipeline
	QLPIN	(MNUMCR,MNUMYR)	QUNTY	tBTU	LP	INDUST	Lease and Plant Fuel
	QCLRS	(MNUMCR,MNUMYR)	QUNTY	tBTU	CL	RESIDN	Coal. Residential
	QCLCM	(MNUMCR,MNUMYR)	QUNTY	tBTU	CL	COMMER	Coal. Commercial
	QCLIN	(MNUMCR,MNUMYR)	QUNTY	tBTU	CL	INDUST	Coal. Industrial
	QCLRF	(MNUMCR,MNUMYR)	QUNTY	tBTU	CL	REFINE	Coal. Refinery
	QCLEL	(MNUMCR,MNUMYR)	QUNTY	tBTU	CL	ELECTR	Coal. Electricity
	QCLSN	(MNUMCR,MNUMYR)	QUNTY	tBTU	CL	SYNTHE	Coal. Synthetics
	QCLAS	(MNUMCR,MNUMYR)	QUNTY	tBTU	CL	ALLSEC	Coal. All Sectors
	QMCIN	(MNUMCR,MNUMYR)	QUNTY	tBTU	MC	INDUST	Metallurgical Coal. Industrial
	QMGCM	(MNUMCR,MNUMYR)	QUNTY	tBTU	MG	COMMER	Motor Gasoline. Commercial
	QMGTR	(MNUMCR,MNUMYR)	QUNTY	tBTU	MG	TRANSP	Motor Gasoline. Transportation
	QMGIN	(MNUMCR,MNUMYR)	QUNTY	tBTU	MG	INDUST	Motor Gasoline. Industrial
	QMGAS	(MNUMCR,MNUMYR)	QUNTY	tBTU	MG	ALLSEC	Motor Gasoline. All Sectors
	QJFTR	(MNUMCR,MNUMYR)	QUNTY	tBTU	JF	TRANSP	Jet Fuel. Transportation

COMMON Block Name	Variable Name	Variable Dimensions	Variable Descriptors	Variable Description
	QDSRS	(MNUMCR,MNUMYR)	QUNTY tBTU DS RESIDN	Distillate. Residential
	QDSCM	(MNUMCR,MNUMYR)	QUNTY tBTU DS COMMER	Distillate. Commercial
	QDSTR	(MNUMCR,MNUMYR)	QUNTY tBTU DS TRANSP	Distillate. Transportation
	QDSIN	(MNUMCR,MNUMYR)	QUNTY tBTU DS INDUST	Distillate. Industrial
	QDSRF	(MNUMCR,MNUMYR)	QUNTY tBTU DS REFINE	Distillate. Refinery
	QDSEL	(MNUMCR,MNUMYR)	QUNTY tBTU DS ELECTR	Distillate. Electricity (incl. pe
	QDSAS	(MNUMCR,MNUMYR)	QUNTY tBTU DS ALLSEC	Distillate. All Sectors
	QKSRS	(MNUMCR,MNUMYR)	QUNTY tBTU KS RESIDN	Kerosene. Residential
	QKSCM	(MNUMCR,MNUMYR)	QUNTY tBTU KS COMMER	Kerosene. Commercial
	QKSIN	(MNUMCR,MNUMYR)	QUNTY tBTU KS INDUST	Kerosene. Industrial
	QKSAS	(MNUMCR,MNUMYR)	QUNTY tBTU KS ALLSEC	Kerosene. All Sectors
	QLGRS	(MNUMCR,MNUMYR)	QUNTY tBTU LG RESIDN	Liquid Petroleum Gases. Residenti
	QLGCM	(MNUMCR,MNUMYR)	QUNTY tBTU LG COMMER	Liquid Petroleum Gases. Commercia
	QLGTR	(MNUMCR,MNUMYR)	QUNTY tBTU LG TRANSP	Liquid Petroleum Gases. Transport
	QLGIN	(MNUMCR,MNUMYR)	QUNTY tBTU LG INDUST	Liquid Petroleum Gases. Industria
	QLGRF	(MNUMCR,MNUMYR)	QUNTY tBTU LG REFINE	Liquid Petroleum Gases. Refinery
	QLGAS	(MNUMCR,MNUMYR)	QUNTY tBTU LG ALLSEC	Liquid Petroleum Gases. All Secto
	QRLCM	(MNUMCR,MNUMYR)	QUNTY tBTU RL COMMER	Residual Fuel, Low Sulfur. Commer
	QRLTR	(MNUMCR,MNUMYR)	QUNTY tBTU RL TRANSP	Residual Fuel, Low Sulfur. Transp
	QRLIN	(MNUMCR,MNUMYR)	QUNTY tBTU RL INDUST	Residual Fuel, Low Sulfur. Indust
	QRLRF	(MNUMCR,MNUMYR)	QUNTY tBTU RL REFINE	Residual Fuel, Low Sulfur. Refine
	QRLEL	(MNUMCR,MNUMYR)	QUNTY tBTU RL ELECTR	Residual Fuel, Low Sulfur. Electr
	QRLAS	(MNUMCR,MNUMYR)	QUNTY tBTU RL ALLSEC	Residual Fuel, Low Sulfur. All Se
	QRHTR	(MNUMCR,MNUMYR)	QUNTY tBTU RH TRANSP	Residual Fuel, High Sulfur. Transp
	QRHEL	(MNUMCR,MNUMYR)	QUNTY tBTU RH ELECTR	Residual Fuel, High Sulfur. Elect
	QRHAS	(MNUMCR,MNUMYR)	QUNTY tBTU RH ALLSEC	Residual Fuel, High Sulfur. All S
	QRSCM	(MNUMCR,MNUMYR)	QUNTY tBTU RS COMMER	Residual Fuel. Commercial
	QRSTR	(MNUMCR,MNUMYR)	QUNTY tBTU RS TRANSP	Residual Fuel. Transportation
	QRSIN	(MNUMCR,MNUMYR)	QUNTY tBTU RS INDUST	Residual Fuel. Industrial
	QRSRF	(MNUMCR,MNUMYR)	QUNTY tBTU RS REFINE	Residual Fuel. Refinery
	QRSEL	(MNUMCR,MNUMYR)	QUNTY tBTU RS ELECTR	Residual Fuel. Electricity
	QRSAS	(MNUMCR,MNUMYR)	QUNTY tBTU RS ALLSEC	Residual Fuel. All Sectors
	QPFIN	(MNUMCR,MNUMYR)	QUNTY tBTU PF INDUST	Petrochemical Feedstocks. Industr
	QSGIN	(MNUMCR,MNUMYR)	QUNTY tBTU SG INDUST	Still Gas. Industrial
	QSGRF	(MNUMCR,MNUMYR)	QUNTY tBTU SG REFINE	Still Gas. Refinery
	QPCIN	(MNUMCR,MNUMYR)	QUNTY tBTU PC INDUST	Petroleum Coke. Industrial
	QPCRF	(MNUMCR,MNUMYR)	QUNTY tBTU PC REFINE	Petroleum Coke. Refinery
	QPCEL	(MNUMCR,MNUMYR)	QUNTY tBTU PC ELECTR	Petroleum Coke. Electricity
	QPCAS	(MNUMCR,MNUMYR)	QUNTY tBTU PC ALLSEC	Petroleum Coke. All Sectors
	QASIN	(MNUMCR,MNUMYR)	QUNTY tBTU AS INDUST	Asphalt and Road Oil. Industrial
	QOTTR	(MNUMCR,MNUMYR)	QUNTY tBTU OT TRANSP	Other Petroleum. Trans (lubes, av
	QOTIN	(MNUMCR,MNUMYR)	QUNTY tBTU OT INDUST	Other Petroleum. Industrial
	QOTRF	(MNUMCR,MNUMYR)	QUNTY tBTU OT REFINE	Other Petroleum. Refinery
	QOTAS	(MNUMCR,MNUMYR)	QUNTY tBTU OT ALLSEC	Other Petroleum. All Sectors
	QTPRS	(MNUMCR,MNUMYR)	QUNTY tBTU TP RESIDN	Total Petroleum. Residential
	QTPCM	(MNUMCR,MNUMYR)	QUNTY tBTU TP COMMER	Total Petroleum. Commercial
	QTPTR	(MNUMCR,MNUMYR)	QUNTY tBTU TP TRANSP	Total Petroleum. Transportation
	QTPIN	(MNUMCR,MNUMYR)	QUNTY tBTU TP INDUST	Total Petroleum. Industrial
	QTPRF	(MNUMCR,MNUMYR)	QUNTY tBTU TP REFINE	Total Petroleum. Refinery
	QTPEL	(MNUMCR,MNUMYR)	QUNTY tBTU TP ELECTR	Total Petroleum. Electricity
	QTPAS	(MNUMCR,MNUMYR)	QUNTY tBTU TP ALLSEC	Total Petroleum. All Sectors
	QMETR	(MNUMCR,MNUMYR)	QUNTY tBTU ME TRANSP	Methanol. Transporation
	QETTR	(MNUMCR,MNUMYR)	QUNTY tBTU ET TRANSP	Ethanol. Transporation
	QHYTR	(MNUMCR,MNUMYR)	QUNTY tBTU HY TRANSP	Liquid Hydrogen. Transportation
	QUREL	(MNUMCR,MNUMYR)	QUNTY tBTU UR ELECTR	Uranium. Electricity
	QHOIN	(MNUMCR,MNUMYR)	QUNTY tBTU HO INDUST	Hydropower. Industrial
	QHOEL	(MNUMCR,MNUMYR)	QUNTY tBTU HO ELECTR	Hydropower. Electricity
	QHOAS	(MNUMCR,MNUMYR)	QUNTY tBTU HO ALLSEC	Hydropower. All Sectors

COMMON Block Name	Variable Name	Variable Dimensions	Variable Descriptors	Variable Descriptio
	QGEIN	(MNUMCR,MNUMYR)	QUNTY tBTU GE INDUST	Geothermal. Industrial
	QGEEL	(MNUMCR,MNUMYR)	QUNTY tBTU GE ELECTR	Geothermal. Electricity
	QGEAS	(MNUMCR,MNUMYR)	QUNTY tBTU GE ALLSEC	Geothermal. All Sectors
	QBMRS	(MNUMCR,MNUMYR)	QUNTY tBTU BM RESIDN	Biomass. Residential
	QBMCM	(MNUMCR,MNUMYR)	QUNTY tBTU BM COMMER	Biomass. Commercial
	QBMIN	(MNUMCR,MNUMYR)	QUNTY tBTU BM INDUST	Biomass. Industrial
	QBMRF	(MNUMCR,MNUMYR)	QUNTY tBTU BM REFINE	Biomass. Refinery
	QBMEL	(MNUMCR,MNUMYR)	QUNTY tBTU BM ELECTR	Biomass. Electricity
	QBMSN	(MNUMCR,MNUMYR)	QUNTY tBTU BM SYNTHE	Biomass. Synthetics
	QBMAS	(MNUMCR,MNUMYR)	QUNTY tBTU BM ALLSEC	Biomass. All Sectors
	QMSIN	(MNUMCR,MNUMYR)	QUNTY tBTU MS INDUST	Municipal Solid Waste. Industrial
	QMSEL	(MNUMCR,MNUMYR)	QUNTY tBTU MS ELECTR	Municipal Solid Waste. Electricit
	QMSAS	(MNUMCR,MNUMYR)	QUNTY tBTU MS ALLSEC	Municipal Solid Waste. All Sector
	QSTRS	(MNUMCR,MNUMYR)	QUNTY tBTU ST RESIDN	Solar Thermal. Residential
	QSTCM	(MNUMCR,MNUMYR)	QUNTY tBTU ST COMMER	Solar Thermal. Commercial
	QSTIN	(MNUMCR,MNUMYR)	QUNTY tBTU ST INDUST	Solar Thermal. Industrial
	QSTEL	(MNUMCR,MNUMYR)	QUNTY tBTU ST ELECTR	Solar Thermal. Electricity
	QSTAS	(MNUMCR,MNUMYR)	QUNTY tBTU ST ALLSEC	Solar Thermal. All Sectors
	QPVRS	(MNUMCR,MNUMYR)	QUNTY tBTU PV RESIDN	Photovoltaic. Residential
	QPVCM	(MNUMCR,MNUMYR)	QUNTY tBTU PV COMMER	Photovoltaic. Commercial
	QPVIN	(MNUMCR,MNUMYR)	QUNTY tBTU PV INDUST	Photovoltaic. Industrial
	QPVEL	(MNUMCR,MNUMYR)	QUNTY tBTU PV ELECTR	Photovoltaic. Electricity
	QPVAS	(MNUMCR,MNUMYR)	QUNTY tBTU PV ALLSEC	Photovoltaic. All Sectors
	QWIIN	(MNUMCR,MNUMYR)	QUNTY tBTU WI INDUST	Wind. Industrial
	QWIEL	(MNUMCR,MNUMYR)	QUNTY tBTU WI ELECTR	Wind. Electricity
	QWIAS	(MNUMCR,MNUMYR)	QUNTY tBTU WI ALLSEC	Wind. All Sectors
	QTRRS	(MNUMCR,MNUMYR)	QUNTY tBTU TR RESIDN	Total Renewables. Residential
	QTRCM	(MNUMCR,MNUMYR)	QUNTY tBTU TR COMMER	Total Renewables. Commercial
	QTRTR	(MNUMCR,MNUMYR)	QUNTY tBTU TR TRANSP	Total Renewables. Transportation
	QTRIN	(MNUMCR,MNUMYR)	QUNTY tBTU TR INDUST	Total Renewables. Industrial
	QTREL	(MNUMCR,MNUMYR)	QUNTY tBTU TR ELECTR	Total Renewables. Electricity
	QTRSN	(MNUMCR,MNUMYR)	QUNTY tBTU TR SYNTHE	Total Renewables. Synthetics
	QTRAS	(MNUMCR,MNUMYR)	QUNTY tBTU TR ALLSEC	Total Renewables. All Sectors
	QEIEL	(MNUMCR,MNUMYR)	QUNTY tBTU EI ELECTR	Net Electricity Imports. Electric
	QCIIN	(MNUMCR,MNUMYR)	QUNTY tBTU CI INDUST	Net Coal Coke Imports. Industrial
	QTSRS	(MNUMCR,MNUMYR)	QUNTY tBTU TS RESIDN	Total Sectoral Energy Consumption.
	QTSCM	(MNUMCR,MNUMYR)	QUNTY tBTU TS COMMER	Total Sectoral Energy Consumption.
	QTSTR	(MNUMCR,MNUMYR)	QUNTY tBTU TS TRANSP	Total Sectoral Energy Consumption.
	QTSIN	(MNUMCR,MNUMYR)	QUNTY tBTU TS INDUST	Total Sectoral Energy Consumption.
	QTSRF	(MNUMCR,MNUMYR)	QUNTY tBTU TS REFINE	Total Sectoral Energy Consumption.
	QTSEL	(MNUMCR,MNUMYR)	QUNTY tBTU TS ELECTR	Total Sectoral Energy Consumption.
	QTSSN	(MNUMCR,MNUMYR)	QUNTY tBTU TS SYNTHE	Total Sectoral Energy Consumption.
	QTSAS	(MNUMCR,MNUMYR)	QUNTY tBTU TS ALLSEC	Total Sectoral Energy Consumption.
*========	================	====== ====== ====== ====== ======	====== ====== ====== ======	==================================
* PRICES Common Block				
*========	================	====== ====== ====== ====== ======	====== ====== ====== ======	==================================
MPBLK			TYPE UNITS FUEL SECTOR	
	PEPRS	(MNUMCR,MNUMYR)	PRICE 87$BTU EP RESIDN	Purchased Electricity, Peak. Resi
	PEPCM	(MNUMCR,MNUMYR)	PRICE 87$BTU EP COMMER	Purchased Electricity, Peak. Comm
	PEPTR	(MNUMCR,MNUMYR)	PRICE 87$BTU EP TRANSP	Purchased Electricity, Peak. Tran
	PEPIN	(MNUMCR,MNUMYR)	PRICE 87$BTU EP INDUST	Purchased Electricity, Peak. Indu
	PEPAS	(MNUMCR,MNUMYR)	PRICE 87$BTU EP ALLSEC	Purchased Electricity, Peak. Refi
	PENRS	(MNUMCR,MNUMYR)	PRICE 87$BTU EN RESIDN	Purchased Electricity, Nonpeak. R
	PENCM	(MNUMCR,MNUMYR)	PRICE 87$BTU EN COMMER	Purchased Electricity, Nonpeak. C
	PENTR	(MNUMCR,MNUMYR)	PRICE 87$BTU EN TRANSP	Purchased Electricity, Nonpeak. T
	PENIN	(MNUMCR,MNUMYR)	PRICE 87$BTU EN INDUST	Purchased Electricity, Nonpeak. I
	PENAS	(MNUMCR,MNUMYR)	PRICE 87$BTU EN ALLSEC	Purchased Electricity, Nonpeak. A
	PELRS	(MNUMCR,MNUMYR)	PRICE 87$BTU EL RESIDN	Purchased Electricity. Residentia

COMMON Block Name	Variable Name	Variable Dimensions	Variable Descriptors	Variable Descriptio
	PELCM	(MNUMCR,MNUMYR)	PRICE 87$BTU EL COMMER	Purchased Electricity. Commercial
	PELTR	(MNUMCR,MNUMYR)	PRICE 87$BTU EL TRANSP	Purchased Electricity. Transporta
	PELIN	(MNUMCR,MNUMYR)	PRICE 87$BTU EL INDUST	Purchased Electricity. Industrial
	PELAS	(MNUMCR,MNUMYR)	PRICE 87$BTU EL ALLSEC	Purchased Electricity. All Sector
	PGFRS	(MNUMCR,MNUMYR)	PRICE 87$BTU GF RESIDN	Natural Gas, Core. Residential
	PGFCM	(MNUMCR,MNUMYR)	PRICE 87$BTU GF COMMER	Natural Gas, Core. Commercial
	PGFTR	(MNUMCR,MNUMYR)	PRICE 87$BTU GF TRANSP	Natural Gas, Core. Transportation
	PGFIN	(MNUMCR,MNUMYR)	PRICE 87$BTU GF INDUST	Natural Gas, Core. Industrial
	PGFEL	(MNUMCR,MNUMYR)	PRICE 87$BTU GF ELECTR	Natural Gas, Core. Electricity
	PGFAS	(MNUMCR,MNUMYR)	PRICE 87$BTU GF ALLSEC	Natural Gas, Core. All Sectors
	PGIRS	(MNUMCR,MNUMYR)	PRICE 87$BTU GI RESIDN	Natural Gas, Noncore. Residential
	PGICM	(MNUMCR,MNUMYR)	PRICE 87$BTU GI COMMER	Natural Gas, Noncore. Commercial
	PGITR	(MNUMCR,MNUMYR)	PRICE 87$BTU GI TRANSP	Natural Gas, Noncore. Transportat
	PGIIN	(MNUMCR,MNUMYR)	PRICE 87$BTU GI INDUST	Natural Gas, Noncore. Industrial
	PGIEL	(MNUMCR,MNUMYR)	PRICE 87$BTU GI ELECTR	Natural Gas, Noncore. Electricity
	PGIAS	(MNUMCR,MNUMYR)	PRICE 87$BTU GI ALLSEC	Natural Gas, Noncore. All Sectors
	PNGRS	(MNUMCR,MNUMYR)	PRICE 87$BTU NG RESIDN	Natural Gas. Residential
	PNGCM	(MNUMCR,MNUMYR)	PRICE 87$BTU NG COMMER	Natural Gas. Commercial
	PNGTR	(MNUMCR,MNUMYR)	PRICE 87$BTU NG TRANSP	Natural Gas. Transportation
	PNGIN	(MNUMCR,MNUMYR)	PRICE 87$BTU NG INDUST	Natural Gas. Industrial
	PNGEL	(MNUMCR,MNUMYR)	PRICE 87$BTU NG ELECTR	Natural Gas. Electricity
	PNGAS	(MNUMCR,MNUMYR)	PRICE 87$BTU NG ALLSEC	Natural Gas. All Sectors
	PGPTR	(MNUMCR,MNUMYR)	PRICE 87$BTU GP TRANSP	Natural Gas. Pipeline
	PLPIN	(MNUMCR,MNUMYR)	PRICE 87$BTU LP INDUST	Lease and Plant Fuel
	PCLRS	(MNUMCR,MNUMYR)	PRICE 87$BTU CL RESIDN	Coal. Residential
	PCLCM	(MNUMCR,MNUMYR)	PRICE 87$BTU CL COMMER	Coal. Commercial
	PCLIN	(MNUMCR,MNUMYR)	PRICE 87$BTU CL INDUST	Coal. Industrial
	PCLEL	(MNUMCR,MNUMYR)	PRICE 87$BTU CL ELECTR	Coal. Electricity
	PCLSN	(MNUMCR,MNUMYR)	PRICE 87$BTU CL SYNTHE	Coal. Synthetics
	PCLAS	(MNUMCR,MNUMYR)	PRICE 87$BTU CL ALLSEC	Coal. All Sectors
	PMCIN	(MNUMCR,MNUMYR)	PRICE 87$BTU MC INDUST	Metallurgical Coal. Industrial
	PMGCM	(MNUMCR,MNUMYR)	PRICE 87$BTU MG COMMER	Motor Gasoline. Commercial
	PMGTR	(MNUMCR,MNUMYR)	PRICE 87$BTU MG TRANSP	Motor Gasoline. Transportation
	PMGIN	(MNUMCR,MNUMYR)	PRICE 87$BTU MG INDUST	Motor Gasoline. Industrial
	PMGAS	(MNUMCR,MNUMYR)	PRICE 87$BTU MG ALLSEC	Motor Gasoline. All Sectors
	PJFTR	(MNUMCR,MNUMYR)	PRICE 87$BTU JF TRANSP	Jet Fuel. Transportation
	PDSRS	(MNUMCR,MNUMYR)	PRICE 87$BTU DS RESIDN	Distillate. Residential
	PDSCM	(MNUMCR,MNUMYR)	PRICE 87$BTU DS COMMER	Distillate. Commercial
	PDSTR	(MNUMCR,MNUMYR)	PRICE 87$BTU DS TRANSP	Distillate. Transportation
	PDSIN	(MNUMCR,MNUMYR)	PRICE 87$BTU DS INDUST	Distillate. Industrial
	PDSEL	(MNUMCR,MNUMYR)	PRICE 87$BTU DS ELECTR	Distillate. Electricity (incl. pe
	PDSAS	(MNUMCR,MNUMYR)	PRICE 87$BTU DS ALLSEC	Distillate. All Sectors
	PKSRS	(MNUMCR,MNUMYR)	PRICE 87$BTU KS RESIDN	Kerosene. Residential
	PKSCM	(MNUMCR,MNUMYR)	PRICE 87$BTU KS COMMER	Kerosene. Commercial
	PKSIN	(MNUMCR,MNUMYR)	PRICE 87$BTU KS INDUST	Kerosene. Industrial
	PKSAS	(MNUMCR,MNUMYR)	PRICE 87$BTU KS ALLSEC	Kerosene. All Sectors
	PLGRS	(MNUMCR,MNUMYR)	PRICE 87$BTU LG RESIDN	Liquid Petroleum Gases. Residenti
	PLGCM	(MNUMCR,MNUMYR)	PRICE 87$BTU LG COMMER	Liquid Petroleum Gases. Commercia
	PLGTR	(MNUMCR,MNUMYR)	PRICE 87$BTU LG TRANSP	Liquid Petroleum Gases. Transporta
	PLGIN	(MNUMCR,MNUMYR)	PRICE 87$BTU LG INDUST	Liquid Petroleum Gases. Industria
	PLGAS	(MNUMCR,MNUMYR)	PRICE 87$BTU LG ALLSEC	Liquid Petroleum Gases. All Secto
	PRLCM	(MNUMCR,MNUMYR)	PRICE 87$BTU RL COMMER	Residual Fuel, Low Sulfur. Commer
	PRLTR	(MNUMCR,MNUMYR)	PRICE 87$BTU RL TRANSP	Residual Fuel, Low Sulfur. Transp
	PRLIN	(MNUMCR,MNUMYR)	PRICE 87$BTU RL INDUST	Residual Fuel, Low Sulfur. Indust
	PRLEL	(MNUMCR,MNUMYR)	PRICE 87$BTU RL ELECTR	Residual Fuel, Low Sulfur. Electr
	PRLAS	(MNUMCR,MNUMYR)	PRICE 87$BTU RL ALLSEC	Residual Fuel, Low Sulfur. All Se
	PRHTR	(MNUMCR,MNUMYR)	PRICE 87$BTU RH TRANSP	Residual Fuel, High Sulfur. Trans
	PRHEL	(MNUMCR,MNUMYR)	PRICE 87$BTU RH ELECTR	Residual Fuel, High Sulfur. Elect

COMMON Block Name	Variable Name	Variable Dimensions	Variable Descriptors				Variable Description
	PRHAS	(MNUMCR,MNUMYR)	PRICE	87$BTU	RH	ALLSEC	Residual Fuel, High Sulfur. All S
	PRSCM	(MNUMCR,MNUMYR)	PRICE	87$BTU	RS	COMMER	Residual Fuel. Commercial
	PRSTR	(MNUMCR,MNUMYR)	PRICE	87$BTU	RS	TRANSP	Residual Fuel. Transportation
	PRSIN	(MNUMCR,MNUMYR)	PRICE	87$BTU	RS	INDUST	Residual Fuel. Industrial
	PRSEL	(MNUMCR,MNUMYR)	PRICE	87$BTU	RS	ELECTR	Residual Fuel. Electricity
	PRSAS	(MNUMCR,MNUMYR)	PRICE	87$BTU	RS	ALLSEC	Residual Fuel. All Sectors
	PPFIN	(MNUMCR,MNUMYR)	PRICE	87$BTU	PF	INDUST	Petrochemical Feedstocks. Industr
	PASIN	(MNUMCR,MNUMYR)	PRICE	87$BTU	AS	INDUST	Asphalt, Road Oil. Industrial
	POTTR	(MNUMCR,MNUMYR)	PRICE	87$BTU	OT	TRANSP	Other. Transporation
	POTIN	(MNUMCR,MNUMYR)	PRICE	87$BTU	OT	INDUST	Other. Industrial
	POTAS	(MNUMCR,MNUMYR)	PRICE	87$BTU	OT	ALLSEC	Other. All Sectors
	PTPRS	(MNUMCR,MNUMYR)	PRICE	87$BTU	TP	RESIDN	Total Petroleum. Residential
	PTPCM	(MNUMCR,MNUMYR)	PRICE	87$BTU	TP	COMMER	Total Petroleum. Commercial
	PTPTR	(MNUMCR,MNUMYR)	PRICE	87$BTU	TP	TRANSP	Total Petroleum. Transportation
	PTPIN	(MNUMCR,MNUMYR)	PRICE	87$BTU	TP	INDUST	Total Petroleum. Industrial
	PTPRF	(MNUMCR,MNUMYR)	PRICE	87$BTU	TP	REFINE	Total Petroleum. Refinery
	PTPEL	(MNUMCR,MNUMYR)	PRICE	87$BTU	TP	ELECTR	Total Petroleum. Electricity
	PTPAS	(MNUMCR,MNUMYR)	PRICE	87$BTU	TP	ALLSEC	Total Petroleum. All Sectors
	PMETR	(MNUMCR,MNUMYR)	PRICE	87$BTU	ME	TRANSP	Methanol. Transporation
	PETTR	(MNUMCR,MNUMYR)	PRICE	87$BTU	ET	TRANSP	Ethanol. Transporation
	PHYTR	(MNUMCR,MNUMYR)	PRICE	87$BTU	HY	TRANSP	Liquid Hydrogen. Transporation
	PUREL	(MNUMCR,MNUMYR)	PRICE	87$BTU	UR	ELECTR	Uranium. Electricity
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* Expected Value (QUANTITY) Common Block							
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MXQBLK			TYPE	UNITS	FUEL	SECTOR	
	XQEPRS	(MNUMCR,MNXYRS)	XQUNTY	tBTU	EP	RESIDN	Purchased Electricity, Peak. Resi
	XQEPCM	(MNUMCR,MNXYRS)	XQUNTY	tBTU	EP	COMMER	Purchased Electricity, Peak. Comm
	XQEPTR	(MNUMCR,MNXYRS)	XQUNTY	tBTU	EP	TRANSP	Purchased Electricity, Peak. Tran
	XQEPIN	(MNUMCR,MNXYRS)	XQUNTY	tBTU	EP	INDUST	Purchased Electricity, Peak. Indu
	XQEPRF	(MNUMCR,MNXYRS)	XQUNTY	tBTU	EP	REFINE	Purchased Electricity, Peak. Refi
	XQEPAS	(MNUMCR,MNXYRS)	XQUNTY	tBTU	EP	ALLSEC	Purchased Electricity, Peak. All
	XQENRS	(MNUMCR,MNXYRS)	XQUNTY	tBTU	EN	RESIDN	Purchased Electricity, Nonpeak. R
	XQENCM	(MNUMCR,MNXYRS)	XQUNTY	tBTU	EN	COMMER	Purchased Electricity, Nonpeak. C
	XQENTR	(MNUMCR,MNXYRS)	XQUNTY	tBTU	EN	TRANSP	Purchased Electricity, Nonpeak. T
	XQENIN	(MNUMCR,MNXYRS)	XQUNTY	tBTU	EN	INDUST	Purchased Electricity, Nonpeak. I
	XQENRF	(MNUMCR,MNXYRS)	XQUNTY	tBTU	EN	REFINE	Purchased Electricity, Nonpeak. R
	XQENAS	(MNUMCR,MNXYRS)	XQUNTY	tBTU	EN	ALLSEC	Purchased Electricity, Nonpeak. A
	XQELRS	(MNUMCR,MNXYRS)	XQUNTY	tBTU	EL	RESIDN	Purchased Electricity. Residentia
	XQELCM	(MNUMCR,MNXYRS)	XQUNTY	tBTU	EL	COMMER	Purchased Electricity. Commercial
	XQELTR	(MNUMCR,MNXYRS)	XQUNTY	tBTU	EL	TRANSP	Purchased Electricity. Transporta
	XQELIN	(MNUMCR,MNXYRS)	XQUNTY	tBTU	EL	INDUST	Purchased Electricity. Industrial
	XQELRF	(MNUMCR,MNXYRS)	XQUNTY	tBTU	EL	REFINE	Purchased Electricity. Refinery
	XQELAS	(MNUMCR,MNXYRS)	XQUNTY	tBTU	EL	ALLSEC	Purchased Electricity. All Sector
	XQGFRS	(MNUMCR,MNXYRS)	XQUNTY	tBTU	GF	RESIDN	Natural Gas, Core. Residential
	XQGFCM	(MNUMCR,MNXYRS)	XQUNTY	tBTU	GF	COMMER	Natural Gas, Core. Commercial
	XQGFTR	(MNUMCR,MNXYRS)	XQUNTY	tBTU	GF	TRANSP	Natural Gas, Core. Transportation
	XQGFIN	(MNUMCR,MNXYRS)	XQUNTY	tBTU	GF	INDUST	Natural Gas, Core. Industrial
	XQGFRF	(MNUMCR,MNXYRS)	XQUNTY	tBTU	GF	REFINE	Natural Gas, Core. Refinery
	XQGFEL	(MNUMCR,MNXYRS)	XQUNTY	tBTU	GF	ELECTR	Natural Gas, Core. Electricity
	XQGFAS	(MNUMCR,MNXYRS)	XQUNTY	tBTU	GF	ALLSEC	Natural Gas, Core. All Sectors
	XQGIRS	(MNUMCR,MNXYRS)	XQUNTY	tBTU	GI	RESIDN	Natural Gas, Noncore. Residential
	XQGICM	(MNUMCR,MNXYRS)	XQUNTY	tBTU	GI	COMMER	Natural Gas, Noncore. Commercial
	XQGITR	(MNUMCR,MNXYRS)	XQUNTY	tBTU	GI	TRANSP	Natural Gas, Noncore. Transportat
	XQGIIN	(MNUMCR,MNXYRS)	XQUNTY	tBTU	GI	INDUST	Natural Gas, Noncore. Industrial
	XQGIRF	(MNUMCR,MNXYRS)	XQUNTY	tBTU	GI	REFINE	Natural Gas, Noncore. Refinery
	XQGIEL	(MNUMCR,MNXYRS)	XQUNTY	tBTU	GI	ELECTR	Natural Gas, Noncore. Electricity
	XQGIAS	(MNUMCR,MNXYRS)	XQUNTY	tBTU	GI	ALLSEC	Natural Gas, Noncore. All Sectors

COMMON Block Name	Variable Name	Variable Dimensions	Variable Descriptors	Variable Description
	XQNGRS	(MNUMCR,MNXYRS)	XQUNTY tBTU NG	RESIDN Natural Gas. Residential
	XQNGCM	(MNUMCR,MNXYRS)	XQUNTY tBTU NG	COMMER Natural Gas. Commercial
	XQNGTR	(MNUMCR,MNXYRS)	XQUNTY tBTU NG	TRANSP Natural Gas. Transportation
	XQNGIN	(MNUMCR,MNXYRS)	XQUNTY tBTU NG	INDUST Natural Gas. Industrial
	XQNGRF	(MNUMCR,MNXYRS)	XQUNTY tBTU NG	REFINE Natural Gas. Refinery
	XQNGEL	(MNUMCR,MNXYRS)	XQUNTY tBTU NG	ELECTR Natural Gas. Electricity
	XQNGAS	(MNUMCR,MNXYRS)	XQUNTY tBTU NG	ALLSEC Natural Gas. All Sectors
	XQGPTR	(MNUMCR,MNXYRS)	XQUNTY tBTU GP	TRANSP Natural Gas. Pipeline
	XQLPIN	(MNUMCR,MNXYRS)	XQUNTY tBTU LP	INDUST Lease and Plant Fuel
	XQCLRS	(MNUMCR,MNXYRS)	XQUNTY tBTU CL	RESIDN Coal. Residential
	XQCLCM	(MNUMCR,MNXYRS)	XQUNTY tBTU CL	COMMER Coal. Commercial
	XQCLIN	(MNUMCR,MNXYRS)	XQUNTY tBTU CL	INDUST Coal. Industrial
	XQCLRF	(MNUMCR,MNXYRS)	XQUNTY tBTU CL	REFINE Coal. Refinery
	XQCLEL	(MNUMCR,MNXYRS)	XQUNTY tBTU CL	ELECTR Coal. Electricity
	XQCLSN	(MNUMCR,MNXYRS)	XQUNTY tBTU CL	SYNTHE Coal. Synthetics
	XQCLAS	(MNUMCR,MNXYRS)	XQUNTY tBTU CL	ALLSEC Coal. All Sectors
	XQMCIN	(MNUMCR,MNXYRS)	XQUNTY tBTU MC	INDUST Metallurgical Coal. Industrial
	XQMGCM	(MNUMCR,MNXYRS)	XQUNTY tBTU MG	COMMER Motor Gasoline. Commercial
	XQMGTR	(MNUMCR,MNXYRS)	XQUNTY tBTU MG	TRANSP Motor Gasoline. Transportation
	XQMGIN	(MNUMCR,MNXYRS)	XQUNTY tBTU MG	INDUST Motor Gasoline. Industrial
	XQMGAS	(MNUMCR,MNXYRS)	XQUNTY tBTU MG	ALLSEC Motor Gasoline. All Sectors
	XQJFTR	(MNUMCR,MNXYRS)	XQUNTY tBTU JF	TRANSP Jet Fuel. Transportation
	XQDSRS	(MNUMCR,MNXYRS)	XQUNTY tBTU DS	RESIDN Distillate. Residential
	XQDSCM	(MNUMCR,MNXYRS)	XQUNTY tBTU DS	COMMER Distillate. Commercial
	XQDSTR	(MNUMCR,MNXYRS)	XQUNTY tBTU DS	TRANSP Distillate. Transportation
	XQDSIN	(MNUMCR,MNXYRS)	XQUNTY tBTU DS	INDUST Distillate. Industrial
	XQDSRF	(MNUMCR,MNXYRS)	XQUNTY tBTU DS	REFINE Distillate. Refinery
	XQDSEL	(MNUMCR,MNXYRS)	XQUNTY tBTU DS	ELECTR Distillate. Electricity (incl. pe
	XQDSAS	(MNUMCR,MNXYRS)	XQUNTY tBTU DS	ALLSEC Distillate. All Sectors
	XQKSRS	(MNUMCR,MNXYRS)	XQUNTY tBTU KS	RESIDN Kerosene. Residential
	XQKSCM	(MNUMCR,MNXYRS)	XQUNTY tBTU KS	COMMER Kerosene. Commercial
	XQKSIN	(MNUMCR,MNXYRS)	XQUNTY tBTU KS	INDUST Kerosene. Industrial
	XQKSAS	(MNUMCR,MNXYRS)	XQUNTY tBTU KS	ALLSEC Kerosene. All Sectors
	XQLGRS	(MNUMCR,MNXYRS)	XQUNTY tBTU LG	RESIDN Liquid Petroleum Gases. Residenti
	XQLGCM	(MNUMCR,MNXYRS)	XQUNTY tBTU LG	COMMER Liquid Petroleum Gases. Commercia
	XQLGTR	(MNUMCR,MNXYRS)	XQUNTY tBTU LG	TRANSP Liquid Petroleum Gases. Transport
	XQLGIN	(MNUMCR,MNXYRS)	XQUNTY tBTU LG	INDUST Liquid Petroleum Gases. Industria
	XQLGRF	(MNUMCR,MNXYRS)	XQUNTY tBTU LG	REFINE Liquid Petroleum Gases. Refinery
	XQLGAS	(MNUMCR,MNXYRS)	XQUNTY tBTU LG	ALLSEC Liquid Petroleum Gases. All Secto
	XQRLCM	(MNUMCR,MNXYRS)	XQUNTY tBTU RL	COMMER Residual Fuel, Low Sulfur. Commer
	XQRLTR	(MNUMCR,MNXYRS)	XQUNTY tBTU RL	TRANSP Residual Fuel, Low Sulfur. Transp
	XQRLIN	(MNUMCR,MNXYRS)	XQUNTY tBTU RL	INDUST Residual Fuel, Low Sulfur. Indust
	XQRLRF	(MNUMCR,MNXYRS)	XQUNTY tBTU RL	REFINE Residual Fuel, Low Sulfur. Refine
	XQRLEL	(MNUMCR,MNXYRS)	XQUNTY tBTU RL	ELECTR Residual Fuel, Low Sulfur. Electr
	XQRLAS	(MNUMCR,MNXYRS)	XQUNTY tBTU RL	ALLSEC Residual Fuel, Low Sulfur. All Se
	XQRHTR	(MNUMCR,MNXYRS)	XQUNTY tBTU RH	TRANSP Residual Fuel, High Sulfur. Trans
	XQRHEL	(MNUMCR,MNXYRS)	XQUNTY tBTU RH	ELECTR Residual Fuel, High Sulfur. Elect
	XQRHAS	(MNUMCR,MNXYRS)	XQUNTY tBTU RH	ALLSEC Residual Fuel, High Sulfur. All S
	XQRSCM	(MNUMCR,MNXYRS)	XQUNTY tBTU RS	COMMER Residual Fuel. Commercial
	XQRSTR	(MNUMCR,MNXYRS)	XQUNTY tBTU RS	TRANSP Residual Fuel. Transportation
	XQRSIN	(MNUMCR,MNXYRS)	XQUNTY tBTU RS	INDUST Residual Fuel. Industrial
	XQRSRF	(MNUMCR,MNXYRS)	XQUNTY tBTU RS	REFINE Residual Fuel. Refinery
	XQRSEL	(MNUMCR,MNXYRS)	XQUNTY tBTU RS	ELECTR Residual Fuel. Electricity
	XQRSAS	(MNUMCR,MNXYRS)	XQUNTY tBTU RS	ALLSEC Residual Fuel. All Sectors
	XQPFIN	(MNUMCR,MNXYRS)	XQUNTY tBTU PF	INDUST Petrochemical Feedstocks. Industr
	XQSGIN	(MNUMCR,MNXYRS)	XQUNTY tBTU SG	INDUST Still Gas. Industrial
	XQSGRF	(MNUMCR,MNXYRS)	XQUNTY tBTU SG	REFINE Still Gas. Refinery
	XQPCIN	(MNUMCR,MNXYRS)	XQUNTY tBTU PC	INDUST Petroleum Coke. Industrial

COMMON Block Name	Variable Name	Variable Dimensions	Variable Descriptors	Variable Descriptio
	XQPCRF	(MNUMCR,MNXYRS)	XQUNTY tBTU PC REFINE	Petroleum Coke. Refinery
	XQPCEL	(MNUMCR,MNXYRS)	XQUNTY tBTU PC ELECTR	Petroleum Coke. Electricity
	XQPCAS	(MNUMCR,MNXYRS)	XQUNTY tBTU PC ALLSEC	Petroleum Coke. All Sectors
	XQASIN	(MNUMCR,MNXYRS)	XQUNTY tBTU AS INDUST	Asphalt and Road Oil. Industrial
	XQOTTR	(MNUMCR,MNXYRS)	XQUNTY tBTU OT TRANSP	Other Petroleum. Trans (lubes, av
	XQOTIN	(MNUMCR,MNXYRS)	XQUNTY tBTU OT INDUST	Other Petroleum. Industrial
	XQOTRF	(MNUMCR,MNXYRS)	XQUNTY tBTU OT REFINE	Other Petroleum. Refinery
	XQOTAS	(MNUMCR,MNXYRS)	XQUNTY tBTU OT ALLSEC	Other Petroleum. All Sectors
	XQTPRS	(MNUMCR,MNXYRS)	XQUNTY tBTU TP RESIDN	Total Petroleum. Residential
	XQTPCM	(MNUMCR,MNXYRS)	XQUNTY tBTU TP COMMER	Total Petroleum. Commercial
	XQTPTR	(MNUMCR,MNXYRS)	XQUNTY tBTU TP TRANSP	Total Petroleum. Transportation
	XQTPIN	(MNUMCR,MNXYRS)	XQUNTY tBTU TP INDUST	Total Petroleum. Industrial
	XQTPRF	(MNUMCR,MNXYRS)	XQUNTY tBTU TP REFINE	Total Petroleum. Refinery
	XQTPEL	(MNUMCR,MNXYRS)	XQUNTY tBTU TP ELECTR	Total Petroleum. Electricity
	XQTPAS	(MNUMCR,MNXYRS)	XQUNTY tBTU TP ALLSEC	Total Petroleum. All Sectors
	XQMETR	(MNUMCR,MNXYRS)	XQUNTY tBTU ME TRANSP	Methanol. Transporation
	XQETTR	(MNUMCR,MNXYRS)	XQUNTY tBTU ET TRANSP	Ethanol. Transporation
	XQHYTR	(MNUMCR,MNXYRS)	XQUNTY tBTU HY TRANSP	Liquid Hydrogen. Transportation
	XQUREL	(MNUMCR,MNXYRS)	XQUNTY tBTU UR ELECTR	Uranium. Electricity
	XQHOIN	(MNUMCR,MNXYRS)	XQUNTY tBTU HO INDUST	Hydropower. Industrial
	XQHOEL	(MNUMCR,MNXYRS)	XQUNTY tBTU HO ELECTR	Hydropower. Electricity
	XQHOAS	(MNUMCR,MNXYRS)	XQUNTY tBTU HO ALLSEC	Hydropower. All Sectors
	XQGEIN	(MNUMCR,MNXYRS)	XQUNTY tBTU GE INDUST	Geothermal. Industrial
	XQGEEL	(MNUMCR,MNXYRS)	XQUNTY tBTU GE ELECTR	Geothermal. Electricity
	XQGEAS	(MNUMCR,MNXYRS)	XQUNTY tBTU GE ALLSEC	Geothermal. All Sectors
	XQBMRS	(MNUMCR,MNXYRS)	XQUNTY tBTU BM RESIDN	Biomass. Residential
	XQBMCM	(MNUMCR,MNXYRS)	XQUNTY tBTU BM COMMER	Biomass. Commercial
	XQBMIN	(MNUMCR,MNXYRS)	XQUNTY tBTU BM INDUST	Biomass. Industrial
	XQBMRF	(MNUMCR,MNXYRS)	XQUNTY tBTU BM REFINE	Biomass. Refinery
	XQBMEL	(MNUMCR,MNXYRS)	XQUNTY tBTU BM ELECTR	Biomass. Electricity
	XQBMSN	(MNUMCR,MNXYRS)	XQUNTY tBTU BM SYNTHE	Biomass. Synthetics
	XQBMAS	(MNUMCR,MNXYRS)	XQUNTY tBTU BM ALLSEC	Biomass. All Sectors
	XQMSIN	(MNUMCR,MNXYRS)	XQUNTY tBTU MS INDUST	Municipal Solid Waste. Industrial
	XQMSEL	(MNUMCR,MNXYRS)	XQUNTY tBTU MS ELECTR	Municipal Solid Waste. Electricit
	XQMSAS	(MNUMCR,MNXYRS)	XQUNTY tBTU MS ALLSEC	Municipal Solid Waste. All Sector
	XQSTRS	(MNUMCR,MNXYRS)	XQUNTY tBTU ST RESIDN	Solar Thermal. Residential
	XQSTCM	(MNUMCR,MNXYRS)	XQUNTY tBTU ST COMMER	Solar Thermal. Commercial
	XQSTIN	(MNUMCR,MNXYRS)	XQUNTY tBTU ST INDUST	Solar Thermal. Industrial
	XQSTEL	(MNUMCR,MNXYRS)	XQUNTY tBTU ST ELECTR	Solar Thermal. Electricity
	XQSTAS	(MNUMCR,MNXYRS)	XQUNTY tBTU ST ALLSEC	Solar Thermal. All Sectors
	XQPVRS	(MNUMCR,MNXYRS)	XQUNTY tBTU PV RESIDN	Photovoltaic. Residential
	XQPVCM	(MNUMCR,MNXYRS)	XQUNTY tBTU PV COMMER	Photovoltaic. Commercial
	XQPVIN	(MNUMCR,MNXYRS)	XQUNTY tBTU PV INDUST	Photovoltaic. Industrial
	XQPVEL	(MNUMCR,MNXYRS)	XQUNTY tBTU PV ELECTR	Photovoltaic. Electricity
	XQPVAS	(MNUMCR,MNXYRS)	XQUNTY tBTU PV ALLSEC	Photovoltaic. All Sectors
	XQWIIN	(MNUMCR,MNXYRS)	XQUNTY tBTU WI INDUST	Wind. Industrial
	XQWIEL	(MNUMCR,MNXYRS)	XQUNTY tBTU WI ELECTR	Wind. Electricity
	XQWIAS	(MNUMCR,MNXYRS)	XQUNTY tBTU WI ALLSEC	Wind. All Sectors
	XQTRRS	(MNUMCR,MNXYRS)	XQUNTY tBTU TR RESIDN	Total Renewables. Residential
	XQTRCM	(MNUMCR,MNXYRS)	XQUNTY tBTU TR COMMER	Total Renewables. Commercial
	XQTRTR	(MNUMCR,MNXYRS)	XQUNTY tBTU TR TRANSP	Total Renewables. Transportation
	XQTRIN	(MNUMCR,MNXYRS)	XQUNTY tBTU TR INDUST	Total Renewables. Industrial
	XQTREL	(MNUMCR,MNXYRS)	XQUNTY tBTU TR ELECTR	Total Renewables. Electricity
	XQTRSN	(MNUMCR,MNXYRS)	XQUNTY tBTU TR SYNTHE	Total Renewables. Synthetics
	XQTRAS	(MNUMCR,MNXYRS)	XQUNTY tBTU TR ALLSEC	Total Renewables. All Sectors
	XQEIEL	(MNUMCR,MNXYRS)	XQUNTY tBTU EI ELECTR	Net Electricity Imports. Electric
	XQCIIN	(MNUMCR,MNXYRS)	XQUNTY tBTU CI INDUST	Net Coal Coke Imports. Industrial
	XQTSRS	(MNUMCR,MNXYRS)	XQUNTY tBTU TS RESIDN	Total Sectoral Energy Consumption.

COMMON Block Name	Variable Name	Variable Dimensions	Variable Descriptors	Variable Descriptio
	XQTSCM	(MNUMCR,MNXYRS)	XQUNTY tBTU TS COMMER	Total Sectoral Energy Consumption.
	XQTSTR	(MNUMCR,MNXYRS)	XQUNTY tBTU TS TRANSP	Total Sectoral Energy Consumption.
	XQTSIN	(MNUMCR,MNXYRS)	XQUNTY tBTU TS INDUST	Total Sectoral Energy Consumption.
	XQTSRF	(MNUMCR,MNXYRS)	XQUNTY tBTU TS REFINE	Total Sectoral Energy Consumption.
	XQTSEL	(MNUMCR,MNXYRS)	XQUNTY tBTU TS ELECTR	Total Sectoral Energy Consumption.
	XQTSSN	(MNUMCR,MNXYRS)	XQUNTY tBTU TS SYNTHE	Total Sectoral Energy Consumption.
	XQTSAS	(MNUMCR,MNXYRS)	XQUNTY tBTU TS ALLSEC	Total Sectoral Energy Consumption.
	XQNGELFN	(21,MNXYRS)	XQUNTY tBTU NG ELECTR	Natural Gas - Firm Consumption.
	XQNGELIN	(21,MNXYRS)	XQUNTY tBTU NG ELECTR	Natural Gas - Interruptible Consum
	XQNGELCN	(21,MNXYRS)	XQUNTY tBTU NG ELECTR	Natural Gas - Competitive Consum.
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* Expected Value (PRICES) Common Block				
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MXPBLK			TYPE UNITS FUEL SECTOR	
	XPEPRS	(MNUMCR,MNXYRS)	XPRICE 87$BTU EP RESIDN	Purchased Electricity, Peak. Resi
	XPEPCM	(MNUMCR,MNXYRS)	XPRICE 87$BTU EP COMMER	Purchased Electricity, Peak. Comm
	XPEPTR	(MNUMCR,MNXYRS)	XPRICE 87$BTU EP TRANSP	Purchased Electricity, Peak. Tran
	XPEPIN	(MNUMCR,MNXYRS)	XPRICE 87$BTU EP INDUST	Purchased Electricity, Peak. Indu
	XPEPAS	(MNUMCR,MNXYRS)	XPRICE 87$BTU EP ALLSEC	Purchased Electricity, Peak. Refi
	XPENRS	(MNUMCR,MNXYRS)	XPRICE 87$BTU EN RESIDN	Purchased Electricity, Nonpeak. R
	XPENCM	(MNUMCR,MNXYRS)	XPRICE 87$BTU EN COMMER	Purchased Electricity, Nonpeak. C
	XPENTR	(MNUMCR,MNXYRS)	XPRICE 87$BTU EN TRANSP	Purchased Electricity, Nonpeak. T
	XPENIN	(MNUMCR,MNXYRS)	XPRICE 87$BTU EN INDUST	Purchased Electricity, Nonpeak. I
	XPENAS	(MNUMCR,MNXYRS)	XPRICE 87$BTU EN ALLSEC	Purchased Electricity, Nonpeak. A
	XPELRS	(MNUMCR,MNXYRS)	XPRICE 87$BTU EL RESIDN	Purchased Electricity. Residentia
	XPELCM	(MNUMCR,MNXYRS)	XPRICE 87$BTU EL COMMER	Purchased Electricity. Commercial
	XPELTR	(MNUMCR,MNXYRS)	XPRICE 87$BTU EL TRANSP	Purchased Electricity. Transporta
	XPELIN	(MNUMCR,MNXYRS)	XPRICE 87$BTU EL INDUST	Purchased Electricity. Industrial
	XPELAS	(MNUMCR,MNXYRS)	XPRICE 87$BTU EL ALLSEC	Purchased Electricity. All Sector
	XPGFRS	(MNUMCR,MNXYRS)	XPRICE 87$BTU GF RESIDN	Natural Gas, Core. Residential
	XPGFCM	(MNUMCR,MNXYRS)	XPRICE 87$BTU GF COMMER	Natural Gas, Core. Commercial
	XPGFTR	(MNUMCR,MNXYRS)	XPRICE 87$BTU GF TRANSP	Natural Gas, Core. Transportation
	XPGFIN	(MNUMCR,MNXYRS)	XPRICE 87$BTU GF INDUST	Natural Gas, Core. Industrial
	XPGFEL	(MNUMCR,MNXYRS)	XPRICE 87$BTU GF ELECTR	Natural Gas, Core. Electricity
	XPGFAS	(MNUMCR,MNXYRS)	XPRICE 87$BTU GF ALLSEC	Natural Gas, Core. All Sectors
	XPGIRS	(MNUMCR,MNXYRS)	XPRICE 87$BTU GI RESIDN	Natural Gas, Noncore. Residential
	XPGICM	(MNUMCR,MNXYRS)	XPRICE 87$BTU GI COMMER	Natural Gas, Noncore. Commercial
	XPGITR	(MNUMCR,MNXYRS)	XPRICE 87$BTU GI TRANSP	Natural Gas, Noncore. Transportat
	XPGIIN	(MNUMCR,MNXYRS)	XPRICE 87$BTU GI INDUST	Natural Gas, Noncore. Industrial
	XPGIEL	(MNUMCR,MNXYRS)	XPRICE 87$BTU GI ELECTR	Natural Gas, Noncore. Electricity
	XPGIAS	(MNUMCR,MNXYRS)	XPRICE 87$BTU GI ALLSEC	Natural Gas, Noncore. All Sectors
	XPNGRS	(MNUMCR,MNXYRS)	XPRICE 87$BTU NG RESIDN	Natural Gas. Residential
	XPNGCM	(MNUMCR,MNXYRS)	XPRICE 87$BTU NG COMMER	Natural Gas. Commercial
	XPNGTR	(MNUMCR,MNXYRS)	XPRICE 87$BTU NG TRANSP	Natural Gas. Transportation
	XPNGIN	(MNUMCR,MNXYRS)	XPRICE 87$BTU NG INDUST	Natural Gas. Industrial
	XPNGEL	(MNUMCR,MNXYRS)	XPRICE 87$BTU NG ELECTR	Natural Gas. Electricity
	XPNGAS	(MNUMCR,MNXYRS)	XPRICE 87$BTU NG ALLSEC	Natural Gas. All Sectors
	XPGPTR	(MNUMCR,MNXYRS)	XPRICE 87$BTU GP TRANSP	Natural Gas. Pipeline
	XPLPIN	(MNUMCR,MNXYRS)	XPRICE 87$BTU LP INDUST	Lease and Plant Fuel
	XPCLRS	(MNUMCR,MNXYRS)	XPRICE 87$BTU CL RESIDN	Coal. Residential
	XPCLCM	(MNUMCR,MNXYRS)	XPRICE 87$BTU CL COMMER	Coal. Commercial
	XPCLIN	(MNUMCR,MNXYRS)	XPRICE 87$BTU CL INDUST	Coal. Industrial
	XPCLEL	(MNUMCR,MNXYRS)	XPRICE 87$BTU CL ELECTR	Coal. Electricity
	XPCLSN	(MNUMCR,MNXYRS)	XPRICE 87$BTU CL SYNTHE	Coal. Synthetics
	XPCLAS	(MNUMCR,MNXYRS)	XPRICE 87$BTU CL ALLSEC	Coal. All Sectors
	XPMCIN	(MNUMCR,MNXYRS)	XPRICE 87$BTU MC INDUST	Metallurgical Coal. Industrial
	XPMGCM	(MNUMCR,MNXYRS)	XPRICE 87$BTU MG COMMER	Motor Gasoline. Commercial
	XPMGTR	(MNUMCR,MNXYRS)	XPRICE 87$BTU MG TRANSP	Motor Gasoline. Transportation

COMMON Block Name	Variable Name	Variable Dimensions	Variable Descriptors	Variable Description
	XPMGIN	(MNUMCR,MNXYRS)	XPRICE 87$BTU MG INDUST	Motor Gasoline. Industrial
	XPMGAS	(MNUMCR,MNXYRS)	XPRICE 87$BTU MG ALLSEC	Motor Gasoline. All Sectors
	XPJFTR	(MNUMCR,MNXYRS)	XPRICE 87$BTU JF TRANSP	Jet Fuel. Transportation
	XPDSRS	(MNUMCR,MNXYRS)	XPRICE 87$BTU DS RESIDN	Distillate. Residential
	XPDSCM	(MNUMCR,MNXYRS)	XPRICE 87$BTU DS COMMER	Distillate. Commercial
	XPDSTR	(MNUMCR,MNXYRS)	XPRICE 87$BTU DS TRANSP	Distillate. Transportation
	XPDSIN	(MNUMCR,MNXYRS)	XPRICE 87$BTU DS INDUST	Distillate. Industrial
	XPDSEL	(MNUMCR,MNXYRS)	XPRICE 87$BTU DS ELECTR	Distillate. Electricity (incl. pe
	XPDSAS	(MNUMCR,MNXYRS)	XPRICE 87$BTU DS ALLSEC	Distillate. All Sectors
	XPKSRS	(MNUMCR,MNXYRS)	XPRICE 87$BTU KS RESIDN	Kerosene. Residential
	XPKSCM	(MNUMCR,MNXYRS)	XPRICE 87$BTU KS COMMER	Kerosene. Commercial
	XPKSIN	(MNUMCR,MNXYRS)	XPRICE 87$BTU KS INDUST	Kerosene. Industrial
	XPKSAS	(MNUMCR,MNXYRS)	XPRICE 87$BTU KS ALLSEC	Kerosene. All Sectors
	XPLGRS	(MNUMCR,MNXYRS)	XPRICE 87$BTU LG RESIDN	Liquid Petroleum Gases. Residenti
	XPLGCM	(MNUMCR,MNXYRS)	XPRICE 87$BTU LG COMMER	Liquid Petroleum Gases. Commercia
	XPLGTR	(MNUMCR,MNXYRS)	XPRICE 87$BTU LG TRANSP	Liquid Petroleum Gases. Transporta
	XPLGIN	(MNUMCR,MNXYRS)	XPRICE 87$BTU LG INDUST	Liquid Petroleum Gases. Industria
	XPLGAS	(MNUMCR,MNXYRS)	XPRICE 87$BTU LG ALLSEC	Liquid Petroleum Gases. All Secto
	XPRLCM	(MNUMCR,MNXYRS)	XPRICE 87$BTU RL COMMER	Residual Fuel, Low Sulfur. Commer
	XPRLTR	(MNUMCR,MNXYRS)	XPRICE 87$BTU RL TRANSP	Residual Fuel, Low Sulfur. Transp
	XPRLIN	(MNUMCR,MNXYRS)	XPRICE 87$BTU RL INDUST	Residual Fuel, Low Sulfur. Indust
	XPRLEL	(MNUMCR,MNXYRS)	XPRICE 87$BTU RL ELECTR	Residual Fuel, Low Sulfur. Electr
	XPRLAS	(MNUMCR,MNXYRS)	XPRICE 87$BTU RL ALLSEC	Residual Fuel, Low Sulfur. All Se
	XPRHTR	(MNUMCR,MNXYRS)	XPRICE 87$BTU RH TRANSP	Residual Fuel, High Sulfur. Trans
	XPRHEL	(MNUMCR,MNXYRS)	XPRICE 87$BTU RH ELECTR	Residual Fuel, High Sulfur. Elect
	XPRHAS	(MNUMCR,MNXYRS)	XPRICE 87$BTU RH ALLSEC	Residual Fuel, High Sulfur. All S
	XPRSCM	(MNUMCR,MNXYRS)	XPRICE 87$BTU RS COMMER	Residual Fuel. Commercial
	XPRSTR	(MNUMCR,MNXYRS)	XPRICE 87$BTU RS TRANSP	Residual Fuel. Transportation
	XPRSIN	(MNUMCR,MNXYRS)	XPRICE 87$BTU RS INDUST	Residual Fuel. Industrial
	XPRSEL	(MNUMCR,MNXYRS)	XPRICE 87$BTU RS ELECTR	Residual Fuel. Electricity
	XPRSAS	(MNUMCR,MNXYRS)	XPRICE 87$BTU RS ALLSEC	Residual Fuel. All Sectors
	XPPFIN	(MNUMCR,MNXYRS)	PRICE 87$BTU PF INDUST	Petrochemical Feedstocks. Industr
	XPASIN	(MNUMCR,MNXYRS)	PRICE 87$BTU AS INDUST	Asphalt, Road Oil. Industrial
	XPOTTR	(MNUMCR,MNXYRS)	XPRICE 87$BTU OT TRANSP	Other. Transporation
	XPOTIN	(MNUMCR,MNXYRS)	XPRICE 87$BTU OT INDUST	Other. Industrial
	XPOTAS	(MNUMCR,MNXYRS)	XPRICE 87$BTU OT ALLSEC	Other. All Sectors
	XPTPRS	(MNUMCR,MNXYRS)	XPRICE 87$BTU TP RESIDN	Total Petroleum. Residential
	XPTPCM	(MNUMCR,MNXYRS)	XPRICE 87$BTU TP COMMER	Total Petroleum. Commercial
	XPTPTR	(MNUMCR,MNXYRS)	XPRICE 87$BTU TP TRANSP	Total Petroleum. Transportation
	XPTPIN	(MNUMCR,MNXYRS)	XPRICE 87$BTU TP INDUST	Total Petroleum. Industrial
	XPTPRF	(MNUMCR,MNXYRS)	XPRICE 87$BTU TP REFINE	Total Petroleum. Refinery
	XPTPEL	(MNUMCR,MNXYRS)	XPRICE 87$BTU TP ELECTR	Total Petroleum. Electricity
	XPTPAS	(MNUMCR,MNXYRS)	XPRICE 87$BTU TP ALLSEC	Total Petroleum. All Sectors
	XPMETR	(MNUMCR,MNXYRS)	XPRICE 87$BTU ME TRANSP	Methanol. Transporation
	XPETTR	(MNUMCR,MNXYRS)	XPRICE 87$BTU ET TRANSP	Ethanol. Transporation
	XPHYTR	(MNUMCR,MNXYRS)	XPRICE 87$BTU HY TRANSP	Liquid Hydrogen. Transporation
	XPUREL	(MNUMCR,MNXYRS)	XPRICE 87$BTU UR ELECTR	Uranium. Electricity
	XIT_WOP	(MNXYRS, 2)	XPRICE 87$BTU WO INTERN	WORLD OIL PRICE (2--UNITS)
	XOGWPRNG	(MNUMOR,MNXYRS)	XPRICE 87$BTU NG PIPELN	NG WELLHEAD PRICE ($87/MCF)
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* History Data From SEDS/Other Sources				
*========	================	====== ====== ====== ====== ======	====== ====== ====== ======	==================================
QSBLK			TYPE UNITS FUEL SECTOR	
	QSEPRS	(MNUMCR,MSEDYR)	HISTOR tBTU EP RESIDN	Purchased Electricity, Peak. Resi
	QSEPCM	(MNUMCR,MSEDYR)	HISTOR tBTU EP COMMER	Purchased Electricity, Peak. Comm
	QSEPTR	(MNUMCR,MSEDYR)	HISTOR tBTU EP TRANSP	Purchased Electricity, Peak. Tran
	QSEPIN	(MNUMCR,MSEDYR)	HISTOR tBTU EP INDUST	Purchased Electricity, Peak. Indu
	QSEPRF	(MNUMCR,MSEDYR)	HISTOR tBTU EP REFINE	Purchased Electricity, Peak. Refi

COMMON Block Name	Variable Name	Variable Dimensions	Variable Descriptors	Variable Descriptio
	QSEPAS	(MNUMCR,MSEDYR)	HISTOR tBTU EP ALLSEC	Purchased Electricity, Peak. All
	QSENRS	(MNUMCR,MSEDYR)	HISTOR tBTU EN RESIDN	Purchased Electricity, Nonpeak. R
	QSENCM	(MNUMCR,MSEDYR)	HISTOR tBTU EN COMMER	Purchased Electricity, Nonpeak. C
	QSENTR	(MNUMCR,MSEDYR)	HISTOR tBTU EN TRANSP	Purchased Electricity, Nonpeak. T
	QSENIN	(MNUMCR,MSEDYR)	HISTOR tBTU EN INDUST	Purchased Electricity, Nonpeak. I
	QSENRF	(MNUMCR,MSEDYR)	HISTOR tBTU EN REFINE	Purchased Electricity, Nonpeak. R
	QSENAS	(MNUMCR,MSEDYR)	HISTOR tBTU EN ALLSEC	Purchased Electricity, Nonpeak. A
	QSELRS	(MNUMCR,MSEDYR)	HISTOR tBTU EL RESIDN	Purchased Electricity. Residentia
	QSELCM	(MNUMCR,MSEDYR)	HISTOR tBTU EL COMMER	Purchased Electricity. Commercial
	QSELTR	(MNUMCR,MSEDYR)	HISTOR tBTU EL TRANSP	Purchased Electricity. Transporta
	QSELIN	(MNUMCR,MSEDYR)	HISTOR tBTU EL INDUST	Purchased Electricity. Industrial
	QSELRF	(MNUMCR,MSEDYR)	HISTOR tBTU EL REFINE	Purchased Electricity. Refinery
	QSELAS	(MNUMCR,MSEDYR)	HISTOR tBTU EL ALLSEC	Purchased Electricity. All Sector
	QSGFRS	(MNUMCR,MSEDYR)	HISTOR tBTU GF RESIDN	Natural Gas, Core. Residential
	QSGFCM	(MNUMCR,MSEDYR)	HISTOR tBTU GF COMMER	Natural Gas, Core. Commercial
	QSGFTR	(MNUMCR,MSEDYR)	HISTOR tBTU GF TRANSP	Natural Gas, Core. Transportation
	QSGFIN	(MNUMCR,MSEDYR)	HISTOR tBTU GF INDUST	Natural Gas, Core. Industrial
	QSGFRF	(MNUMCR,MSEDYR)	HISTOR tBTU GF REFINE	Natural Gas, Core. Refinery
	QSGFEL	(MNUMCR,MSEDYR)	HISTOR tBTU GF ELECTR	Natural Gas, Core. Electricity
	QSGFAS	(MNUMCR,MSEDYR)	HISTOR tBTU GF ALLSEC	Natural Gas, Core. All Sectors
	QSGIRS	(MNUMCR,MSEDYR)	HISTOR tBTU GI RESIDN	Natural Gas, Noncore. Residential
	QSGICM	(MNUMCR,MSEDYR)	HISTOR tBTU GI COMMER	Natural Gas, Noncore. Commercial
	QSGITR	(MNUMCR,MSEDYR)	HISTOR tBTU GI TRANSP	Natural Gas, Noncore. Transportat
	QSGIIN	(MNUMCR,MSEDYR)	HISTOR tBTU GI INDUST	Natural Gas, Noncore. Industrial
	QSGIRF	(MNUMCR,MSEDYR)	HISTOR tBTU GI REFINE	Natural Gas, Noncore. Refinery
	QSGIEL	(MNUMCR,MSEDYR)	HISTOR tBTU GI ELECTR	Natural Gas, Noncore. Electricity
	QSGIAS	(MNUMCR,MSEDYR)	HISTOR tBTU GI ALLSEC	Natural Gas, Noncore. All Sectors
	QSNGRS	(MNUMCR,MSEDYR)	HISTOR tBTU NG RESIDN	Natural Gas. Residential
	QSNGCM	(MNUMCR,MSEDYR)	HISTOR tBTU NG COMMER	Natural Gas. Commercial
	QSNGTR	(MNUMCR,MSEDYR)	HISTOR tBTU NG TRANSP	Natural Gas. Transportation
	QSNGIN	(MNUMCR,MSEDYR)	HISTOR tBTU NG INDUST	Natural Gas. Industrial
	QSNGRF	(MNUMCR,MSEDYR)	HISTOR tBTU NG REFINE	Natural Gas. Refinery
	QSNGEL	(MNUMCR,MSEDYR)	HISTOR tBTU NG ELECTR	Natural Gas. Electricity
	QSNGAS	(MNUMCR,MSEDYR)	HISTOR tBTU NG ALLSEC	Natural Gas. All Sectors
	QSGPTR	(MNUMCR,MSEDYR)	HISTOR tBTU GP TRANSP	Natural Gas. Pipeline
	QSLPIN	(MNUMCR,MSEDYR)	HISTOR tBTU LP INDUST	Lease and Plant Fuel
	QSCLRS	(MNUMCR,MSEDYR)	HISTOR tBTU CL RESIDN	Coal. Residential
	QSCLCM	(MNUMCR,MSEDYR)	HISTOR tBTU CL COMMER	Coal. Commercial
	QSCLIN	(MNUMCR,MSEDYR)	HISTOR tBTU CL INDUST	Coal. Industrial
	QSCLRF	(MNUMCR,MSEDYR)	HISTOR tBTU CL REFINE	Coal. Refinery
	QSCLEL	(MNUMCR,MSEDYR)	HISTOR tBTU CL ELECTR	Coal. Electricity
	QSCLSN	(MNUMCR,MSEDYR)	HISTOR tBTU CL SYNTHE	Coal. Synthetics
	QSCLAS	(MNUMCR,MSEDYR)	HISTOR tBTU CL ALLSEC	Coal. All Sectors
	QSMCIN	(MNUMCR,MSEDYR)	HISTOR tBTU MC INDUST	Metallurgical Coal. Industrial
	QSMGCM	(MNUMCR,MSEDYR)	HISTOR tBTU MG COMMER	Motor Gasoline. Commercial
	QSMGTR	(MNUMCR,MSEDYR)	HISTOR tBTU MG TRANSP	Motor Gasoline. Transportation
	QSMGIN	(MNUMCR,MSEDYR)	HISTOR tBTU MG INDUST	Motor Gasoline. Industrial
	QSMGAS	(MNUMCR,MSEDYR)	HISTOR tBTU MG ALLSEC	Motor Gasoline. All Sectors
	QSJFTR	(MNUMCR,MSEDYR)	HISTOR tBTU JF TRANSP	Jet Fuel. Transportation
	QSDSRS	(MNUMCR,MSEDYR)	HISTOR tBTU DS RESIDN	Distillate. Residential
	QSDSCM	(MNUMCR,MSEDYR)	HISTOR tBTU DS COMMER	Distillate. Commercial
	QSDSTR	(MNUMCR,MSEDYR)	HISTOR tBTU DS TRANSP	Distillate. Transportation
	QSDSIN	(MNUMCR,MSEDYR)	HISTOR tBTU DS INDUST	Distillate. Industrial
	QSDSRF	(MNUMCR,MSEDYR)	HISTOR tBTU DS REFINE	Distillate. Refinery
	QSDSEL	(MNUMCR,MSEDYR)	HISTOR tBTU DS ELECTR	Distillate. Electricity (incl. pe
	QSDSAS	(MNUMCR,MSEDYR)	HISTOR tBTU DS ALLSEC	Distillate. All Sectors
	QSKSRS	(MNUMCR,MSEDYR)	HISTOR tBTU KS RESIDN	Kerosene. Residential
	QSKSCM	(MNUMCR,MSEDYR)	HISTOR tBTU KS COMMER	Kerosene. Commercial

COMMON Block Name	Variable Name	Variable Dimensions	Variable Descriptors	Variable Descriptio
	QSKSIN	(MNUMCR,MSEDYR)	HISTOR tBTU KS INDUST	Kerosene. Industrial
	QSKSAS	(MNUMCR,MSEDYR)	HISTOR tBTU KS ALLSEC	Kerosene. All Sectors
	QSLGRS	(MNUMCR,MSEDYR)	HISTOR tBTU LG RESIDN	Liquid Petroleum Gases. Residenti
	QSLGCM	(MNUMCR,MSEDYR)	HISTOR tBTU LG COMMER	Liquid Petroleum Gases. Commercia
	QSLGTR	(MNUMCR,MSEDYR)	HISTOR tBTU LG TRANSP	Liquid Petroleum Gases. Industria
	QSLGIN	(MNUMCR,MSEDYR)	HISTOR tBTU LG INDUST	Liquid Petroleum Gases. Industria
	QSLGRF	(MNUMCR,MSEDYR)	HISTOR tBTU LG REFINE	Liquid Petroleum Gases. Refinery
	QSLGAS	(MNUMCR,MSEDYR)	HISTOR tBTU LG ALLSEC	Liquid Petroleum Gases. All Secto
	QSRLCM	(MNUMCR,MSEDYR)	HISTOR tBTU RL COMMER	Residual Fuel, Low Sulfur. Commer
	QSRLTR	(MNUMCR,MSEDYR)	HISTOR tBTU RL TRANSP	Residual Fuel, Low Sulfur. Transp
	QSRLIN	(MNUMCR,MSEDYR)	HISTOR tBTU RL INDUST	Residual Fuel, Low Sulfur. Indust
	QSRLRF	(MNUMCR,MSEDYR)	HISTOR tBTU RL REFINE	Residual Fuel, Low Sulfur. Refine
	QSRLEL	(MNUMCR,MSEDYR)	HISTOR tBTU RL ELECTR	Residual Fuel, Low Sulfur. Electr
	QSRLAS	(MNUMCR,MSEDYR)	HISTOR tBTU RL ALLSEC	Residual Fuel, Low Sulfur. All Se
	QSRHTR	(MNUMCR,MSEDYR)	HISTOR tBTU RH TRANSP	Residual Fuel, High Sulfur. Trans
	QSRHEL	(MNUMCR,MSEDYR)	HISTOR tBTU RH ELECTR	Residual Fuel, High Sulfur. Elect
	QSRHAS	(MNUMCR,MSEDYR)	HISTOR tBTU RH ALLSEC	Residual Fuel, High Sulfur. All S
	QSRSCM	(MNUMCR,MSEDYR)	HISTOR tBTU RS COMMER	Residual Fuel. Commercial
	QSRSTR	(MNUMCR,MSEDYR)	HISTOR tBTU RS TRANSP	Residual Fuel. Transportation
	QSRSIN	(MNUMCR,MSEDYR)	HISTOR tBTU RS INDUST	Residual Fuel. Industrial
	QSRSRF	(MNUMCR,MSEDYR)	HISTOR tBTU RS REFINE	Residual Fuel. Refinery
	QSRSEL	(MNUMCR,MSEDYR)	HISTOR tBTU RS ELECTR	Residual Fuel. Electricity
	QSRSAS	(MNUMCR,MSEDYR)	HISTOR tBTU RS ALLSEC	Residual Fuel. All Sectors
	QSPFIN	(MNUMCR,MSEDYR)	HISTOR tBTU PF INDUST	Petrochemical Feedstocks. Industr
	QSSGIN	(MNUMCR,MSEDYR)	HISTOR tBTU SG INDUST	Still Gas. Industrial
	QSSGRF	(MNUMCR,MSEDYR)	HISTOR tBTU SG REFINE	Still Gas. Refinery
	QSPCIN	(MNUMCR,MSEDYR)	HISTOR tBTU PC INDUST	Petroleum Coke. Industrial
	QSPCRF	(MNUMCR,MSEDYR)	HISTOR tBTU PC REFINE	Petroleum Coke. Refinery
	QSPCEL	(MNUMCR,MSEDYR)	HISTOR tBTU PC ELECTR	Petroleum Coke. Refinery
	QSPCAS	(MNUMCR,MSEDYR)	HISTOR tBTU PC ALLSEC	Petroleum Coke. All Sectors
	QSASIN	(MNUMCR,MSEDYR)	HISTOR tBTU AS INDUST	Asphalt and Road Oil. Industrial
	QSOTTR	(MNUMCR,MSEDYR)	HISTOR tBTU OT TRANSP	Other Petroleum. Trans (lubes, av
	QSOTIN	(MNUMCR,MSEDYR)	HISTOR tBTU OT INDUST	Other Petroleum. Industrial
	QSOTRF	(MNUMCR,MSEDYR)	HISTOR tBTU OT REFINE	Other Petroleum. Refinery
	QSOTAS	(MNUMCR,MSEDYR)	HISTOR tBTU OT ALLSEC	Other Petroleum. All Sectors
	QSTPRS	(MNUMCR,MSEDYR)	HISTOR tBTU TP RESIDN	Total Petroleum. Residential
	QSTPCM	(MNUMCR,MSEDYR)	HISTOR tBTU TP COMMER	Total Petroleum. Commercial
	QSTPTR	(MNUMCR,MSEDYR)	HISTOR tBTU TP TRANSP	Total Petroleum. Transportation
	QSTPIN	(MNUMCR,MSEDYR)	HISTOR tBTU TP INDUST	Total Petroleum. Industrial
	QSTPRF	(MNUMCR,MSEDYR)	HISTOR tBTU TP REFINE	Total Petroleum. Refinery
	QSTPEL	(MNUMCR,MSEDYR)	HISTOR tBTU TP ELECTR	Total Petroleum. Electricity
	QSTPAS	(MNUMCR,MSEDYR)	HISTOR tBTU TP ALLSEC	Total Petroleum. All Sectors
	QSMETR	(MNUMCR,MSEDYR)	HISTOR tBTU ME TRANSP	Methanol. Transporation
	QSETTR	(MNUMCR,MSEDYR)	HISTOR tBTU ET TRANSP	Methanol. Transporation
	QSHYTR	(MNUMCR,MSEDYR)	HISTOR tBTU HY TRANSP	Methanol. Transporation
	QSUREL	(MNUMCR,MSEDYR)	HISTOR tBTU UR ELECTR	Uranium. Electricity
	QSHOIN	(MNUMCR,MSEDYR)	HISTOR tBTU HO INDUST	Hydropower. Industrial
	QSHOEL	(MNUMCR,MSEDYR)	HISTOR tBTU HO ELECTR	Hydropower. Electricity
	QSHOAS	(MNUMCR,MSEDYR)	HISTOR tBTU HO ALLSEC	Hydropower. All Sectors
	QSGEIN	(MNUMCR,MSEDYR)	HISTOR tBTU GE INDUST	Geothermal. Industrial
	QSGEEL	(MNUMCR,MSEDYR)	HISTOR tBTU GE ELECTR	Geothermal. Electricity
	QSGEAS	(MNUMCR,MSEDYR)	HISTOR tBTU GE ALLSEC	Geothermal. All Sectors
	QSBMRS	(MNUMCR,MSEDYR)	HISTOR tBTU BM RESIDN	Biomass. Residential
	QSBMCM	(MNUMCR,MSEDYR)	HISTOR tBTU BM COMMER	Biomass. Commercial
	QSBMIN	(MNUMCR,MSEDYR)	HISTOR tBTU BM INDUST	Biomass. Industrial
	QSBMRF	(MNUMCR,MSEDYR)	HISTOR tBTU BM REFINE	Biomass. Industrial
	QSBMEL	(MNUMCR,MSEDYR)	HISTOR tBTU BM ELECTR	Biomass. Electricity
	QSBMSN	(MNUMCR,MSEDYR)	HISTOR tBTU BM SYNTHE	Biomass. Synthetics

COMMON Block Name	Variable Name	Variable Dimensions	Variable Descriptors	Variable Description
	QSBMAS	(MNUMCR,MSEDYR)	HISTOR tBTU BM ALLSEC	Biomass. All Sectors
	QSMSIN	(MNUMCR,MSEDYR)	HISTOR tBTU MS INDUST	Municipal Solid Waste. Industrial
	QSMSEL	(MNUMCR,MSEDYR)	HISTOR tBTU MS ELECTR	Municipal Solid Waste. Electricit
	QSMSAS	(MNUMCR,MSEDYR)	HISTOR tBTU MS ALLSEC	Municipal Solid Waste. All Sector
	QSSTRS	(MNUMCR,MSEDYR)	HISTOR tBTU ST RESIDN	Solar Thermal. Residential
	QSSTCM	(MNUMCR,MSEDYR)	HISTOR tBTU ST COMMER	Solar Thermal. Commercial
	QSSTIN	(MNUMCR,MSEDYR)	HISTOR tBTU ST INDUST	Solar Thermal. Industrial
	QSSTEL	(MNUMCR,MSEDYR)	HISTOR tBTU ST ELECTR	Solar Thermal. Electricity
	QSSTAS	(MNUMCR,MSEDYR)	HISTOR tBTU ST ALLSEC	Solar Thermal. All Sectors
	QSPVRS	(MNUMCR,MSEDYR)	HISTOR tBTU PV RESIDN	Photovoltaic. Residential
	QSPVCM	(MNUMCR,MSEDYR)	HISTOR tBTU PV COMMER	Photovoltaic. Commercial
	QSPVIN	(MNUMCR,MSEDYR)	HISTOR tBTU PV INDUST	Photovoltaic. Industrial
	QSPVEL	(MNUMCR,MSEDYR)	HISTOR tBTU PV ELECTR	Photovoltaic. Electricity
	QSPVAS	(MNUMCR,MSEDYR)	HISTOR tBTU PV ALLSEC	Photovoltaic. All Sectors
	QSWIIN	(MNUMCR,MSEDYR)	HISTOR tBTU WI INDUST	Wind. Industrial
	QSWIEL	(MNUMCR,MSEDYR)	HISTOR tBTU WI ELECTR	Wind. Electricity
	QSWIAS	(MNUMCR,MSEDYR)	HISTOR tBTU WI ALLSEC	Wind. All Sectors
	QSTRRS	(MNUMCR,MSEDYR)	HISTOR tBTU TR RESIDN	Total Renewables. Residential
	QSTRCM	(MNUMCR,MSEDYR)	HISTOR tBTU TR COMMER	Total Renewables. Commercial
	QSTRTR	(MNUMCR,MSEDYR)	HISTOR tBTU TR TRANSP	Total Renewables. Transportation
	QSTRIN	(MNUMCR,MSEDYR)	HISTOR tBTU TR INDUST	Total Renewables. Industrial
	QSTREL	(MNUMCR,MSEDYR)	HISTOR tBTU TR ELECTR	Total Renewables. Electricity
	QSTRSN	(MNUMCR,MSEDYR)	HISTOR tBTU TR SYNTHE	Total Renewables. Synthetics
	QSTRAS	(MNUMCR,MSEDYR)	HISTOR tBTU TR ALLSEC	Total Renewables. All Sectors
	QSEIEL	(MNUMCR,MSEDYR)	HISTOR tBTU EI ELECTR	Net Electricity Imports. Electric
	QSCIIN	(MNUMCR,MSEDYR)	HISTOR tBTU CI INDUST	Net Coal Coke Imports. Industrial
	QSTSRS	(MNUMCR,MSEDYR)	HISTOR tBTU TS RESIDN	Total Sectoral Energy Consumption.
	QSTSCM	(MNUMCR,MSEDYR)	HISTOR tBTU TS COMMER	Total Sectoral Energy Consumption.
	QSTSTR	(MNUMCR,MSEDYR)	HISTOR tBTU TS TRANSP	Total Sectoral Energy Consumption.
	QSTSIN	(MNUMCR,MSEDYR)	HISTOR tBTU TS INDUST	Total Sectoral Energy Consumption.
	QSTSRF	(MNUMCR,MSEDYR)	HISTOR tBTU TS REFINE	Total Sectoral Energy Consumption.
	QSTSEL	(MNUMCR,MSEDYR)	HISTOR tBTU TS ELECTR	Total Sectoral Energy Consumption.
	QSTSSN	(MNUMCR,MSEDYR)	HISTOR tBTU TS SYNTHE	Total Sectoral Energy Consumption.
	QSTSAS	(MNUMCR,MSEDYR)	HISTOR tBTU TS ALLSEC	Total Sectoral Energy Consumption.
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* Control Modules Common Block				
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NCNTRL			TYPE UNITS	
	EXW	(1)	CNTROL ON_OFF	EXECUTE WORLD (INTERNATIONA
	EXM	(1)	CNTROL ON_OFF	EXECUTE MAC (MACROECONOMIC)
	EXR	(1)	CNTROL ON_OFF	EXECUTE RESD (RESIDENTIAL)
	EXK	(1)	CNTROL ON_OFF	EXECUTE COMM (COMMERCIAL)
	EXI	(1)	CNTROL ON_OFF	EXECUTE IND (INDUSTRIAL)
	EXT	(1)	CNTROL ON_OFF	EXECUTE TRAN (TRANSPORTATION)
	EXE	(1)	CNTROL ON_OFF	EXECUTE UTIL (UTILITY)
	EXC	(1)	CNTROL ON_OFF	EXECUTE COAL (COAL SUPPLY)
	EXL	(1)	CNTROL ON_OFF	EXECUTE WELL (OIL AND GAS SUPPLY
	EXG	(1)	CNTROL ON_OFF	EXECUTE PIPE (GAS TRANS.& DISTR.
	EXO	(1)	CNTROL ON_OFF	EXECUTE REFINE (PETROLEUM REFINERY
	EXN	(1)	CNTROL ON_OFF	EXECUTE RENEW (RENEWABLES)
	RUNMOD	(12)	CNTROL BLANK	FLAGS FOR WHETHER EACH MODEL IS BE
	FIRSYR	(1)	CNTROL BLANK	FIRST FORECAST YEAR INDEX (EG. 2)
	LASTYR	(1)	CNTROL BLANK	LAST FORECAST YEAR INDEX (EG. 29)
	MAXITR	(1)	CNTROL BLANK	MAXIMUM ITERATIONS
	FRCTOL	(1)	CNTROL BLANK	MINIMUM FRACTIONAL CONVERGENCE TOL
	ABSTOL	(1)	CNTROL BLANK	MINIMUM ABSOLUTE CONVERGENCE TOLER
	RLXPC	(1)	CNTROL BLANK	RELAXATION FRACTION
	NYRS	(1)	CNTROL BLANK	NUMBER OF GROWTH YEARS FOR EXPECTA

COMMON Block Name	Variable Name	Variable Dimensions	Variable Descriptors	Variable Description
	I4SITE	(1)	CNTROL BLANK	FORESIGHT OPT (1:MYOPIC, 2: ADAPTI
	I4SCNT	(1)	CNTROL BLANK	FORESIGHT CONTROL: (1: MAIN, 2: SU
	IRELAX	(1)	CNTROL BLANK	OPTION TO RUN HEURISTIC ROUTINE TO
	WWOP	(1)	CNTROL BLANK	WORLD OIL PRICE CASE
	MMAC	(1)	CNTROL BLANK	MACRO CASE
	HISTORY	(1)	CNTROL BLANK	OPTION TO OVERWRITE 1990 DATA W/SE
	CURITR	(1)	CNTROL BLANK	CURRENT ITERATIONS
	CURIYR	(1)	CNTROL BLANK	CURRENT IYEAR INDEX
	BASEYR	(1)	CNTROL BLANK	YEAR CORRESPONDING TO FIRSYR=1
	ENDYR	(1)	CNTROL BLANK	YEAR CORRESPONDING TO LASTYR=29
	LOOPOP	(1)	CNTROL BLANK	NEMS YEAR LOOPING (1: A YEAR AT A
	CTEST	(1)	CNTROL BLANK	OVERALL CONVERGENCE TEST (0: NOT,
	FCRL	(1)	CNTROL BLANK	FINAL CONVERGENCE AND REPORTING LO
	NCRL	(1)	CNTROL BLANK	REPORTING LOOP SWITCH FOR EACH MOD
	MACFDBK	(1)	CNTROL ON_OFF	MACROECONOMIC FEEDBACK SWITCH
	ELASSW	(1)	CNTROL ON_OFF	ELASTICITY SWITCH (0->OFF, 1->ON)
	DSMSWTCH	(1)	CNTROL ON_OFF	DEM SIDE MGMT SWITCH(0->OFF,1->ON)
	DBDUMP	(1)	CNTROL ON_OFF	DATABASE DUMP/YR SW (0->OFF,1->ON)
	MODELON	(1)	CNTROL ON_OFF	MODELS NEVER OFF SWITCH(0->OFF,1->
	ECPSTART	(1)	CNTROL ON_OFF	START YEAR FOR ECP MODULE (DEF=1)
	CNVTST	(12,MNUMYR)	CNTROL BLANK	CONVERGENCE TEST FLAGS FOR EACH MO
	ITIMNG	(1)	CNTROL BLANK	TIMING SWITCH (ITIMNG=1 MEANS TIMI
	YEARPR	(1)	CNTROL BLANK	FOR REPORTING, YEAR DOLLARS
	SCALPR	(1)	CNTROL BLANK	FOR REPORTING, DEFLATOR FOR YEARPR
	MORDER	(12)	CNTROL BLANK	MODULE EXECUTION ORDER
	PRTDBGW	(1)	CNTROL BLANK	PRINT DEBUG IN WORLD (INTERNATION
	PRTDBGM	(1)	CNTROL BLANK	PRINT DEBUG IN MAC (MACROECONOM
	PRTDBGR	(1)	CNTROL BLANK	PRINT DEBUG IN RESD (RESIDENTIAL
	PRTDBGK	(1)	CNTROL BLANK	PRINT DEBUG IN COMM (COMMERCIAL)
	PRTDBGI	(1)	CNTROL BLANK	PRINT DEBUG IN IND (INDUSTRIAL)
	PRTDBGT	(1)	CNTROL BLANK	PRINT DEBUG IN TRAN (TRANSPORTAT
	PRTDBGE	(1)	CNTROL BLANK	PRINT DEBUG IN UTIL (UTILITY)
	PRTDBGC	(1)	CNTROL BLANK	PRINT DEBUG IN COAL (COAL SUPPLY
	PRTDBGL	(1)	CNTROL BLANK	PRINT DEBUG IN WELL (OIL AND GAS
	PRTDBGG	(1)	CNTROL BLANK	PRINT DEBUG IN PIPE (GAS TRANS.&
	PRTDBGO	(1)	CNTROL BLANK	PRINT DEBUG IN REFINE (PETROLEUM R
	PRTDBGN	(1)	CNTROL BLANK	PRINT DEBUG IN RENEW (RENEWABLES)
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* Refinery Module Output				
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PMMOUT			TYPE UNITS	
	RFREV	(MNUMYR)	QUNTY tBTU	7 Refinery revenues
	RFQPRDT	(MNUMCR,MNUMYR)	QUNTY tBTU	TOTAL PRODUCT SUPPLIED
	RFQDCRD	(15,MNUMYR)	QUNTY MMBBL	DOMESTIC TOTAL CRUDE MMBBL/YR/OGSM
	RFSPRFR	(MNUMYR)	QUNTY tBTU	RF SPR FILL RATE
	RFSPRIM	(MNUMYR)	QUNTY tBTU	SPR IMPORTS
	RFCAPEXP	(MNUMYR)	PRICE 87$BTU	RF CAPITAL EXPENDITURES
	RFSAL	(MNUMYR)	QUNTY tBTU	SULFUR ALLOWANCES TONS/YR U.S. 35,
	RFPQNGL	(MNUMPR,MNUMYR, 6, 2)	QUNTY tBTU	PRICE/QUANITY OF NGL BY PADD FOR 6
	RFQDINPOT	(MNUMPR,MNUMYR)	QUNTY tBTU	QUANT. DOMESTIC OTHER INPUTS TO RE
	RFQPRCG	(MNUMPR,MNUMYR)	QUNTY tBTU	QUANT. OF PROCESSING GAINS MMBBLD
	PCTPLT_PADD	(MNUMPR,MNUMYR)	QUNTY tBTU	GAS PLANT FUEL CONSUMED/TOTAL NG P
	DCRDWHP	(MNUMOR,MNUMYR)	PRICE 87$BBL	DOMESTIC CRUDE WELLHEAD PRICE
	XDCRDWHP	(MNUMOR,MNUMYR)	PRICE 87$BBL	EXPECTED DOMESTIC CRUDE WELLHEAD P
	XRFQDCRD	(MNUMOR,MNUMYR)	PRICE 87$BBL	EXPECTED DOMESTIC CRUDE PRODUCTION
	RFQTDCRD	(15,MNUMYR)	QUNTY MMBBL	DOMESTIC TOTAL CRUDE (INCL EOR) MM
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* Refinery Module Parameters				

COMMON Block Name	Variable Name	Variable Dimensions		Variable Descriptors		Variable Descriptio
PMMPARAM				TYPE	UNITS	
	RFSHRRF	(MNUMCR,MNUMYR)		PARAM	BLANK	Gasoline share-Reformulated
	RFSHROX	(MNUMCR,MNUMYR)		PARAM	BLANK	Gasoline share-Oxygenated
	RFSHROR	(MNUMCR,MNUMYR)		PARAM	BLANK	Gasoline share-oxygenated/reform
	RFSHRTR	(MNUMCR,MNUMYR)		PARAM	BLANK	Gasoline share-?
	RFDSTAX	(MNUMYR)		PARAM	BLANK	Federal Diesel Tax Rate
	RFSWDH	(1)		PARAM	BLANK	Switch reduction for dist fuel
* Refinery Module Report Writer Variables						
PMMRPT				TYPE	UNITS	
	RFELPURPD	(MNUMPR,MNUMYR)		QUNTY	MKWH	ELECTRICITY PURCHASED BY P
	RFCGCAPCD	(MNUMCR,MNUMYR)		QUNTY	MKWH	COGEN CAP KWH/YR->CGRECAP
	RFCGCAPPD	(MNUMPR,MNUMYR)		QUNTY	MKWH	COGEN CAPACITY KWH/YR BY P
	RFCGCAPADDPD	(MNUMPR,MNUMYR)		QUNTY	MKWH	COGEN CAP KWH/YR BY PADD A
	RFDSTCAP	(MNUMPR,MNUMYR)		QUNTY	tBTU	REFINERY DISTILLATION CAPACITY
	RFDSTUTL	(MNUMPR,MNUMYR)		QUNTY	tBTU	CAPACITY UTILIZATION RATE
	RFIPQCLL	(MNUMPR,MNUMYR,	2)	QUNTY	BBL/DA	IMPORT CRUDE-LO SULFUR LT(P,Q)
	RFIPQCMH	(MNUMPR,MNUMYR,	2)	QUNTY	BBL/DA	IMPORT CRUDE-MD SULFUR HVY
	RFIPQCHL	(MNUMPR,MNUMYR,	2)	QUNTY	BBL/DA	IMPORT CRUDE-HI SULFUR LT
	RFIPQCHH	(MNUMPR,MNUMYR,	2)	QUNTY	BBL/DA	IMPORT CRUDE-HI SULFUR HVY
	RFIPQCHV	(MNUMPR,MNUMYR,	2)	QUNTY	BBL/DA	IMPORT CRUDE-HI SULFUR V HVY
	RFIPQMG	(MNUMPR,MNUMYR,	2)	QUNTY	BBL/DA	IMPORTS MOTOR GASOLINE(P,Q)
	RFIPQDS	(MNUMPR,MNUMYR,	2)	QUNTY	BBL/DA	IMPORTS DISTILLATE (P,Q)
	RFIPQRL	(MNUMPR,MNUMYR,	2)	QUNTY	BBL/DA	IMPORTS LO SULFUR RESID (P,Q)
	RFIPQRH	(MNUMPR,MNUMYR,	2)	QUNTY	BBL/DA	IMPORTS HI SULFUR RESID (P,Q)
	RFIPQJF	(MNUMPR,MNUMYR,	2)	QUNTY	BBL/DA	IMPORTS JET FUEL (P,Q)
	RFIPQLG	(MNUMPR,MNUMYR,	2)	QUNTY	BBL/DA	IMPORTS LPG (P,Q)
	RFIPQME	(MNUMPR,MNUMYR,	2)	QUNTY	BBL/DA	IMPORTS METHANOL (P,Q)
	RFIPQMT	(MNUMPR,MNUMYR,	2)	QUNTY	BBL/DA	IMPORTS MTBE(P,Q)
	RFIMCR	(MNUMPR,MNUMYR)		QUNTY	tBTU	1 Crude net imports
	RFIMTP	(MNUMPR,MNUMYR)		QUNTY	tBTU	2 Total prod net imports
	RFQMG	(MNUMCR,MNUMYR)		QUNTY	tBTU	REFORMULATED /
	RFQDS	(MNUMCR,MNUMYR)		QUNTY	tBTU	DISTILLATE FUEL OIL --> QDSAS (M
	RFQJF	(MNUMCR,MNUMYR)		QUNTY	tBTU	JET FUEL --> QJFTR (MNU
	RFQRL	(MNUMCR,MNUMYR)		QUNTY	tBTU	RESIDUAL FUEL OIL LOW SULFUR --> Q
	RFQRH	(MNUMCR,MNUMYR)		QUNTY	tBTU	RESIDUAL FUEL OIL HIGH SULFUR -->
	RFQLG	(MNUMCR,MNUMYR)		QUNTY	tBTU	LPG --> QLGAS MNUMCR, M
	RFQPF	(MNUMCR,MNUMYR)		QUNTY	tBTU	PETROCHEMICAL FEED STOCKS --> QPFI
	RFQKS	(MNUMCR,MNUMYR)		QUNTY	tBTU	KEROSENE --> QKSAS (MNUMCR,
	RFQOTH	(MNUMCR,MNUMYR)		QUNTY	tBTU	OTHER --> QOTAS (MNUMCR,
	RFQARO	(MNUMCR,MNUMYR)		QUNTY	tBTU	QUANTITY OF ASPHALT AND ROAD OIL
	RFQSTG	(MNUMCR,MNUMYR)		QUNTY	tBTU	QUANTITY OF STILL GAS
	RFQPCK	(MNUMCR,MNUMYR)		QUNTY	tBTU	QUANTITY OF PETROLEUM COKE
	RFPQIPRDT	(MNUMPR,MNUMYR,	2)	QUNTY	tBTU	TOTAL PRODUCT IMPORTED
	RFQEXPRDT	(MNUMPR,MNUMYR)		QUNTY	tBTU	CRUDE EXPORTED
	RFQEXCRD	(MNUMPR,MNUMYR)		QUNTY	tBTU	CRUDE EXPORTED
	RFQICRD	(MNUMPR,MNUMYR)		QUNTY	BBL/DA	IMPORTED TOTAL CRUDE MMBBLD/PADD
	RFPQUFC	(MNUMPR,MNUMYR,	2)	QUNTY	tBTU	TOTAL IMPORTS OF UNFINISHED REF MO
	RFQIN	(MNUMYR)		QUNTY	tBTU	INDUSTRIAL PRDS
	RFQTR	(MNUMYR)		QUNTY	tBTU	TRANSP. PRDS
	RFQRC	(MNUMYR)		QUNTY	tBTU	RESID/COMM.PRDS
	RFQEL	(MNUMYR)		QUNTY	tBTU	UTILITY PRDS
	RFQSECT	(MNUMYR)		QUNTY	tBTU	TOTAL SECT.PRDS
	RFDPRDLPG	(MNUMPR,MNUMYR)		QUNTY	tBBL/D	REF PRD; LPG
	RFDPRDTRG	(MNUMPR,MNUMYR)		QUNTY	tBBL/D	REF PRD; MOTOR GASOLINE
	RFDPRDRFG	(MNUMPR,MNUMYR)		QUNTY	tBBL/D	REF PRD; REFORMULATED MOGAS

COMMON Block Name	Variable Name	Variable Dimensions	Variable Descriptors		Variable Descriptio
	RFDPRDTRH	(MNUMPR,MNUMYR)	QUNTY	tBBL/D	REF PRD; HIGH OXYGENATED MOGAS
	RFDPRDRFH	(MNUMPR,MNUMYR)	QUNTY	tBBL/D	REF PRD; REFORM HI OXYG MOGAS
	RFDPRDJTA	(MNUMPR,MNUMYR)	QUNTY	tBBL/D	REF PRD; JET FUEL
	RFDPRDKER	(MNUMPR,MNUMYR)	QUNTY	tBBL/D	REF PRD; KEROSENE
	RFDPRDN2H	(MNUMPR,MNUMYR)	QUNTY	tBBL/D	REF PRD; NO. 2 DISTILLATE
	RFDPRDN6I	(MNUMPR,MNUMYR)	QUNTY	tBBL/D	REF PRD; LO SULFER RESID OIL
	RFDPRDN6B	(MNUMPR,MNUMYR)	QUNTY	tBBL/D	REF PRD; HI SULFER RESID OIL
	RFDPRDOTH	(MNUMPR,MNUMYR)	QUNTY	tBBL/D	REF PRD; OTHER PETROLEUM
	RFDPRDPCF	(MNUMPR,MNUMYR)	QUNTY	tBBL/D	REF PRD;PETROCHEM FEEDSTOCKS
	RFDPRDAST	(MNUMPR,MNUMYR)	QUNTY	tBBL/D	REF PRD; ASPHALT & ROAD OIL
	RFDPRDDSL	(MNUMPR,MNUMYR)	QUNTY	tBBL/D	REF PRD; LOW SULFUR DIESEL
	RFDPRDSTG	(MNUMPR,MNUMYR)	QUNTY	tBBL/D	REF PRD; STILL GAS
	RFDPRDCOK	(MNUMPR,MNUMYR)	QUNTY	tBBL/D	REF PRD; PETROLEUM COKE
	RFDSCUM	(MNUMPR,MNUMYR)	QUNTY	tBBL/D	REF CUM CAP EXPANSION
	RFBDSTCAP	(MNUMPR,MNUMYR)	QUNTY	BBL/DA	REF BASE DISTILLATION CAPACITY
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* Oil & Gas Module Output					
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OGSMOUT			TYPE	UNITS	
	OGRESNGON	(17,MNUMYR)	QUNTY	BCF	NA dry gas reserves onshore
	OGPRRNGON	(17,MNUMYR)	PARAM	SCALAR	NA dry gas p/r ratio onshore
	OGELSNGON	(17,MNUMYR)	PARAM	SCALAR	NA dry gas prod fcn param onshr
	OGRESNGOF	(3,MNUMYR)	QUNTY	BCF	NA dry gas reserves offsfore
	OGPRRNGOF	(3,MNUMYR)	PARAM	SCALAR	NA dry gas p/r ratio onshore
	OGELSNGOF	(3,MNUMYR)	PARAM	SCALAR	NA dry gas prod fcn parm offshr
	OGSPEND	(MNUMYR)	QUNTY	BLANK	TOTAL NATIONAL EXPENDITURES
	OGELSCO	(MNUMOR,MNUMYR)	QUNTY	BLANK	OIL ELASTICITY
	OGPRRCO	(MNUMOR,MNUMYR)	QUNTY	SCALAR	OIL P/R RATIO
	OGRESCO	(MNUMOR,MNUMYR)	QUNTY	MMBBL	OIL RESERVES (MILL. BARRELS)
	OGQNGEXP	(MNUMBX,MNUMYR)	QUNTY	BCF	NG EXPORTS (BILL. CU FT)
	OGQNGIMP	(MNUMBX,MNUMYR)	QUNTY	BCF	NG IMPORTS (BILL. CU FT)
	OGPNGEXP	(MNUMBX,MNUMYR)	PRICE	87$MCF	NG PRICE EXPORTS ($ / MMCF)
	OGPNGIMP	(MNUMBX,MNUMYR)	PRICE	87$MCF	NG PRICE IMPORTS ($ / MMCF)
	OGPCRWHP	(MNUMYR)	QUNTY	87$BBL	CRUDE AVG WELLHEAD PRICE
	OGQCRREP	(NOGCRO,MNUMYR)	QUNTY	MMBBL	CRUDE PRODUCTION BY OIL CAT
	OGQCRRSV	(MNUMYR)	QUNTY	MMBBL	CRUDE RESERVES
	OGPNGWHP	(MNUMYR)	QUNTY	87$MCF	NG AVG WELLHEAD PRICE
	OGQNGREP	(NOGCAT,MNUMYR)	QUNTY	BCF	NG PRODUCTION BY GAS CAT
	OGQNGRSV	(MNUMYR)	QUNTY	BCF	NG RESERVES
	OGNOWELL	(MNUMYR)	QUNTY	SCALAR	WELLS COMPLETED
	OGTECHON	(3, 6,MNUMYR)	QUNTY	SCALAR	TECH FACTORS BY COSTCAT/FUEL/YEAR
	OGELSCAN	(2,MNUMYR)	QUNTY	SCALAR	(BETA) PRICE ELASTICITY (1=OIL,
	OGPRRCAN	(2,MNUMYR)	QUNTY	SCALAR	(OMEGA) GAS EXTRACTION RATE; P/R R
	OGRESCAN	(2,MNUMYR)	QUNTY	SCALAR	(R) END-OF-YEAR RESERVES.
	OGCNQPRD	(2,MNUMYR)	QUNTY	SCALAR	CANADIAN PRODUCTION OF OIL & GAS
	OGCNPPRD	(2,MNUMYR)	QUNTY	SCALAR	CANADIAN PRICE OF OIL & GAS
	OGCNPARM1	(1)	QUNTY	SCALAR	(ALPHA) ACTUAL GAS ALLOCATION FACT
	OGCNPARM2	(1)	QUNTY	SCALAR	(Y) RESPONSIVENESS OF FLOW TO DIFF
	OGADFACT	(1)	QUNTY	SCALAR	AD GAS FACTOR (BCF/MMB)
	OGDIFWOP	(1)	QUNTY	SCALAR	CANADA WORLD OIL->WELLHD PRC DIFFE
	OGCNDEM	(3)	QUNTY	SCALAR	CANADIAN DEMAND CALCULATION PARAME
	OGCNCAP	(6,MNUMYR)	QUNTY	SCALAR	CANADIAN CAPACITIES AT BORDER CROS
	OGCNFLW	(6)	QUNTY	SCALAR	INITIAL FLOW RATES AT BORDER CROSS
	OGCNBLOSS	(6)	QUNTY	SCALAR	GAS LOST IN TRANSIT TO BORDER
	OGCNEXLOSS	(1)	QUNTY	SCALAR	GAS LOST FROM US EXPORT TO CANADA
	OGCNDMLOSS	(1)	QUNTY	SCALAR	GAS LOST FROM WELL HEAD TO CANADA
	OGCNPMARKUP	(6)	QUNTY	SCALAR	TRANSPORTATION MARK-UP AT BORDER
	OGQNGSAKMX	(MNUMYR)	QUNTY	SCALAR	MAXIMUM PRODUCTION LIMIT OF SOUTH

COMMON Block Name	Variable Name	Variable Dimensions	Variable Descriptors		Variable Descriptio
	OGQEORCON	(6,MNUMYR)	QUNTY	SCALAR	CRUDE OIL CONSUMPTION FOR EOR BY R
	OGQEORPR	(6,MNUMYR)	QUNTY	SCALAR	CRUDE OIL SUPPLY FROM EOR BY REGIO
	OGQEORNGC	(6, 2,MNUMYR)	QUNTY	SCALAR	NG CONSUMPTION FOR EOR PROD BY REG
	OGQEORNGP	(6,MNUMYR)	QUNTY	SCALAR	NG (COPRODUCT) PRODUCTION FROM EOR
	OGEORCOGC	(6, 2,MNUMYR)	QUNTY	SCALAR	COGEN ELEC CAPACITY FROM EOR BY RE
	OGEORCOGG	(6, 2,MNUMYR)	QUNTY	SCALAR	COGEN ELEC GENERATION FROM EOR BY
	OGQANGTS	(MNUMYR)	QUNTY	BCF	GAS FLOW AT U.S. BORDER FROM ANGTS
	OGANGTSMX	(MNUMYR)	QUNTY	BCF	MAX KNOWN FLOW IN CURRENT YR (BCF)
	OGCNCON	(2,MNUMYR)	QUNTY	BCF	CANADIAN GAS CONSUMPTION
	OGQLNGMAX	(4,MNUMYR)	QUNTY	BCF	MAX FORESEEABLE LNG REGAS FLOWS
	OGCORSV	(NOGCRO,MNUMYR)	QUNTY	MMBBL	CRUDE RESERVES BY OIL CATEGORY
	OGNGRSV	(NOGCAT,MNUMYR)	QUNTY	BCF	NG RESERVES BY GAS CATEGORY
	OGCOPRD	(NOGRGN,MNUMYR)	QUNTY	MMBBL	CRUDE PRODUCTION BY OIL CATEGORY
	OGNGPRD	(NOGRGN,MNUMYR)	QUNTY	BCF	NG PRODUCTION BY GAS CATEGORY
	OGCOWHP	(NOGRGN,MNUMYR)	PRICE	87$BBL	CRUDE WELLHEAD PRICE BY OIL CATEGO
	OGNGWHP	(NOGRGN,MNUMYR)	PRICE	87$MCF	NG WELLHEAD PRICE BY GAS CATEGORY
	EXSPEND	(NOGDTP,MNUMYR)	PRICE	m87$	EXPLORATORY EXPENDITURES
	DVSPEND	(NOGDTP,MNUMYR)	PRICE	m87$	DEVELOPMENT EXPENDITURES
	EXOILFT	(NOGDTP,MNUMYR)	QUNTY	MILL	OIL FOOTAGE (EXPL.)
	DVOILFT	(NOGDTP,MNUMYR)	QUNTY	MILL	OIL FOOTAGE (DEV.)
	EXGASFT	(NOGDTP,MNUMYR)	QUNTY	MILL	GAS FOOTAGE (EXPL.)
	DVGASFT	(NOGDTP,MNUMYR)	QUNTY	MILL	GAS FOOTAGE (DEV.)
	EXDRYFT	(NOGDTP,MNUMYR)	QUNTY	MILL	DRY FOOTAGE (EXPL.)
	DVDRYFT	(NOGDTP,MNUMYR)	QUNTY	MILL	DRY FOOTAGE (DEV.)
	EXFTAGE	(NOGDTP,MNUMYR)	QUNTY	MILL	TOTAL FOOTAGE (EXPL.)
	DVFTAGE	(NOGDTP,MNUMYR)	QUNTY	MILL	TOTAL FOOTAGE (DEV.)
	FNGIMPORT	(NFNGSS,MNUMYR)	QUNTY	BCF	NG IMPORTS
	FNGEXPORT	(NFNGSS,MNUMYR)	QUNTY	BCF	NG EXPORTS
	FNGIMPRIC	(NFNGSS,MNUMYR)	QUNTY	87$MCF	IMPORT PRICES
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* Natural Gas Transmission & Distribution Module Output					
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NGTDMOUT			TYPE	UNITS	
	OGPRDNGON	(17,MNUMYR)	QUNTY	BCF	NA DRY GAS PROD ONSHORE (BCF)
	OGPRDNGOF	(3,MNUMYR)	QUNTY	BCF	NA DRY GAS PROD OFFSHORE (BCF)
	PRNG_PADD	(MNUMPR,MNUMYR)	QUNTY	BCF	TOT DRY GAS PRODUCTION (BCF) W/L&P
	PGFELGR	(21,MNUMYR)	PRICE	87$BTU	E UTIL FIRM NG PRICE (T BTU)
	PGIELGR	(21,MNUMYR)	PRICE	87$BTU	E UTIL INTERRUPTIBLE NG PRICE (T B
	PGCELGR	(21,MNUMYR)	PRICE	87$BTU	E UTIL COMPETITIVE NG PRICE (T BTU
	CLSYNGWP	(17,MNUMYR)	PRICE	87$BTU	SYNTHETIC NG PRICE FROM COAL
*========	================	====== ====== ====== ====== ======	======	====== ====== ======	==================================
* Natural Gas Transmission & Distribution report Writer outputs					
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NGTDMREP			TYPE	UNITS	
	OGWPRNG	(MNUMOR,MNUMYR)	PRICE	87$MCF	NG WELLHEAD PRICE (87$/MCF)
	OGIMNGP	(MNUMYR)	QUNTY	BCF	NET IMPORTS - PIPELINE NG
	OGIMLNG	(MNUMYR)	QUNTY	BCF	NET IMPORTS OF LNG
	OGPRSUP	(MNUMYR)	QUNTY	BCF	TOTAL SUPPLEMENTAL GAS (SYN+OTH)
	OGPRDNG	(MNUMOR,MNUMYR)	QUNTY	BCF	DOMESTIC DRY NG PRODUCTION
	OGIMMEX	(MNUMYR)	QUNTY	BCF	NET IMPORTS OF MEX NG
	OGIMCAN	(MNUMYR)	QUNTY	BCF	NET IMPORTS OF CAN NG
	NGSTRCAP	(24,MNUMYR)	QUNTY	MCF	NG UNDERGROUND STORAGE CAPACITY
	NGPIPCAP	(2,MNUMYR)	QUNTY	BCF	NG PIPELINE CAPACITY - NATIONAL
	OGPRSUP3	(3,MNUMYR)	QUNTY	BCF	SUPPLEMENTAL NG SUBCATEGORIES
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* Utility EFP Module Output					
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UEFPOUT			TYPE	UNITS	

COMMON Block Name	Variable Name	Variable Dimensions	Variable Descriptors		Variable Descriptio
	PELAV	(MNUMCR,MNUMYR)	PRICE	87$KWH	Utility avoided costs
	PELCP	(MNUMCR,MNUMYR)	PRICE	87$KWH	Capital component of price
	PELFL	(MNUMCR,MNUMYR)	PRICE	87$KWH	Fuel component of price
	PELOM	(MNUMCR,MNUMYR)	PRICE	87$KWH	O&M component of price
	PELWH	(MNUMCR,MNUMYR)	PRICE	87$KWH	Wholesale Electricity Price
	PELTL	(MNUMCR,MNUMYR)	PRICE	87$KWH	Total price
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* Utility EFP Module Output					
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EFPOUT			TYPE	UNITS	
	PEPRSNR	(MNUMNR,MNUMYR)	PRICE	87$KWH	Pur. Elec, Peak. Res. by NERC
	PEPCMNR	(MNUMNR,MNUMYR)	PRICE	87$KWH	Pur. Elec, Peak. Com. by NERC
	PEPTRNR	(MNUMNR,MNUMYR)	PRICE	87$KWH	Pur. Elec, Peak. Trans. by NERC
	PEPINNR	(MNUMNR,MNUMYR)	PRICE	87$KWH	Pur. Elec, Peak. Ind. by NERC
	PEPASNR	(MNUMNR,MNUMYR)	PRICE	87$KWH	Pur. Elec, Peak. All by NERC
	PENRSNR	(MNUMNR,MNUMYR)	PRICE	87$KWH	Pur. Elec, Nonpk. Res. by NERC
	PENCMNR	(MNUMNR,MNUMYR)	PRICE	87$KWH	Pur. Elec, Nonpk. Com. by NERC
	PENTRNR	(MNUMNR,MNUMYR)	PRICE	87$KWH	Pur. Elec, Nonpk. Trans. by NERC
	PENINNR	(MNUMNR,MNUMYR)	PRICE	87$KWH	Pur. Elec, Nonpk. Ind. by NERC
	PENASNR	(MNUMNR,MNUMYR)	PRICE	87$KWH	Pur. Elec, Nonpk. All by NERC
	PELRSNR	(MNUMNR,MNUMYR)	PRICE	87$KWH	Pur. Elec. Res. by NERC
	PELCMNR	(MNUMNR,MNUMYR)	PRICE	87$KWH	Pur. Elec. Com. by NERC
	PELTRNR	(MNUMNR,MNUMYR)	PRICE	87$KWH	Pur. Elec. Trans. by NERC
	PELINNR	(MNUMNR,MNUMYR)	PRICE	87$KWH	Pur. Elec. Ind. by NERC
	PELASNR	(MNUMNR,MNUMYR)	PRICE	87$KWH	Pur. Elec. All Sectors by NERC
	PELCPNR	(MNUMNR,MNUMYR)	PRICE	87$KWH	Capital Component by NERC
	PELFLNR	(MNUMNR,MNUMYR)	PRICE	87$KWH	Fuel Component by NERC
	PELOMNR	(MNUMNR,MNUMYR)	PRICE	87$KWH	O&M Component by NERC
	PELWHNR	(MNUMNR,MNUMYR)	PRICE	87$KWH	WHOLESALE Component by NERC
	PELTLNR	(MNUMNR,MNUMYR)	PRICE	87$KWH	Avg--All Components by NERC
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* Utility EFD Module Output					
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UEFDOUT			TYPE	UNITS	
	UGNCLNR	(2,MNUMNR,MNUMYR)	QUNTY	MKWH	Coal Gen by Ownership Type/NERC
	UGNGFNR	(2,MNUMNR,MNUMYR)	QUNTY	MKWH	Gas (Firm) Gen by Ownership Type/N
	UGNGINR	(2,MNUMNR,MNUMYR)	QUNTY	MKWH	Gas (Int.) Gen by Ownership Type/N
	UGNGCNR	(2,MNUMNR,MNUMYR)	QUNTY	MKWH	Gas (Comp.) Gen by Ownership Type/
	UGNDSNR	(2,MNUMNR,MNUMYR)	QUNTY	MKWH	DS Gen by Ownership type/NERC
	UGNRLNR	(2,MNUMNR,MNUMYR)	QUNTY	MKWH	RL Gen by Ownership type/NERC
	UGNRHNR	(2,MNUMNR,MNUMYR)	QUNTY	MKWH	RH Gen by Ownership type/NERC
	UGNURNR	(2,MNUMNR,MNUMYR)	QUNTY	MKWH	Nuc Gen by Ownership type/NERC
	UGNPSNR	(2,MNUMNR,MNUMYR)	QUNTY	MKWH	PS Gen by Ownership type/NERC
	UGNHYNR	(2,MNUMNR,MNUMYR)	QUNTY	MKWH	Hyd (Not PS) Gen by Ownership type
	UGNGENR	(2,MNUMNR,MNUMYR)	QUNTY	MKWH	Geothermal Gen by Ownership type/N
	UGNMSNR	(2,MNUMNR,MNUMYR)	QUNTY	MKWH	MSW Gen by Ownership type/NERC
	UGNWDNR	(2,MNUMNR,MNUMYR)	QUNTY	MKWH	Wind Gen by Ownership type/NERC
	UGNSONR	(2,MNUMNR,MNUMYR)	QUNTY	MKWH	Solar Gen by Ownership type/NERC
	UGNPVNR	(2,MNUMNR,MNUMYR)	QUNTY	MKWH	Photovoltaic Gen by Ownership type
	UGNWNNR	(2,MNUMNR,MNUMYR)	QUNTY	MKWH	Wind Gen by Ownership type/NERC
	UGNHONR	(2,MNUMNR,MNUMYR)	QUNTY	MKWH	Hyd/Oth Gen by Ownership type/NER
	UGNTLNR	(2,MNUMNR,MNUMYR)	QUNTY	MKWH	Tot. Gen by Ownership Type/NERC
	UPRCLNR	(MNUMNR,MNUMYR)	PRICE	87$KWH	Coal Price by Ownership Type/NERC
	UPRGFNR	(MNUMNR,MNUMYR)	PRICE	87$KWH	Gas (Firm) Price by Ownership Type
	UPRGINR	(MNUMNR,MNUMYR)	PRICE	87$KWH	Gas (Int.) Price by Ownership Type
	UPRGCNR	(MNUMNR,MNUMYR)	PRICE	87$KWH	Gas (Comp) Price by Ownership Type
	UPRDSNR	(MNUMNR,MNUMYR)	PRICE	87$KWH	DS Price by Ownership Type/NERC
	UPRRLNR	(MNUMNR,MNUMYR)	PRICE	87$KWH	RL Price by Ownership Type/NERC

COMMON Block Name	Variable Name	Variable Dimensions	Variable Descriptors		Variable Descriptio
	UPRRHNR	(MNUMNR,MNUMYR)	PRICE	87$KWH	RH Price by Ownership Type/NERC
	UPRURNR	(MNUMNR,MNUMYR)	PRICE	87$KWH	Nuc Price by Ownership Type/NERC
	UPRHONR	(MNUMNR,MNUMYR)	PRICE	87$KWH	Ren. Price by Ownership Type/NERC
	UTSO2	(MNUMNR,MNUMYR)	QUNTY	MKWH	Total SO2 Emissions by NERC
	UTNOX	(MNUMNR,MNUMYR)	QUNTY	MKWH	Total NOX Emissions by NERC
	UTCO2	(MNUMNR,MNUMYR)	QUNTY	MKWH	Total CO2 Emissions by NERC
	URETTLU	(MNUMNR,MNUMYR)	QUNTY	MKWH	Util Total Retirements by Nerc
	UGNUBCR	(MNUMCR,MNUMYR)	QUNTY	MKWH	Util BWR Nuclear gener. by CENSUS
	UGNUPCR	(MNUMCR,MNUMYR)	QUNTY	MKWH	Util PWR Nuclear gener. by CENSUS
	QBCELNR	(NDREGN,MNUMYR)	QUNTY	MKWH	VLS Bit Coal consumption by Coal R
	QBDELNR	(NDREGN,MNUMYR)	QUNTY	MKWH	LS Bit Coal consumption by Coal Re
	QBMELNR	(NDREGN,MNUMYR)	QUNTY	MKWH	MS Bit Coal consumption by Coal Re
	QBHELNR	(NDREGN,MNUMYR)	QUNTY	MKWH	HS Bit Coal consumption by Coal Re
	QSCELNR	(NDREGN,MNUMYR)	QUNTY	MKWH	VLS Sub Coal consumption by Coal R
	QSDELNR	(NDREGN,MNUMYR)	QUNTY	MKWH	LS Sub Coal consumption by Coal Re
	QSMELNR	(NDREGN,MNUMYR)	QUNTY	MKWH	MS Sub Coal consumption by Coal Re
	QSHELNR	(NDREGN,MNUMYR)	QUNTY	MKWH	HS Sub Coal consumption by Coal Re
	QLCELNR	(NDREGN,MNUMYR)	QUNTY	MKWH	VLS Lig Coal consumption by Coal R
	QLDELNR	(NDREGN,MNUMYR)	QUNTY	MKWH	LS Lig Coal consumption by Coal Re
	QLMELNR	(NDREGN,MNUMYR)	QUNTY	MKWH	MS Lig Coal consumption by Coal Re
	QLHELNR	(NDREGN,MNUMYR)	QUNTY	MKWH	HS Lig Coal consumption by Coal Re
	QBTELNR	(NDREGN,MNUMYR)	QUNTY	MKWH	1-4 Bit Coal consumption by Coal R
	QSTELNR	(NDREGN,MNUMYR)	QUNTY	MKWH	5-7 Sub Coal consumption by Coal R
	QLTELNR	(NDREGN,MNUMYR)	QUNTY	MKWH	9-12 Lig Coal consumption by Coal
	QGFELGR	(21,MNUMYR)	QUNTY	MKWH	NG "firm" consumption by NGTDM
	QGIELGR	(21,MNUMYR)	QUNTY	MKWH	NG "inter" consumption by NGTDM
	QGCELGR	(21,MNUMYR)	QUNTY	MKWH	NG "compet" consumption by NGTDM
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* Utility DAT Module Output					
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UDATOUT			TYPE	UNITS	
	UCAPCSU	(MNUMNR,MNUMYR)	QUNTY	tMWATT	Util Coal Steam Capacity by NERC
	UCAPOSU	(MNUMNR,MNUMYR)	QUNTY	tMWATT	Util Other Steam Capacity by NERC
	UCAPCCU	(MNUMNR,MNUMYR)	QUNTY	tMWATT	Util Combined Cycle Capacity by NE
	UCAPCTU	(MNUMNR,MNUMYR)	QUNTY	tMWATT	Util Combustion Turb. Capacity by
	UCAPNUU	(MNUMNR,MNUMYR)	QUNTY	tMWATT	Util Nuclear Capacity by NERC
	UCAPPSU	(MNUMNR,MNUMYR)	QUNTY	tMWATT	Util Pump Storage Capacity by NERC
	UCAPHYU	(MNUMNR,MNUMYR)	QUNTY	tMWATT	Util Convention Hydro Cap by NERC
	UCAPGEU	(MNUMNR,MNUMYR)	QUNTY	tMWATT	Util Geothermal Capacity by NERC
	UCAPMSU	(MNUMNR,MNUMYR)	QUNTY	tMWATT	Util MSW Capacity by NERC
	UCAPWDU	(MNUMNR,MNUMYR)	QUNTY	tMWATT	Util Biomass/Wood Capacity by NERC
	UCAPSTU	(MNUMNR,MNUMYR)	QUNTY	tMWATT	Util Solar Thermal Capacity by NER
	UCAPPVU	(MNUMNR,MNUMYR)	QUNTY	tMWATT	Util Photovoltaic Capacity by NERC
	UCAPWNU	(MNUMNR,MNUMYR)	QUNTY	tMWATT	Util Wind Capacity by NERC
	UCAPRNU	(MNUMNR,MNUMYR)	QUNTY	tMWATT	Util Renewable (exclud PS) Cap by
	UCAPTLU	(MNUMNR,MNUMYR)	QUNTY	tMWATT	Util Total Capacity by NERC
	UCAPCSN	(MNUMNR,MNUMYR)	QUNTY	tMWATT	NonUtil Coal Steam Capacity by NER
	UCAPOSN	(MNUMNR,MNUMYR)	QUNTY	tMWATT	NonUtil Other Steam Capacity by NE
	UCAPCCN	(MNUMNR,MNUMYR)	QUNTY	tMWATT	NonUtil Combined Cycle Cap by NERC
	UCAPCTN	(MNUMNR,MNUMYR)	QUNTY	tMWATT	NonUtil Comb Turb. Capacity by NER
	UCAPNUN	(MNUMNR,MNUMYR)	QUNTY	tMWATT	NonUtil Nuclear Capacity by NERC
	UCAPPSN	(MNUMNR,MNUMYR)	QUNTY	tMWATT	NonUtil Pump Storage Capacity by N
	UCAPHYN	(MNUMNR,MNUMYR)	QUNTY	tMWATT	NonUtil Convention Hydro Cap by N
	UCAPGEN	(MNUMNR,MNUMYR)	QUNTY	tMWATT	NonUtil Geothermal Capacity by NER
	UCAPMSN	(MNUMNR,MNUMYR)	QUNTY	tMWATT	NonUtil MSW Capacity by NERC
	UCAPWDN	(MNUMNR,MNUMYR)	QUNTY	tMWATT	NonUtil Biomass/Wood Capacity by N
	UCAPSTN	(MNUMNR,MNUMYR)	QUNTY	tMWATT	NonUtil Solar Thermal Capacity by
	UCAPPVN	(MNUMNR,MNUMYR)	QUNTY	tMWATT	NonUtil Photovoltaic Capacity by N

COMMON Block Name	Variable Name	Variable Dimensions	Variable Descriptors		Variable Description
	UCAPWNN	(MNUMNR,MNUMYR)	QUNTY	tMWATT	NonUtl Wind Capacity by NERC
	UCAPRNN	(MNUMNR,MNUMYR)	QUNTY	tMWATT	NonUtil Renewable (ex PS) Cap by N
	UCAPTLN	(MNUMNR,MNUMYR)	QUNTY	tMWATT	NonUtil Total Capacity by NERC
* Utility ECP Module Output					
UECPOUT			TYPE	UNITS	
	UADDCSU	(2,MNUMNR,MNUMYR)	QUNTY	tMWATT	Util coal steam additions by Nerc
	UADDOSU	(2,MNUMNR,MNUMYR)	QUNTY	tMWATT	Util other steam additions by Nerc
	UADDCCU	(2,MNUMNR,MNUMYR)	QUNTY	tMWATT	Util combined cycle additions by N
	UADDCTU	(2,MNUMNR,MNUMYR)	QUNTY	tMWATT	Util comb. turb. additions by Nerc
	UADDNUU	(2,MNUMNR,MNUMYR)	QUNTY	tMWATT	Util nuclear additions by Nerc
	UADDRNU	(2,MNUMNR,MNUMYR)	QUNTY	tMWATT	Util hydro additions by Nerc
	UADDPSU	(2,MNUMNR,MNUMYR)	QUNTY	tMWATT	Util pump storage additions by Ner
	UADDTLU	(2,MNUMNR,MNUMYR)	QUNTY	tMWATT	Util total additions by Nerc
	UADDCSN	(2,MNUMNR,MNUMYR)	QUNTY	tMWATT	NUGS coal additions by Nerc
	UADDOSN	(2,MNUMNR,MNUMYR)	QUNTY	tMWATT	NUGS gas additions by Nerc
	UADDCCN	(2,MNUMNR,MNUMYR)	QUNTY	tMWATT	NUGS oil additions by Nerc
	UADDCTN	(2,MNUMNR,MNUMYR)	QUNTY	tMWATT	NUGS hydro additions by Nerc
	UADDNUN	(2,MNUMNR,MNUMYR)	QUNTY	tMWATT	NUGS other additions by Nerc
	UADDRNN	(2,MNUMNR,MNUMYR)	QUNTY	tMWATT	NUGS total additions by Nerc
	UADDPSN	(2,MNUMNR,MNUMYR)	QUNTY	tMWATT	NUGS total additions by Nerc
	UADDTLN	(2,MNUMNR,MNUMYR)	QUNTY	tMWATT	NUGS total additions by Nerc
	XPELAVN	(MNUMNR,MECPYR)	QUNTY	tMWATT	Exp. Avoided EL cost by Nerc
	UADDHYT	(MNUMNR,MECPYR)	QUNTY	tMWATT	Total hydro additions by Nerc
	UADDGET	(MNUMNR,MECPYR)	QUNTY	tMWATT	Tot Geoth. Additions by Nerc
	UADDMST	(MNUMNR,MECPYR)	QUNTY	tMWATT	Tot MSW additions by Nerc
	UADDWDT	(MNUMNR,MECPYR)	QUNTY	tMWATT	Tot wood additions by Nerc
	UADDSTT	(MNUMNR,MECPYR)	QUNTY	tMWATT	Tot solar th. additions by Nerc
	UADDPVT	(MNUMNR,MECPYR)	QUNTY	tMWATT	Tot PV additions by Nerc
	UADDWNT	(MNUMNR,MECPYR)	QUNTY	tMWATT	Tot wind additions by Nerc
	UADDPST	(MNUMNR,MECPYR)	QUNTY	tMWATT	Tot pump stor. additions by Nerc
* LDSM Module Output					
ULDSMOUT			TYPE	UNITS	
	UDSMNRG	(MNUMNR,MNUMYR)	QUNTY	MKWH	DSM Energy Savings--Nerc (Mkwh)
	UDSMCAP	(MNUMNR,MNUMYR)	QUNTY	MKWH	DSM Capacity Savings--Nerc (Mkwh)
	UDSMEXP	(MNUMNR,MNUMYR)	QUNTY	MKWH	DSM Expenditures--Nerc (MM$)
* Utility ETT Module Output					
UETTOUT			TYPE	UNITS	
	UTDMMF	(MNUMNR,MNUMYR)	QUNTY	MKWH	Domestic Firm Power Sales--Nerc (M
	UTDMME	(MNUMNR,MNUMYR)	QUNTY	MKWH	Domestic Economy Sales--Nerc (Mkwh
	UTDMDF	(MNUMNR,MNUMYR)	QUNTY	m87$	Domestic Firm Power Sales--Nerc (M
	UTDMDE	(MNUMNR,MNUMYR)	QUNTY	m87$	Domestic Economy Sales--Nerc (MM$)
	UTIMPF	(MNUMNR,MNUMYR)	QUNTY	MKWH	Firm Power Imports--Nerc (Mkwh)
	UTIMPE	(MNUMNR,MNUMYR)	QUNTY	MKWH	Economy Power Imports--Nerc (Mkwh)
	UTEXPF	(MNUMNR,MNUMYR)	QUNTY	MKWH	Firm Power Exports--Nerc (Mwh)
	UTEXPE	(MNUMNR,MNUMYR)	QUNTY	MKWH	Economy Power Exports--Nerc (Mwh)
	UTEXMF	(MNUMNR,MNUMYR)	QUNTY	MKWH	Gross Dom. Firm Power --Nerc (Mkw
	UTEXME	(MNUMNR,MNUMYR)	QUNTY	MKWH	Gross Dom. Economy Sales-Nerc (Mkw
	UTEXDF	(MNUMNR,MNUMYR)	QUNTY	m87$	Gross Dom. Firm Power -Nerc (MM$
	UTEXDE	(MNUMNR,MNUMYR)	QUNTY	m87$	Gross Dom. Economy Sales--Nerc (MM
* UGOIL Electricity Market Module Output					

COMMON Block Name	Variable Name	Variable Dimensions	Variable Descriptors		Variable Descriptio
UGOILOUT			TYPE	UNITS	
	PRLELCR	(MNUMCR,MNUMYR)	PRICE	87$KWH	LS RESID PRC FOR D-F PLANTS
	PRHELCR	(MNUMCR,MNUMYR)	PRICE	87$KWH	HS RESID PRC FOR D-F PLANTS
	QRLELGR	(21,MNUMYR)	QUNTY	MKWH	LS RESID USE IN D-F PLANTS
	QRHELGR	(21,MNUMYR)	QUNTY	MKWH	HS RESID USE IN D-F PLANTS
	GSHRMIN	(21,MNUMYR)	QUNTY	MKWH	MIN GAS USE IN D-F PLANTS
	GRATMIN	(21,MNUMYR)	QUNTY	MKWH	G/O PRC RATIO AT MIN USE
	GSHRMAX	(21,MNUMYR)	QUNTY	MKWH	MAX GAS USE IN D-F PLANTS
	GRATMAX	(21,MNUMYR)	QUNTY	MKWH	G/O PRC RATIO AT MAX USE
	GSHRPAR	(21,MNUMYR)	QUNTY	MKWH	PAR GAS USE IN D-F PLANTS
	GRATPAR	(21,MNUMYR)	QUNTY	MKWH	G/O PRC RATIO AT PAR USE
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* Coal Module Output					
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COALOUT			TYPE	UNITS	
	COTN_TM	(MNUMCR,MNUMYR)	QUNTY	TON_ML	Coal transportation ton-miles
	COPRCLQ	(MNUMCR,MNUMYR)	QUNTY	tBTU	Supply of coal liquids
	COPRCLG	(MNUMCR,MNUMYR)	QUNTY	tBTU	Supply of coal gases
	COIM	(MNUMXR,CLTYPE,MNUMYR)	QUNTY	tBTU	Coal exports
	COIMP	(MNUMXR,CLTYPE,MNUMYR)	PRICE	87$BTU	Coal export prices
	COCCLQ	(MNUMCR,MNUMYR)	PRICE	87$BTU	Delivered costs of coal liquids
	COCCLG	(MNUMCR,MNUMYR)	PRICE	87$BTU	Delivered costs of coal gases
	COSUPC	(MNUMXR,CLTYPE,MNUMYR)	QUNTY	tBTU	Coal supply curves
	COELPRC	(CLTYPE,MNUMYR)	PRICE	87$BTU	Utility Coal price
	CLSYNGPR	(17,MNUMYR)	PRICE	87$BTU	Synthetic NG Price from Coal
	CLSYNGQN	(17,MNUMYR)	QUNTY	tBTU	Synthetic NG quantity
	CQSBB	(3,MNUMYR)	QUNTY	tBTU	Coal Prod (East,West Miss)
	CQSBT	(3,MNUMYR)	PARAM	SCALAR	Coal Conv Factor for Prod
	CPSB	(3,MNUMYR)	PRICE	87$BTU	Coal Minemouth Price
	CQDBFT	(MNUMCR, 6,MNUMYR)	PARAM	SCALAR	Coal Conv Factor for Cons
	CQDBFB	(MNUMCR, 6,MNUMYR)	QUNTY	tBTU	Imports, Exports, Stock Changes
	PBCELNR	(NDREGN,MNUMYR)	PRICE	87$BTU	VLS BIT COAL PRICE BY NERC
	PBDELNR	(NDREGN,MNUMYR)	PRICE	87$BTU	LS BIT COAL PRICE BY NERC
	PBMELNR	(NDREGN,MNUMYR)	PRICE	87$BTU	MS BIT COAL PRICE BY NERC
	PBHELNR	(NDREGN,MNUMYR)	PRICE	87$BTU	HS BIT COAL PRICE BY NERC
	PSCELNR	(NDREGN,MNUMYR)	PRICE	87$BTU	VLS SUB COAL PRICE BY NERC
	PSDELNR	(NDREGN,MNUMYR)	PRICE	87$BTU	LS SUB COAL PRICE BY NERC
	PSMELNR	(NDREGN,MNUMYR)	PRICE	87$BTU	MS SUB COAL PRICE BY NERC
	PSHELNR	(NDREGN,MNUMYR)	PRICE	87$BTU	HS SUB COAL PRICE BY NERC
	PLCELNR	(NDREGN,MNUMYR)	PRICE	87$BTU	VLS LIG COAL PRICE BY NERC
	PLDELNR	(NDREGN,MNUMYR)	PRICE	87$BTU	LS LIG COAL PRICE BY NERC
	PLMELNR	(NDREGN,MNUMYR)	PRICE	87$BTU	MS LIG COAL PRICE BY NERC
	PLHELNR	(NDREGN,MNUMYR)	PRICE	87$BTU	HS LIG COAL PRICE BY NERC
	BBCELNR	(NDREGN,MNUMYR)	LEVEL	SCALAR	VLS BIT COAL BTU FACT. BY NERC
	BBDELNR	(NDREGN,MNUMYR)	LEVEL	SCALAR	LS BIT COAL BTU FACT. BY NERC
	BBMELNR	(NDREGN,MNUMYR)	LEVEL	SCALAR	MS BIT COAL BTU FACT. BY NERC
	BBHELNR	(NDREGN,MNUMYR)	LEVEL	SCALAR	HS BIT COAL BTU FACT. BY NERC
	BSCELNR	(NDREGN,MNUMYR)	LEVEL	SCALAR	VLS SUB COAL BTU FACT. BY NERC
	BSDELNR	(NDREGN,MNUMYR)	LEVEL	SCALAR	LS SUB COAL BTU FACT. BY NERC
	BSMELNR	(NDREGN,MNUMYR)	LEVEL	SCALAR	MS SUB COAL BTU FACT. BY NERC
	BSHELNR	(NDREGN,MNUMYR)	LEVEL	SCALAR	HS SUB COAL BTU FACT. BY NERC
	BLCELNR	(NDREGN,MNUMYR)	LEVEL	SCALAR	VLS LIG COAL BTU FACT. BY NERC
	BLDELNR	(NDREGN,MNUMYR)	LEVEL	SCALAR	LS LIG COAL BTU FACT. BY NERC
	BLMELNR	(NDREGN,MNUMYR)	LEVEL	SCALAR	MS LIG COAL BTU FACT. BY NERC
	BLHELNR	(NDREGN,MNUMYR)	LEVEL	SCALAR	HS LIG COAL BTU FACT. BY NERC
	SBCELNR	(NDREGN,MNUMYR)	LEVEL	SCALAR	VLS BIT COAL SULF. FACT. BY NERC
	SBDELNR	(NDREGN,MNUMYR)	LEVEL	SCALAR	LS BIT COAL SULF. FACT. BY NERC
	SBMELNR	(NDREGN,MNUMYR)	LEVEL	SCALAR	MS BIT COAL SULF. FACT. BY NERC

COMMON Block Name	Variable Name	Variable Dimensions	Variable Descriptors		Variable Descriptio
	SBHELNR	(NDREGN,MNUMYR)	LEVEL	SCALAR	HS BIT COAL SULF. FACT. BY NERC
	SSCELNR	(NDREGN,MNUMYR)	LEVEL	SCALAR	VLS SUB COAL SULF. FACT. BY NERC
	SSDELNR	(NDREGN,MNUMYR)	LEVEL	SCALAR	LS SUB COAL SULF. FACT. BY NERC
	SSMELNR	(NDREGN,MNUMYR)	LEVEL	SCALAR	MS SUB COAL SULF. FACT. BY NERC
	SSHELNR	(NDREGN,MNUMYR)	LEVEL	SCALAR	HS SUB COAL SULF. FACT. BY NERC
	SLCELNR	(NDREGN,MNUMYR)	LEVEL	SCALAR	VLS LIG COAL SULF. FACT. BY NERC
	SLDELNR	(NDREGN,MNUMYR)	LEVEL	SCALAR	LS LIG COAL SULF. FACT. BY NERC
	SLMELNR	(NDREGN,MNUMYR)	LEVEL	SCALAR	MS LIG COAL SULF. FACT. BY NERC
	SLHELNR	(NDREGN,MNUMYR)	LEVEL	SCALAR	HS LIG COAL SULF. FACT. BY NERC
* Coal Module Report					
COALREP			TYPE	UNITS	
	COALPROD	(MNUMCR,MNUMLR,MNUMYR)	QUNTY	mSTONS	COAL DISTRIBUTION
	COALPROD2	(MNUMCR,MNUMLR,MNUMYR)	QUNTY	mSTONS	COAL DISTRIBUTION INCLUDING EXPORT
	COALIMP	(MNUMCR,MNUMYR)	QUNTY	mSTONS	COAL IMPORTS
	COALPRICE	(MNUMLR,MNUMYR)	PRICE	$/TON	COAL PRICE
	ABSULF	(4,MNUMYR)	QUNTY	mSTONS	Appalachia Bituminous Coal
	ALSULF	(4,MNUMYR)	QUNTY	mSTONS	Appalachia Lignite Coal
	IBSULF	(4,MNUMYR)	QUNTY	mSTONS	Interior Bituminous Coal
	ILSULF	(4,MNUMYR)	QUNTY	mSTONS	Interior Lignite Coal
	WBSULF	(4,MNUMYR)	QUNTY	mSTONS	West Bituminous Coal
	WSSULF	(4,MNUMYR)	QUNTY	mSTONS	West Sub-Bituminous Coal
	WLSULF	(4,MNUMYR)	QUNTY	mSTONS	West Lignite Coal
	WSCF	(4, 10, 6)	QUNTY	mSTONS	Steam Coal World Flows
	WMCF	(4, 10, 6)	QUNTY	mSTONS	Metallurgical Coal World Flows
	WTCF	(4, 10, 6)	QUNTY	mSTONS	Total Coal World Flows
* Industrial Module Output					
INDOUT			TYPE	UNITS	
	INGNELNU	(MNUMCR,MNUMYR)	QUNTY	tBTU	Nonutility generation of electrici
	INSGELNU	(MNUMCR,MNUMYR)	QUNTY	tBTU	Nonutility electricity sales to th
	INCAELNU	(MNUMCR,MNUMYR)	QUNTY	tBTU	Nonutility capacity
	INQNGNU	(MNUMCR,MNUMYR)	QUNTY	tBTU	Nonutility consumption: NG
	INQCLNU	(MNUMCR,MNUMYR)	QUNTY	tBTU	Nonutility consumption: Steam Coal
	INQRENU	(MNUMCR,MNUMYR)	QUNTY	tBTU	Nonutility consumption: Residual o
	INQBMNU	(MNUMCR,MNUMYR)	QUNTY	tBTU	Nonutility consumption: Biomass
	INQBMRN	(MNUMCR,MNUMYR)	QUNTY	tBTU	Consumption of renewables: Biomass
	INQHYRN	(MNUMCR,MNUMYR)	QUNTY	tBTU	Consumption of renewables: Hydro
	INQSORN	(MNUMCR,MNUMYR)	QUNTY	tBTU	Consumption of renewables: Solar
	INQWIRN	(MNUMCR,MNUMYR)	QUNTY	tBTU	Consumption of renewables: Wind
	INQGORN	(MNUMCR,MNUMYR)	QUNTY	tBTU	Consumption of renewables: Geother
	INQOTRN	(MNUMCR,MNUMYR)	QUNTY	tBTU	Consumption of renewables: Other
* Industrial Module Report					
INDREP			TYPE	UNITS	
	MANHP	(12,MNUMYR)	QUNTY	tBTU	MFG, HEAT & POWER
	NONHP	(8,MNUMYR)	QUNTY	tBTU	NON-MFG, HEAT & POWER
	MISCFD	(6,MNUMYR)	QUNTY	tBTU	PAPER INDUSTRY CONSUMPTION
	FOODCON	(8,MNUMYR)	QUNTY	tBTU	FOOD INDUSTRY CONSUMPTION
	PAPERCON	(8,MNUMYR)	QUNTY	tBTU	PAPER INDUSTRY CONSUMPTION
	CHEMCON	(8,MNUMYR)	QUNTY	tBTU	CHEMICAL INDUSTRY CONSUMPTION
	GLASSCON	(8,MNUMYR)	QUNTY	tBTU	GLASS INDUSTRY CONSUMPTION
	CEMENTCON	(8,MNUMYR)	QUNTY	tBTU	CEMENT INDUSTRY CONSUMPTION
	STEELCON	(10,MNUMYR)	QUNTY	tBTU	STEEL INDUSTRY CONSUMPTION
	ALUMCON	(8,MNUMYR)	QUNTY	tBTU	ALUMINUM INDUSTRY CONSUMPTION

COMMON Block Name	Variable Name	Variable Dimensions	Variable Descriptors	Variable Descriptio
	REFCON	(9,MNUMYR)	QUNTY tBTU	REFINERY INDUSTRY CONSUMPTION
* Residential Module Output Common Blocks				
HTCN			TYPE UNITS	
	HTRCON	(26, 7, 9)	QUNTY tBTU	Space Heating Consumption
CLCN			TYPE UNITS	
	COOLCN	(26, 3, 9)	QUNTY tBTU	Space Cooling Consumption
HWCN			TYPE UNITS	
	H2OCON	(26, 4, 9)	QUNTY tBTU	Hot Water Heat Consumption
CKCN			TYPE UNITS	
	CKCON	(26, 3, 9)	QUNTY tBTU	Cooking Consumption
DRYCN			TYPE UNITS	
	DRYCON	(26, 2, 9)	QUNTY tBTU	Dryer Consumption
RFCN			TYPE UNITS	
	REFCON	(26, 9)	QUNTY tBTU	Refrigeration Consumption
FZCN			TYPE UNITS	
	FRZCON	(26, 9)	QUNTY tBTU	Freezer Consumption
LTC			TYPE UNITS	
	LTCON	(26, 9)	QUNTY tBTU	Lighting Consumption
APC			TYPE UNITS	
	APCON	(26, 9)	QUNTY tBTU	Appliance Consumption
SHC			TYPE UNITS	
	SHTCON	(26, 7, 9)	QUNTY tBTU	Secondary Heat Consumption
* Residential Module Report Variables				
RESDREP			TYPE UNITS	
	RSEH	(MNUMYR, 3)	LEVEL MILL	Existing Housing
	RSNH	(MNUMYR, 3)	LEVEL MILL	New Housing
	RSHSEADD	(MNUMYR, 3)	LEVEL MILL	Housing Starts
	RSHTRCON	(MNUMYR, 8)	QUNTY tBTU	Space Heating Consumption
	RSCOOLCN	(MNUMYR, 3)	QUNTY tBTU	Space Cooling Consumption
	RSH20CON	(MNUMYR, 5)	QUNTY tBTU	Hot Water Heat Consumption
	RSCKCON	(MNUMYR, 3)	QUNTY tBTU	Cooking Consumption
	RSDRYCON	(MNUMYR, 2)	QUNTY tBTU	Dryer Consumption
	RSREFCON	(MNUMYR)	QUNTY tBTU	Refrigeration Consumption
	RSFRZCON	(MNUMYR)	QUNTY tBTU	Freezer Consumption
	RSLTCON	(MNUMYR)	QUNTY tBTU	Lighting Consumption
	RSAPCON	(MNUMYR, 4)	QUNTY tBTU	Appliance Consumption
	RSHTRS	(MNUMYR, 9)	QUNTY MILL	Heating Equipment
	RSCOOLERS	(MNUMYR, 5)	QUNTY MILL	Cooling Equipment
	RSWATER	(MNUMYR, 5)	QUNTY MILL	Water Equipment
	RSCOOK	(MNUMYR, 3)	QUNTY MILL	Cooking Equipment
	RSDRY	(MNUMYR, 2)	QUNTY MILL	Drying Equipment
	RSREF	(MNUMYR)	QUNTY MILL	Refrigerator Equipment
	RSFRZ	(MNUMYR)	QUNTY MILL	Freezer Equipment
	RSEEFHT	(MNUMYR, 5)	HEATRT FRACT	Heating Efficiency
	RSEEFCL	(MNUMYR, 5)	HEATRT FRACT	Cooling Efficiency

COMMON Block Name	Variable Name	Variable Dimensions	Variable Descriptors	Variable Descriptio
	RSEEFHW	(MNUMYR, 4)	HEATRT FRACT	Hot Water Efficiency
	RSEEFRF	(MNUMYR)	HEATRT FRACT	Refrigerator efficiency
	RSEEFFZ	(MNUMYR)	HEATRT FRACT	Freezer Efficiency
	RSNEFHT	(MNUMYR, 5)	HEATRT FRACT	Heating Efficiency
	RSNEFCL	(MNUMYR, 5)	HEATRT FRACT	Cooling Efficiency
	RSNEFHW	(MNUMYR, 4)	HEATRT FRACT	Hot Water Efficiency
	RSNEFRF	(MNUMYR)	HEATRT FRACT	Refrigerator Efficiency
	RSNEFFZ	(MNUMYR)	HEATRT FRACT	Freezer Efficiency
	QGERS	(MNUMCR,MNUMYR)	QUNTY tBTU	Geothermal Consumption
* Commercial Module Output				
COMOUT			TYPE UNITS	
	CMnuGen	(MNUMCR,MNUMYR)	QUNTY tBTU	Nonutility generation of electrici
	CMnuGrid	(MNUMCR,MNUMYR)	QUNTY tBTU	Nonutility electricity sales to th
	CMnuCap	(MNUMCR,MNUMYR)	QUNTY tBTU	Nonutility capacity
	CMnuConNG	(MNUMCR,MNUMYR)	QUNTY tBTU	Nonutility consumption: NG
	CMnuConSC	(MNUMCR,MNUMYR)	QUNTY tBTU	Nonutility consumption: Steam Coal
	CMnuConRS	(MNUMCR,MNUMYR)	QUNTY tBTU	Nonutility consumption: Residual o
	CMnuConBio	(MNUMCR,MNUMYR)	QUNTY tBTU	Nonutility consumption: Biomass
	CMrwConBio	(MNUMCR,MNUMYR)	QUNTY tBTU	Consumption of renewables: Biomass
	CMrwConHyd	(MNUMCR,MNUMYR)	QUNTY tBTU	Consumption of renewables: Hydro
	CMrwConSol	(MNUMCR,MNUMYR)	QUNTY tBTU	Consumption of renewables: Solar
	CMrwConWind	(MNUMCR,MNUMYR)	QUNTY tBTU	Consumption of renewables: Wind
	CMrwConGeo	(MNUMCR,MNUMYR)	QUNTY tBTU	Consumption of renewables: Geother
	CMrwConOth	(MNUMCR,MNUMYR)	QUNTY tBTU	Consumption of renewables: Other
	CMnuConDS	(MNUMCR,MNUMYR)	QUNTY tBTU	Nonutility Consumption of Dist
* Commercial Module Parameters				
COMPARAM			TYPE UNITS	
	CMRisk_Prem	(9)	PARAM SCALAR	(premium over zero risk rate)
	CMLog_Parm_A	(11)	PARAM SCALAR	(logistic survival function parm A
	CMLog_Parm_B	(11)	PARAM SCALAR	(logistic survival function parm B
	CMDSM_Capital	(45,MNUMCR)	PARAM SCALAR	(dollar value of capital incentive
	CMDSM_Rate	(45,MNUMCR)	PARAM SCALAR	(DSM rate incentives)
	CMBehav_Rule	(3)	PARAM SCALAR	(technology choice behavioral rule
	CMMinFuelGrowth	(5,MNUMCR)	PARAM SCALAR	(minor fuels growth rate)
	CMNonBldgGrowth	(8,MNUMCR)	PARAM SCALAR	(non-bldg growth rate)
	CMTechPenRate	(45, 9,MNUMCR)	PARAM SCALAR	(technology penetration rate)
	CMmode	(1)	PARAM SCALAR	(0= PC Standalone; 1= NEMS Integra
	CMSTElas	(1)	PARAM SCALAR	ST Elasticity (0= Off; 1= On)
	CMTechShareOpt	(45)	PARAM SCALAR	(compete technology (1) or use use
	EndUseConsump	(8, 9, 11,MNUMCR)	QUNTY tBTU	End Use Consumption
* Commercial Module Report Variables				
COMMREP			TYPE UNITS	
	CMUSSurvFloorTot	(MNUMYR)	LEVEL MILL	Surviving Floorspace
	CMUSNewFloorTot	(MNUMYR)	LEVEL MILL	Floorspace - New Additions
	CMUSConsumption	(7, 3,MNUMYR)	QUNTY tBTU	Consumption-by End-Use, Fuel
	CMSurvFloorTot	(11,MNUMYR)	QUNTY tBTU	Survival Flrspc-Bldg Type
	CMNewFlrSpace	(11,MNUMYR)	QUNTY tBTU	New Floorspace by Bld Type
	CMFinalEndUseCon	(11,MNUMYR)	QUNTY tBTU	Consumption by Bldg Type
	CMUSAvgEff	(6, 3,MNUMYR)	QUNTY tBTU	Avg Tech Eff by End Use, Fuel
* Transportation Module Report Variables				

COMMON Block Name	Variable Name	Variable Dimensions	Variable Descriptors		Variable Description
TRANREP			TYPE	UNITS	
	TRQHWY	(6,MNUMYR)	QUNTY	tBTU	Highway Energy Use
	TRQNHWY	(4,MNUMYR)	QUNTY	tBTU	Non-highway Energy Use
	TRQENUSE	(12,MNUMYR)	QUNTY	tBTU	Energy Use by Fuel Type
	TRQLD	(8,MNUMYR)	QUNTY	tBTU	Light-Duty Energy Use
	TRQFTRK	(5,MNUMYR)	QUNTY	tBTU	Freight Truck Energy Use
	TRQRRF	(3,MNUMYR)	QUNTY	tBTU	Railroad Freight Energy Use
	TRQDOMS	(3,MNUMYR)	QUNTY	tBTU	Domestic Shipping Energy Use
	TRQINTS	(2,MNUMYR)	QUNTY	tBTU	International Shipping Energy Use
	TRQAIRT	(2,MNUMYR)	QUNTY	tBTU	Air Transportation Energy Use
	TRQMIL	(4,MNUMYR)	QUNTY	tBTU	Military Energy Use
	TRQBUS	(5,MNUMYR)	QUNTY	tBTU	Bus Transportation Energy Use
	TRQRRP	(5,MNUMYR)	QUNTY	tBTU	Passenger Rail Energy Use
	TRQBOAT	(MNUMYR)	QUNTY	tBTU	Recreational Boats Energy Use
	TRQLUB	(MNUMYR)	QUNTY	tBTU	Lubricants Energy Use
	TREFFCAR	(8,MNUMYR)	QUNTY	MPG	New Car Fuel Eff by Size Class
	TREFFTRK	(8,MNUMYR)	QUNTY	MPG	New Truck Fuel Eff by Size Class
	TREFFALTC	(4,MNUMYR)	QUNTY	MPG	Alt Fuel Cars Eff by Size Class
	TREFFALTT	(4,MNUMYR)	QUNTY	MPG	Alt Fuel Trucks Eff by Size Class
	TRSLSHRC	(7,MNUMYR)	LEVEL	FRACT	New Car Sales Share
	TRSLSHRT	(7,MNUMYR)	LEVEL	FRACT	New Truck Sales Share
	TRHPCAR	(7,MNUMYR)	QUNTY	1000s	New Car Average Horsepower
	TRHPTRK	(7,MNUMYR)	QUNTY	1000s	New Truck Average Horsepower
	TRLDQTEK	(17,MNUMYR)	QUNTY	tBTU	Lt Duty Vehicle Energy Consumptn
	TRLDSALC	(17,MNUMYR)	QUNTY	1000s	Lt Duty New Car Sales
	TRLDSALT	(17,MNUMYR)	QUNTY	1000s	Lt Duty New Truck Sales
	TRLDSTKC	(17,MNUMYR)	QUNTY	1000s	Lt Duty New Car Stock
	TRLDSTKT	(17,MNUMYR)	QUNTY	1000s	Lt Duty New Truck Stock
	TRLDMPGC	(17,MNUMYR)	QUNTY	MPG	Lt Duty New Car Efficiency
	TRLDMPGT	(17,MNUMYR)	QUNTY	MPG	Lt Duty New Trk Efficiency
	TRLDMPGF	(3,MNUMYR)	QUNTY	MPG	Lt Duty Fleet Efficiency
	TRLDVMT	(17,MNUMYR)	QUNTY	SCALAR	Lt Duty Vehicle Miles Travelled
	TRLDVMTE	(12,MNUMYR)	LEVEL	SCALAR	Lt Duty VMT Effects
	TRTRAVLD	(11,MNUMYR)	QUNTY	SCALAR	Travel Demand
	TRAIRSLS	(2,MNUMYR)	QUNTY	1000s	Aircraft Sales
	TRAIRSTK	(2,MNUMYR)	QUNTY	1000s	Aircraft Stock
	TRAIREFFN	(3,MNUMYR)	QUNTY	MPG	Aircraft New Efficiency
	TRAIREFFS	(3,MNUMYR)	QUNTY	MPG	Aircraft Stock Efficiency
	TRSTMDEM	(2,MNUMYR)	LEVEL	1000s	Seat Miles Demanded
	TREFFTRKF	(3, 5,MNUMYR)	QUNTY	MPG	Fuel Eff by Trk Type by Fuel
	TRVMTTRK	(3, 5,MNUMYR)	QUNTY	1000s	VMT by Truck Type by Fuel
	TRTMRR	(2,MNUMYR)	QUNTY	TON_ML	Billion Ton Miles by Railroad
	TRTMSHIP	(2,MNUMYR)	QUNTY	TON_ML	Billion Ton Miles by Dom Ship
	TRIMSHIP	(MNUMYR)	QUNTY	tBTU	International Shipping - Imports
	TRXLDVMT	(MNUMYR)	INDEX	SCALAR	Light Duty Vehicle Index
	TRXFRVMT	(MNUMYR)	INDEX	SCALAR	Freight Truck Index
	TRXAIR	(MNUMYR)	INDEX	SCALAR	Air Travel Index
	TRXRAIL	(MNUMYR)	INDEX	SCALAR	Rail Travel Index
	TRXSHIP	(MNUMYR)	INDEX	SCALAR	Ship Travel Index
	TRXAIREFF	(MNUMYR)	INDEX	SCALAR	Aircraft Efficiency Index
	TRXFREFF	(MNUMYR)	INDEX	SCALAR	Freight Truck Efficiency Index
	TRXRAILEFF	(MNUMYR)	INDEX	SCALAR	Rail Efficiency Index
	TRXSHIPEFF	(MNUMYR)	INDEX	SCALAR	Domestic Shipping Eff Index
	TRQLDV	(9,MNUMCR,MNUMYR)	QUNTY	tBTU	Lt Duty Vehicle Energy Use
	TRQRAILR	(3,MNUMCR,MNUMYR)	QUNTY	tBTU	RR Passenger Energy Use
	FLTECHRPT	(2, 6,MNUMYR)	QUNTY	1000s	Fleet Car/Truck Sales
	FLTECHSTKRPT	(2, 6,MNUMYR)	QUNTY	1000s	Fleet Car/Truck Stock
	FLTFCLDVBTU	(2, 6,MNUMYR)	QUNTY	tBTU	Fleet Car/Truck Consumption

COMMON Block Name	Variable Name	Variable Dimensions	Variable Descriptors		Variable Descriptio
	FLTECHVMTRPT	(2, 6,MNUMYR)	QUNTY	1000s	Fleet Car/Truck VMT
	REGSALERPT	(9, 5,MNUMYR)	QUNTY	MILL	Regional Car Sales
	DEGRPT	(2,MNUMYR)	RATE	PERCNT	Degredation Factor
	TREFFFLT	(4,MNUMYR)	QUNTY	MPG	Fleet Vehicle Efficiency (EPA Rati
	EMLDTGAS	(MNPOLL,MNUMCR,MNUMYR)	QUNTY	mMTONS	Emmissions Lt Dt Gas
	EMLDTDES	(MNPOLL,MNUMCR,MNUMYR)	QUNTY	mMTONS	Emmissions Lt Dt DES
	EMLDTMET	(MNPOLL,MNUMCR,MNUMYR)	QUNTY	mMTONS	Emmissions Lt Dt MET
	EMLDTCNG	(MNPOLL,MNUMCR,MNUMYR)	QUNTY	mMTONS	Emmissions Lt Dt CNG
	EMLDTHYD	(MNPOLL,MNUMCR,MNUMYR)	QUNTY	mMTONS	Emmissions Lt Dt HYD
	EMLDTETH	(MNPOLL,MNUMCR,MNUMYR)	QUNTY	mMTONS	Emmissions Lt Dt ETH
	EMLDTLPG	(MNPOLL,MNUMCR,MNUMYR)	QUNTY	mMTONS	Emmissions Lt Dt LPG
	EMFRTGAS	(MNPOLL,MNUMCR,MNUMYR)	QUNTY	mMTONS	Emmissions Frght Gas
	EMFRTDES	(MNPOLL,MNUMCR,MNUMYR)	QUNTY	mMTONS	Emmissions Frght DES
	EMFRTCNG	(MNPOLL,MNUMCR,MNUMYR)	QUNTY	mMTONS	Emmissions Frght CNG
	EMRLTDES	(MNPOLL,MNUMCR,MNUMYR)	QUNTY	mMTONS	Emmissions Rail DES
	EMRLTRES	(MNPOLL,MNUMCR,MNUMYR)	QUNTY	mMTONS	Emmissions Rail RES
	EMDSTDES	(MNPOLL,MNUMCR,MNUMYR)	QUNTY	mMTONS	Emmissions Dom DES
	EMDSTRES	(MNPOLL,MNUMCR,MNUMYR)	QUNTY	mMTONS	Emmissions Dom RES
	EMDSTGAS	(MNPOLL,MNUMCR,MNUMYR)	QUNTY	mMTONS	Emmissions Dom GAS
	EMISTDES	(MNPOLL,MNUMCR,MNUMYR)	QUNTY	mMTONS	Emmissions Int DES
	EMISTRES	(MNPOLL,MNUMCR,MNUMYR)	QUNTY	mMTONS	Emmissions Int RES
	EMAITJET	(MNPOLL,MNUMCR,MNUMYR)	QUNTY	mMTONS	Emmissions Air Jet
	EMAITAVG	(MNPOLL,MNUMCR,MNUMYR)	QUNTY	mMTONS	Emmissions Air Avg
	EMMILT	(MNPOLL,MNUMCR,MNUMYR)	QUNTY	mMTONS	Emmissions Mil
	EMBUST	(MNPOLL,MNUMCR,MNUMYR)	QUNTY	mMTONS	Emmissions Bus
	EMRAILT	(MNPOLL,MNUMCR,MNUMYR)	QUNTY	mMTONS	Emmissions Rail
	EMRECT	(MNPOLL,MNUMCR,MNUMYR)	QUNTY	mMTONS	Emmissions Rec Boat
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* Macroeconomic Module Output					
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MACOUT			TYPE	UNITS	
	MC_GDP	(MNUMYR)	LEVEL	b87$	Real gross domestic product
	MC_GNP	(MNUMYR)	LEVEL	b87$	Real gross national product
	MC_PGDP	(MNUMYR)	INDEX	87=1.0	Implicit GDP price deflator
	MC_RMPUAANS	(MNUMYR)	RATE	PERCNT	Yield on AA utility bonds
	MC_REALRMGBLUS	(MNUMYR)	RATE	PERCNT	Yield on U.S. govt 10-yr bonds
	MC_RMGBS3NS	(MNUMYR)	RATE	PERCNT	Avg market rate of US Govt 3 mo bi
	MC_IFIXNR	(MNUMYR)	LEVEL	b87$	Real gross pvt nonres investment
	MC_ECIWSPNS	(MNUMYR)	INDEX	87=1.0	Employment cost index-pvt wages &
	MC_RMMBCNEWNS	(MNUMYR)	RATE	PERCNT	Avg Yield-New issue-Hi grade Corp
	MC_RMMTGCCNS	(MNUMYR)	RATE	PERCNT	Conventional commitment mortgage r
	MC_SQDTRUCKSL	(MNUMYR)	LEVEL	MILL	Truck deliveres-Light duty
	MC_RUC	(MNUMYR)	RATE	PERCNT	Unemployment rate
	MC_EXCH	(MNUMYR)	RATE	FCUR/$	U.S. trade-weighted exchange rate
	MC_EX82	(MNUMYR)	LEVEL	b87$	Real exports
	MC_IM82	(MNUMYR)	LEVEL	b87$	Real imports
	MC_SQTRCARS	(MNUMYR)	LEVEL	MILL	Unit sales of automobiles
	MC_CPI	(MNUMCR,MNUMYR)	INDEX	82=1.0	Consumer price index
	MC_YD	(MNUMCR,MNUMYR)	LEVEL	b87$	Real disposable personal income
	MC_YP	(MNUMCR,MNUMYR)	LEVEL	b87$	Real personal income
	MC_WSD	(MNUMCR,MNUMYR)	LEVEL	b87$	Wage & Salary disbursements
	MC_MFGI	(MNUMCR,MNUMYR)	INDEX	87=1.0	Index of mfg gross output
	MC_MFGWGRT	(MNUMCR,MNUMYR)	LEVEL	$/HR	Manufacturing wage rate
	MC_NMFGWGRT	(MNUMCR,MNUMYR)	LEVEL	$/HR	Non-manufacturing wage rate
	MC_POPAFO	(MNUMCR,MNUMYR)	LEVEL	MILL	Pop-incl armed forces overseas
	MC_POP16	(MNUMCR,MNUMYR)	LEVEL	MILL	Pop-aged 16 and over
	MC_COMMFLSP	(MNUMCR, 14,MNUMYR)	LEVEL	bSQFT	Commercial floorspace
	MC_EMPNA	(MNUMCR,MFTYPE,MNUMYR)	LEVEL	MILL	Employment-non-agriculture

COMMON Block Name	Variable Name	Variable Dimensions	Variable Descriptors	Variable Descriptio
	MC_NMFGO	(MNUMCR,NSICNM,MNUMYR)	LEVEL m82$	Real gross output:non-mfg
	MC_MFGO	(MNUMCR,MNSICM,MNUMYR)	LEVEL m82$	Real gross output:mfg
	MC_EXDN87	(MNUMYR)	LEVEL b87$	Exports of mershandise
	MC_SHUMBL	(MNUMCR,MNUMYR)	LEVEL MILL	Shipments of mobile homes
	MC_HUSTS1	(MNUMCR,MNUMYR)	LEVEL MILL	Housing starts-Single family
	MC_HUSTS2	(MNUMCR,MNUMYR)	LEVEL MILL	Housing starts-Multi family
	MC_KQMH	(MNUMCR,MNUMYR)	LEVEL MILL	Housing stock-Mobile homes
	MC_KQHUSTS1	(MNUMCR,MNUMYR)	LEVEL MILL	Housing stock-Single family
	MC_KQHUSTS2	(MNUMCR,MNUMYR)	LEVEL MILL	Housing stock-Multi family
	MC_GFML87	(MNUMYR)	LEVEL b87$	Fed Govt Purchases-Defense
	MC_SQTRCARSIMP	(MNUMYR)	LEVEL MILL	Unit sales of autos-Foreign
	MC_SQTRCARSDOM	(MNUMYR)	LEVEL MILL	Unit sales of autos-Domestic
	MC_CONS	(MNUMYR)	LEVEL b87$	Real Consumption
	MC_INVEST	(MNUMYR)	LEVEL b87$	Real Investment
	MC_GOVT	(MNUMYR)	LEVEL b87$	Real Govt Spending
	MC_JULCNF	(MNUMYR)	INDEX 82=1.0	Unit Labor Cost Index
	MC_WPI	(MNUMYR)	INDEX 82=1.0	Producer Price Index
	MC_WPI14	(MNUMYR)	INDEX 82=1.0	PPI - Transportation
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* MACRO Module Parameters				
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MACPARMS			TYPE UNITS	
	MCNMMAC	(1)	PARAM SCALAR	NUMBER OF MACRO VARIABLES, NOT REG
	MCNWLAG	(1)	PARAM SCALAR	NUMBER OF YEARS OF WPI LAGS FOR FO
	MCNELAG	(1)	PARAM SCALAR	NUMBER OF YEARS OF ENDOG. LAGS FOR
	MCNMIND	(1)	PARAM SCALAR	# OF FORECASTED INDUSTRY SECTORS I
	MCLHISYR	(1)	PARAM SCALAR	LAST HISTORICAL YEAR
	MCBIMPRD	(MNUMCR)	PARAM SCALAR	BASE YEAR MANUFACTURING OUTPUT,198
	MCNMMACREG	(1)	PARAM SCALAR	NUMBER OF MACRO VARIABLES, REGIONA
	MCNMFDVARS	(1)	PARAM SCALAR	NUMBER OF FINAL DEMAND VARIABLES
	MCNUMMNF	(1)	PARAM SCALAR	# OF MANUFACTURING VARIABLES IN BA
	MCNUMREGS	(1)	PARAM SCALAR	NUMBER OF REGIONS
	MCNUMNONMFG	(1)	PARAM SCALAR	# OF NO N-MANUF VARIABLES IN BASEL
	MCRETCOD	(1)	PARAM SCALAR	ERROR RETURN CODE
	MCTOTIND	(1)	PARAM SCALAR	TOTAL # OF IND SECTORS FORECAST LE
	MACINV	(1)	PARAM SCALAR	Investment Multiplication Factor
	MACLC	(1)	PARAM SCALAR	Labor Force Multiplication Factor
	MACRAW	(1)	PARAM SCALAR	Productivity Multiplication Factor
	MCRAMPINV	(1)	PARAM SCALAR	Investment Ramping Factor
	MCRAMPLC	(1)	PARAM SCALAR	Labor Force Ramping Factor
	MCRAMPRAW	(1)	PARAM SCALAR	Productivity Ramping Factor
	MCNMDRVRS	(1)	PARAM SCALAR	Number of Macro Driver Variables
	MCNMBDRVRS	(1)	PARAM SCALAR	Number of Macro baseline Driver Va
	MCADJ	(16,MNUMYR)	PARAM SCALAR	Adjustment Factors
	MCNMFLTYPE	(1)	PARAM SCALAR	Number of Floorspace types
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* MACRO Module Report Output				
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MACREP			TYPE UNITS	
	WPI05	(MNUMYR)	INDEX 89=1.0	AGGREGATE ENERGY PRICE INDEX
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* International Module Output				
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INTOUT			TYPE UNITS	
	IT_WOP	(MNUMYR, 2)	PRICE 87$BTU	WORLD OIL PRICE (
	Q_ITIMCRSC	(MNUMYR, 5, 5, 3)	QUNTY tBTU	CRUDE IMPORTS SUPPLY CURVE QUANTS
	P_ITIMCRSC	(MNUMYR, 5, 5, 3)	PRICE 87$BBL	CRUDE IMPORTS SUPPLY CURVE PRICES
	ITIMRGSC	(MNUMYR, 5, 3, 2)	QUNTY tBTU	REF GASOLINE IMPORT SUPPLY CURVE

COMMON Block Name	Variable Name	Variable Dimensions	Variable Descriptors	Variable Descriptio
	ITIMGSSC	(MNUMYR, 5, 3, 2)	QUNTY tBTU	GASOLINE "
	ITIMDSSC	(MNUMYR, 5, 3, 2)	QUNTY tBTU	DISTILLATE "
	ITIMLDSC	(MNUMYR, 5, 3, 2)	QUNTY tBTU	LO SUL DIS "
	ITIMLRSC	(MNUMYR, 5, 3, 2)	QUNTY tBTU	LO SUL RES "
	ITIMHRSC	(MNUMYR, 5, 3, 2)	QUNTY tBTU	HI SUL RES "
	ITIMJFSC	(MNUMYR, 5, 3, 2)	QUNTY tBTU	JET FUEL "
	ITIMLPSC	(MNUMYR, 5, 3, 2)	QUNTY tBTU	LPG "
	ITIMPFSC	(MNUMYR, 5, 3, 2)	QUNTY tBTU	PETCHEM FEED "
	ITIMOTSC	(MNUMYR, 5, 3, 2)	QUNTY tBTU	OTHER "
	ITIMMESC	(MNUMYR, 5, 3, 2)	QUNTY tBTU	METHANOL "
	ITIMMTSC	(MNUMYR, 5, 3, 2)	QUNTY tBTU	MTBE? "
	REPORT	(MNUMYR, 29)	QUNTY tBTU	REPORT WRITER VARIABLES
* Uranium Module Output				
UMMOUT			TYPE UNITS	
	UMPUM	(MNUMYR)	PRICE 87$BTU	Levelized nuclear prices
	UMQNUM	(MNUMPR,MNUMYR)	QUNTY tBTU	Natural uranium reactor demand
	UMQEUM	(MNUMPR,MNUMYR)	QUNTY tBTU	Enriched uranium reactor demand
* Capital Expenditures				
CAPEXP			TYPE UNITS	
	CAPERF	(MNUMYR)	PRICE b87$	Capital expenditures for refinerie
	CAPEOG	(MNUMYR)	PRICE b87$	Capital expenditures at the wellhe
	CAPENT	(MNUMYR)	PRICE b87$	Capital expenditures for NGTDM
	CAPEEL	(MNUMYR)	PRICE b87$	Capital expenditures for EMM
	CAPECL	(MNUMYR)	PRICE b87$	Capital expenditures for Coal Modu
* Demand Side Management				
DSM			TYPE UNITS	
	DSMQELRS	(MNUMCR,DSMPRS,MNUMYR)	QUNTY tBTU	DSM program savings from residenti
	DSMQELCM	(MNUMCR,DSMPCM,MNUMYR)	QUNTY tBTU	DSM program savings from commercia
* Emission Output				
EMISSION			TYPE UNITS	
	EMRFSA	(MNUMYR)	QUNTY TONS	Sulfur allowances
	EMELPSO2	(MNUMYR)	QUNTY $/TON	Sulfur dioxide emission allowance
	EMUMM	(MNUMYR)	QUNTY tMTONS	Spent nuclear fuel discharges
	EMRS	(4,MNPOLL,MNUMYR)	QUNTY mMTONS	Resd Emissions of Air Pollutants
	EMRSC	(MNUMCR,MNPOLL,MNUMYR)	QUNTY mMTONS	Resd Emissions by Region
	EMCM	(5,MNPOLL,MNUMYR)	QUNTY mMTONS	Comm Emissions by Air Pollutants
	EMCMC	(MNUMCR,MNPOLL,MNUMYR)	QUNTY mMTONS	Comm Emissions by Region
	EMINC	(4,MNPOLL,MNUMYR)	QUNTY mMTONS	Ind Emis by Fuel-Combustion
	EMINCC	(MNUMCR,MNPOLL,MNUMYR)	QUNTY mMTONS	Ind Emis by Region-Comb
	EMINCN	(MNUMCR,MNPOLL,MNUMYR)	QUNTY mMTONS	Ind Emis by Reg-Noncomb
	EMTR	(5,MNPOLL,MNUMYR)	QUNTY mMTONS	Transportation Emissions by Fuel
	EMTRC	(MNUMCR,MNPOLL,MNUMYR)	QUNTY mMTONS	Trans Emissions by Region
	EMTRS	(5,MNPOLL,MNUMYR)	QUNTY mMTONS	Trans Emissions by Trans Modes
	EMNT	(MNUMCR,MNPOLL,MNUMYR)	QUNTY mMTONS	NGTDM Emissions by Region
	EMOGC	(MNUMCR,MNPOLL,MNUMYR)	QUNTY mMTONS	Oil&Gas Emissions by Region
	EMOGCS	(2,MNPOLL,MNUMYR)	QUNTY mMTONS	O&G Emis by Activity (Onshore/Offs
	EMOGF	(2,MNPOLL,MNUMYR)	QUNTY mMTONS	O&G Emis by Fuel (Oil, NG)
	EMEL	(4,MNPOLL,MNUMYR)	QUNTY mMTONS	EMM Emissions by Fuel Type
	EMELC	(MNUMCR,MNPOLL,MNUMYR)	QUNTY mMTONS	EMM Emissions by Region
	EMPMC	(4,MNPOLL,MNUMYR)	QUNTY mMTONS	Petroleum Emis by Fuel-Combustion

COMMON Block Name	Variable Name	Variable Dimensions	Variable Descriptors	Variable Description
	EMPMCC	(MNUMCR,MNPOLL,MNUMYR)	QUNTY mMTONS	PMM Emis by Regn-Comb
	EMPMCN	(MNUMCR,MNPOLL,MNUMYR)	QUNTY mMTONS	PMM Emis by Reg-Noncomb
	EMCP	(MNUMCR,MNPOLL,MNUMYR)	QUNTY mMTONS	Coal Supply Emissions by Region
	EMCPS	(3,MNPOLL,MNUMYR)	QUNTY mMTONS	Coal Supply Emissions by Activity
	EMCS	(MNUMCR,MNPOLL,MNUMYR)	QUNTY mMTONS	Coal Synthetics Emissions by Reg
	EMRN	(3,MNPOLL,MNUMYR)	QUNTY mMTONS	Renewable Emissions by Fuel
	EMRNC	(MNUMCR,MNPOLL,MNUMYR)	QUNTY mMTONS	Renewable Emissions by Region
	EMCARBON	(FLTYPE,MNUMYR)	QUNTY mMTONS	National Carbon emissions by fuel
	EMRNET	(MNETOH,MNPOLL,MNUMYR)	QUNTY mMTONS	Ethanol Emissions by Vol
	EMRNEC	(MNETOH,MNPOLL,MNUMYR)	QUNTY mMTONS	Ethanol Emissions by Reg
	EMBTAX	(15,MNUMYR)	QUNTY 87$BTU	Btu Tax by Fuel
	EMETAX	(15,MNUMYR)	QUNTY 87$BTU	Excise (Consumption) Tax by Fuel
	EMEMTAX	(MNPOLL,MNUMYR)	QUNTY $/TON	Emissions Tax by Air Pollutant
	EMLIM	(3,MNUMYR)	QUNTY $/TON	Emission Constraints by (CO2,SOx,N
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* Cogeneration				
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COGEN			TYPE UNITS	
	CGOTCAP	(MNUMNR,MNUMYR, 4)	QUNTY MWATT	OTHER COGEN CAPACITY (MEGAWATTS)
	CGOTGEN	(MNUMNR,MNUMYR, 4)	QUNTY GWTHRS	OTHER COGEN GENERATION (GIGAWATT H
	CGOTHR	(4)	HEATRT BTUKWH	HEAT RATES BY FUEL FOR OTHER FACIL
	CGREQ	(MNUMCR,MNUMYR, 4, 2)	QUNTY tBTU	REFINERY FUEL CONSUMPT (TRILLION B
	CGRECAP	(MNUMCR,MNUMYR, 4, 2, 2)	QUNTY MWATT	REFINERY COGEN CAPACITY
	CGREGEN	(MNUMCR,MNUMYR, 4, 2)	QUNTY GWTHRS	GENERATION
	CGOGQ	(MNUMCR,MNUMYR, 4, 2)	HEATRT BTUKWH	EOR HEAT RATES BY FUEL (TRILLION B
	CGOGCAP	(MNUMCR,MNUMYR, 4, 2, 2)	QUNTY MWATT	OIL & GAS COGEN CAPACITY
	CGOGGEN	(MNUMCR,MNUMYR, 4, 2)	QUNTY GWTHRS	GENERATION
	CGINDQ	(MNUMCR,MNUMYR, 4, 2)	QUNTY tBTU	INDUSTRIAL FUEL CONSUMPT
	CGINDCAP	(MNUMCR,MNUMYR, 4, 2, 2)	QUNTY MWATT	INDUSTRIAL COGEN CAPACITY
	CGINDGEN	(MNUMCR,MNUMYR, 4, 2)	QUNTY GWTHRS	GENERATION
	CGCOMGEN	(MNUMCR,MNUMYR, 4)	QUNTY GWTHRS	NONUTIL GENERATION OF ELEC
	CGCOMQ	(MNUMCR,MNUMYR, 4)	QUNTY GWTHRS	NONUTIL ELEC SALES TO GRID
	CGCOMCAP	(MNUMCR,MNUMYR, 4, 2)	QUNTY MWATT	NONUTIL CAPACITY
	GRIDSHR	(MNUMCR,MNUMYR)	LEVEL SCALAR	GRID/OWN USE SHARES
	CGTLCAP	(MNUMNR,MNUMYR)	QUNTY MWATT	TOTAL COGEN CAPACITY
	CGTLGEN	(MNUMNR,MNUMYR, 2)	QUNTY GWTHRS	COGEN GENERATION GRID AND OWN USE
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* Renewable Information				
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WRENEW			TYPE UNITS	
	WCAHYEL	(MNUMNR,MNUMYR)	QUNTY UNIT1	UTIL HYDRO GENER CAPACITY MW
	WCFHYEL	(MNUMNR,MNUMYR)	QUNTY UNIT1	UTIL HYDRO CAPACITY FACTOR FRACT
	WCCHYEL	(MNUMNR,MNUMYR)	PRICE UNIT1	UTIL HYDRO CAPITAL COST $/KW
	WOCHYEL	(MNUMNR,MNUMYR)	PRICE UNIT1	UTIL HYDRO FIXED OP COST mills/Kw
	WVCHYEL	(MNUMNR,MNUMYR)	PRICE UNIT1	UTIL HYDRO VAR OP COST mills/Kwh
	WHRHYEL	(MNUMNR,MNUMYR)	QUNTY UNIT1	UTIL HYDRO HEAT RATE BTU/KWH
	WLIHYEL	(1)	QUNTY UNIT1	UTIL HYDRO UNIT LIFE YRS
	WCAGFEL	(MNUMNR,MNUMYR)	QUNTY UNIT1	UTIL FLASH GEOTH GENER CAPACITY MW
	WCFGFEL	(MNUMNR,MNUMYR)	QUNTY UNIT1	UTIL FLASH GEOTH CAPACITY FACTOR F
	WCCGFEL	(MNUMNR,MNUMYR)	PRICE UNIT1	UTIL FLASH GEOTH CAPITAL COST $/KW
	WOCGFEL	(MNUMNR,MNUMYR)	PRICE UNIT1	UTIL FLASH GEOTH FIXED OP COST mil
	WVCGFEL	(MNUMNR,MNUMYR)	PRICE UNIT1	UTIL FLASH GEOTH VAR OP COST mills
	WHRGFEL	(MNUMNR,MNUMYR)	QUNTY UNIT1	UTIL FLASH GEOTH HEAT RATE BTU/KWH
	WLIGFEL	(1)	QUNTY UNIT1	UTIL FLASH GEOTH UNIT LIFE YRS
	WCAGBEL	(MNUMNR,MNUMYR)	QUNTY UNIT1	UTIL BINARY GEOTH GENER CAPACITY M
	WCFGBEL	(MNUMNR,MNUMYR)	QUNTY UNIT1	UTIL BINARY GEOTH CAPACITY FACTOR
	WCCGBEL	(MNUMNR,MNUMYR)	PRICE UNIT1	UTIL BINARY GEOTH CAPITAL COST $/K
	WOCGBEL	(MNUMNR,MNUMYR)	PRICE UNIT1	UTIL BINARY GEOTH FIXED OP COST mi

COMMON Block Name	Variable Name	Variable Dimensions	Variable Descriptors	Variable Descriptio
	WVCGBEL	(MNUMNR,MNUMYR)	PRICE UNIT1	UTIL BINARY GEOTH VAR OP COST mill
	WHRGBEL	(MNUMNR,MNUMYR)	QUNTY UNIT1	UTIL BINARY GEOTH HEAT RATE BTU/KW
	WLIGBEL	(1)	QUNTY UNIT1	UTIL BINARY GEOTH UNIT LIFE YRS
	WCAGERS	(MNUMCR,MNUMYR)	QUNTY UNIT1	RESIDEN GEOTH CAP MMBTU
	WCFGERS	(MNUMCR,MNUMYR)	QUNTY UNIT1	RESIDEN GEOTH CAP FACTOR HOURS
	WCCGERS	(MNUMCR,MNUMYR)	PRICE UNIT1	RESIDEN GEOTH CAP COST $/MMBTU-YR
	WOCGERS	(MNUMCR,MNUMYR)	PRICE UNIT1	RESIDEN GEOTH FIXED OP COST mills/
	WVCGERS	(MNUMCR,MNUMYR)	PRICE UNIT1	RESIDEN GEOTH VAR OP COST mills/Kw
	WHRGERS	(MNUMCR,MNUMYR)	QUNTY UNIT1	RESIDEN GEOTH HEAT RATE COP
	WLIGERS	(1)	QUNTY UNIT1	RESIDEN GEOTH LIFE YRS
	WCAGECM	(MNUMCR,MNUMYR)	QUNTY UNIT1	COMMERC GEOTH CAP MMBTU
	WCFGECM	(MNUMCR,MNUMYR)	QUNTY UNIT1	COMMERC GEOTH CAP FACTOR HOURS
	WCCGECM	(MNUMCR,MNUMYR)	PRICE UNIT1	COMMERC GEOTH CAP COST $/MMBTU-YR
	WOCGECM	(MNUMCR,MNUMYR)	PRICE UNIT1	COMMERC GEOTH FIXED OP COST mills/
	WVCGECM	(MNUMCR,MNUMYR)	PRICE UNIT1	COMMERC GEOTH VAR OP COST mills/Kw
	WHRGECM	(MNUMCR,MNUMYR)	QUNTY UNIT1	COMMERC GEOTH HEAT RATE COP
	WLIGECM	(1)	QUNTY UNIT1	COMMERC GEOTH LIFE YRS
	WCAMSEL	(MNUMNR,MNUMYR)	QUNTY UNIT1	UTIL MSW GENER CAPACITY MW
	WCFMSEL	(MNUMNR,MNUMYR)	QUNTY UNIT1	UTIL MSW CAPACITY FACTOR FRACT
	WCCMSEL	(MNUMNR,MNUMYR)	PRICE UNIT1	UTIL MSW CAPITAL COST $/KW
	WOCMSEL	(MNUMNR,MNUMYR)	PRICE UNIT1	UTIL MSW FIXED OP COST mills/Kw
	WVCMSEL	(MNUMNR,MNUMYR)	PRICE UNIT1	UTIL MSW VAR OP COST mills/Kwh
	WHRMSEL	(MNUMNR,MNUMYR)	QUNTY UNIT1	UTIL MSW HEAT RATE BTU/KWH
	WHCMSEL	(MNUMNR,MNUMYR)	QUNTY UNIT1	UTIL MSW HEAT CONT BTU/LB
	WLIMSEL	(1)	QUNTY UNIT1	UTIL MSW UNIT LIFE YRS
	WCAMSCM	(MNUMCR,MNUMYR)	QUNTY UNIT1	COMMERC MSW CAP MW
	WCFMSCM	(MNUMCR,MNUMYR)	QUNTY UNIT1	COMMERC MSW CAP FACTOR FRACT
	WCCMSCM	(MNUMCR,MNUMYR)	PRICE UNIT1	COMMERC MSW CAP COST $/KW
	WOCMSCM	(MNUMCR,MNUMYR)	PRICE UNIT1	COMMERC MSW FIXED OP COST mills/Kw
	WVCMSCM	(MNUMCR,MNUMYR)	PRICE UNIT1	COMMERC MSW VAR OP COST mills/Kwh
	WHRMSCM	(MNUMCR,MNUMYR)	QUNTY UNIT1	COMMERC MSW HEAT RATE BTU/KWH
	WHCMSCM	(MNUMCR,MNUMYR)	QUNTY UNIT1	COMMERC MSW HEAT CONT BTU/LB
	WLIMSCM	(1)	QUNTY UNIT1	COMMERC MSW LIFE YRS
	WCAMSIN	(MNUMCR,MNUMYR)	QUNTY UNIT1	INDUST MSW CAP MW
	WCFMSIN	(MNUMCR,MNUMYR)	QUNTY UNIT1	INDUST MSW CAP FACTOR FRACT
	WCCMSIN	(MNUMCR,MNUMYR)	PRICE UNIT1	INDUST MSW CAP COST $/KW
	WOCMSIN	(MNUMCR,MNUMYR)	PRICE UNIT1	INDUST MSW FIXED OP COST mills/Kw
	WVCMSIN	(MNUMCR,MNUMYR)	PRICE UNIT1	INDUST MSW VAR OP COST mills/Kwh
	WHRMSIN	(MNUMCR,MNUMYR)	QUNTY UNIT1	INDUST MSW HEAT RATE BTU/KWH
	WHCMSIN	(MNUMCR,MNUMYR)	QUNTY UNIT1	INDUST MSW HEAT CONT BTU/LB
	WLIMSIN	(1)	QUNTY UNIT1	INDUST MSW LIFE YRS
	WCABMEL	(MNUMNR,MNUMYR)	QUNTY UNIT1	UTIL WOOD GENER CAPACITY MW
	WCFBMEL	(MNUMNR,MNUMYR)	QUNTY UNIT1	UTIL WOOD CAPACITY FACTOR FRACT
	WCCBMEL	(MNUMNR,MNUMYR)	PRICE UNIT1	UTIL WOOD CAPITAL COST $/KW
	WOCBMEL	(MNUMNR,MNUMYR)	PRICE UNIT1	UTIL WOOD FIXED OP COST mills/Kw
	WVCBMEL	(MNUMNR,MNUMYR)	PRICE UNIT1	UTIL WOOD VAR OP COST mills/Kwh
	WHRBMEL	(MNUMNR,MNUMYR)	QUNTY UNIT1	UTIL WOOD HEAT RATE BTU/KWH
	WHCBMEL	(MNUMNR,MNUMYR)	QUNTY UNIT1	UTIL WOOD HEAT CONT MMBTU/TON
	WLIBMEL	(1)	QUNTY UNIT1	UTIL WOOD UNIT LIFE YRS
	WCABMRS	(MNUMCR,MNUMYR)	QUNTY UNIT1	RESIDEN WOOD CAP MMBTU
	WCFBMRS	(MNUMCR,MNUMYR)	QUNTY UNIT1	RESIDEN WOOD CAP FACTOR FRACT
	WCCBMRS	(MNUMCR,MNUMYR)	PRICE UNIT1	RESIDEN WOOD CAP COST $/MMBTU-YR
	WOCBMRS	(MNUMCR,MNUMYR)	PRICE UNIT1	RESIDEN WOOD FIXED OP COST mills/K
	WVCBMRS	(MNUMCR,MNUMYR)	PRICE UNIT1	RESIDEN WOOD VAR OP COST mills/Kwh
	WHRBMRS	(MNUMCR,MNUMYR)	QUNTY UNIT1	RESIDEN WOOD HEAT RATE MMBTU/TON
	WLIBMRS	(1)	QUNTY UNIT1	RESIDEN WOOD LIFE YRS
	WCABMCM	(MNUMCR,MNUMYR)	QUNTY UNIT1	COMMERC WOOD CAP MMBTU
	WCFBMCM	(MNUMCR,MNUMYR)	QUNTY UNIT1	COMMERC WOOD CAP FACTOR FRACT

COMMON Block Name	Variable Name	Variable Dimensions	Variable Descriptors	Variable Descriptio
	WCCBMCM	(MNUMCR,MNUMYR)	PRICE UNIT1	COMMERC WOOD CAP COST $/MMBTU-YR
	WOCBMCM	(MNUMCR,MNUMYR)	PRICE UNIT1	COMMERC WOOD FIXED OP COST mills/K
	WVCBMCM	(MNUMCR,MNUMYR)	PRICE UNIT1	COMMERC WOOD VAR OP COST mills/Kwh
	WHRBMCM	(MNUMCR,MNUMYR)	QUNTY UNIT1	COMMERC WOOD HEAT RATE MMBTU/TON
	WLIBMCM	(1)	QUNTY UNIT1	COMMERC WOOD LIFE YRS
	WCABMIN	(MNUMCR,MNUMYR)	QUNTY UNIT1	INDUST WOOD CAP MMBTU
	WCFBMIN	(MNUMCR,MNUMYR)	QUNTY UNIT1	INDUST WOOD CAP FACTOR FRACT
	WCCBMIN	(MNUMCR,MNUMYR)	PRICE UNIT1	INDUST WOOD CAP COST $/MMBTU-YR
	WOCBMIN	(MNUMCR,MNUMYR)	PRICE UNIT1	INDUST WOOD FIXED OP COST mills/Kw
	WVCBMIN	(MNUMCR,MNUMYR)	PRICE UNIT1	INDUST WOOD VAR OP COST mills/Kwh
	WHRBMIN	(MNUMCR,MNUMYR)	QUNTY UNIT1	INDUST WOOD HEAT RATE MMBTU/TON
	WLIBMIN	(1)	QUNTY UNIT1	INDUST WOOD LIFE YRS
	WCASTEL	(MNUMNR,MNUMYR)	QUNTY UNIT1	UTIL SOLAR TH GENER CAPACITY MW
	WCFSTEL	(MNUMNR,MNUMYR)	QUNTY UNIT1	UTIL SOLAR TH CAPACITY FACTOR FRAC
	WCCSTEL	(MNUMNR,MNUMYR)	PRICE UNIT1	UTIL SOLAR TH CAPITAL COST $/KW
	WOCSTEL	(MNUMNR,MNUMYR)	PRICE UNIT1	UTIL SOLAR TH FIXED OP COST mills/
	WVCSTEL	(MNUMNR,MNUMYR)	PRICE UNIT1	UTIL SOLAR TH VAR OP COST mills/Kw
	WHRSTEL	(MNUMNR,MNUMYR)	QUNTY UNIT1	UTIL SOLAR TH HEAT RATE BTU/KWH
	WHCSTEL	(MNUMNR,MNUMYR)	QUNTY UNIT1	UTIL SOLAR TH HEAT CONT BTU/SFT
	WLISTEL	(1)	QUNTY UNIT1	UTIL SOLAR TH UNIT LIFE YRS
	WCASWRS	(MNUMCR,MNUMYR)	QUNTY UNIT1	RESIDEN SOL TH CAP MMBTU
	WCFSWRS	(MNUMCR,MNUMYR)	QUNTY UNIT1	RESIDEN SOL TH CAP FACTOR HOURS
	WCCSWRS	(MNUMCR,MNUMYR)	PRICE UNIT1	RESIDEN SOL TH CAP COST $/MMBTU-YR
	WOCSWRS	(MNUMCR,MNUMYR)	PRICE UNIT1	RESIDEN SOL TH FIXED OP COST mills
	WVCSWRS	(MNUMCR,MNUMYR)	PRICE UNIT1	RESIDEN SOL TH VAR OP COST mills/K
	WHRSWRS	(MNUMCR,MNUMYR)	QUNTY UNIT1	RESIDEN SOL TH HEAT RATE MMBTU/SFT
	WLISWRS	(1)	QUNTY UNIT1	RESIDEN SOL TH LIFE YRS
	WCASSRS	(MNUMCR,MNUMYR)	QUNTY UNIT1	RESIDEN SOL TH CAP MMBTU
	WCFSSRS	(MNUMCR,MNUMYR)	QUNTY UNIT1	RESIDEN SOL TH CAP FACTOR HOURS
	WCCSSRS	(MNUMCR,MNUMYR)	PRICE UNIT1	RESIDEN SOL TH CAP COST $/MMBTU-YR
	WOCSSRS	(MNUMCR,MNUMYR)	PRICE UNIT1	RESIDEN SOL TH FIXED OP COST mills
	WVCSSRS	(MNUMCR,MNUMYR)	PRICE UNIT1	RESIDEN SOL TH VAR OP COST mills/K
	WHRSSRS	(MNUMCR,MNUMYR)	QUNTY UNIT1	RESIDEN SOL TH HEAT RATE MMBTU/SFT
	WLISSRS	(1)	QUNTY UNIT1	RESIDEN SOL TH LIFE YRS
	WCASWCM	(MNUMCR,MNUMYR)	QUNTY UNIT1	COMMERC SOL TH CAP MMBTU
	WCFSWCM	(MNUMCR,MNUMYR)	QUNTY UNIT1	COMMERC SOL TH CAP FACTOR HOURS
	WCCSWCM	(MNUMCR,MNUMYR)	PRICE UNIT1	COMMERC SOL TH CAP COST $/MMBTU-YR
	WOCSWCM	(MNUMCR,MNUMYR)	PRICE UNIT1	COMMERC SOL TH FIXED OP COST mills
	WVCSWCM	(MNUMCR,MNUMYR)	PRICE UNIT1	COMMERC SOL TH VAR OP COST mills/K
	WHRSWCM	(MNUMCR,MNUMYR)	QUNTY UNIT1	COMMERC SOL TH HEAT RATE MMBTU/SFT
	WLISWCM	(1)	QUNTY UNIT1	COMMERC SOL TH LIFE YRS
	WCASSCM	(MNUMCR,MNUMYR)	QUNTY UNIT1	COMMERC SOL TH CAP MMBTU
	WCFSSCM	(MNUMCR,MNUMYR)	QUNTY UNIT1	COMMERC SOL TH CAP FACTOR HOURS
	WCCSSCM	(MNUMCR,MNUMYR)	PRICE UNIT1	COMMERC SOL TH CAP COST $/MMBTU-YR
	WOCSSCM	(MNUMCR,MNUMYR)	PRICE UNIT1	COMMERC SOL TH FIXED OP COST mills
	WVCSSCM	(MNUMCR,MNUMYR)	PRICE UNIT1	COMMERC SOL TH VAR OP COST mills/K
	WHRSSCM	(MNUMCR,MNUMYR)	QUNTY UNIT1	COMMERC SOL TH HEAT RATE MMBTU/SFT
	WLISSCM	(1)	QUNTY UNIT1	COMMERC SOL TH LIFE YRS
	WCAPVEL	(MNUMNR,MNUMYR)	QUNTY UNIT1	UTIL PHOTOV GENER CAPACITY MW
	WCFPVEL	(MNUMNR,MNUMYR)	QUNTY UNIT1	UTIL PHOTOV CAPACITY FACTOR FRACT
	WCCPVEL	(MNUMNR,MNUMYR)	QUNTY UNIT1	UTIL PHOTOV CAPITAL COST $/KW
	WOCPVEL	(MNUMNR,MNUMYR)	PRICE UNIT1	UTIL PHOTOV FIXED OP COST mills/Kw
	WVCPVEL	(MNUMNR,MNUMYR)	PRICE UNIT1	UTIL PHOTOV VAR OP COST mills/Kwh
	WHRPVEL	(MNUMNR,MNUMYR)	QUNTY UNIT1	UTIL PHOTOV HEAT RATE BTU/KWH
	WHCPVEL	(MNUMNR,MNUMYR)	QUNTY UNIT1	UTIL PHOTOV HEAT CONT BTU/SFT
	WLIPVEL	(1)	QUNTY UNIT1	UTIL PHOTOV UNIT LIFE YRS
	WCAPVRS	(MNUMCR,MNUMYR)	QUNTY UNIT1	RESIDEN SOL PV CAP MMBTU
	WCFPVRS	(MNUMCR,MNUMYR)	QUNTY UNIT1	RESIDEN SOL PV CAP FACTOR HOURS

COMMON Block Name	Variable Name	Variable Dimensions	Variable Descriptors	Variable Descriptio
	WCCPVRS	(MNUMCR,MNUMYR)	PRICE UNIT1	RESIDEN SOL PV CAP COST $/MMBTU-YR
	WOCPVRS	(MNUMCR,MNUMYR)	PRICE UNIT1	RESIDEN SOL PV FIXED OP COST mills
	WVCPVRS	(MNUMCR,MNUMYR)	PRICE UNIT1	RESIDEN SOL PV VAR OP COST mills/K
	WHRPVRS	(MNUMCR,MNUMYR)	QUNTY UNIT1	RESIDEN SOL PV HEAT RATE BTU/KWH
	WHCPVRS	(MNUMCR,MNUMYR)	QUNTY UNIT1	RESIDEN SOL PV HEAT CONT MMBTU/SFT
	WLIPVRS	(1)	QUNTY UNIT1	RESIDEN SOL PV LIFE YRS
	WCAPVCM	(MNUMCR,MNUMYR)	QUNTY UNIT1	COMMERC SOL PV CAP MMBTU
	WCFPVCM	(MNUMCR,MNUMYR)	QUNTY UNIT1	COMMERC SOL PV CAP FACTOR HOURS
	WCCPVCM	(MNUMCR,MNUMYR)	PRICE UNIT1	COMMERC SOL PV CAP COST $/MMBTU-YR
	WOCPVCM	(MNUMCR,MNUMYR)	PRICE UNIT1	COMMERC SOL PV FIXED OP COST mills
	WVCPVCM	(MNUMCR,MNUMYR)	PRICE UNIT1	COMMERC SOL PV VAR OP COST mills/K
	WHRPVCM	(MNUMCR,MNUMYR)	QUNTY UNIT1	COMMERC SOL PV HEAT RATE BTU/KWH
	WHCPVCM	(MNUMCR,MNUMYR)	QUNTY UNIT1	COMMERC SOL PV HEAT CONT MMBTU/SFT
	WLIPVCM	(1)	QUNTY UNIT1	COMMERC SOL PV LIFE YRS
	WCAWIEL	(MNUMNR,MNUMYR)	QUNTY UNIT1	UTIL WIND GENER CAPACITY MW
	WCFWIEL	(MNUMNR,MNUMYR)	QUNTY UNIT1	UTIL WIND CAPACITY FACTOR FRACT
	WCCWIEL	(MNUMNR,MNUMYR)	PRICE UNIT1	UTIL WIND CAPITAL COST $/KW
	WOCWIEL	(MNUMNR,MNUMYR)	PRICE UNIT1	UTIL WIND FIXED OP COST mills/Kw
	WVCWIEL	(MNUMNR,MNUMYR)	PRICE UNIT1	UTIL WIND VAR OP COST mills/Kwh
	WHRWIEL	(MNUMNR,MNUMYR)	QUNTY UNIT1	UTIL WIND HEAT RATE BTU/KWH
	WHCWIEL	(MNUMNR,MNUMYR)	QUNTY UNIT1	UTIL WIND HEAT CONT BTU/SQKM
	WLIWIEL	(1)	QUNTY UNIT1	UTIL WIND UNIT LIFE YRS
	WPETOH	(MNCROP,MNUMCR,MNUMYR,MNETOH)	QUNTY UNIT1	ETHANOL PRICE/STEP
	WQETOH	(MNCROP,MNUMCR,MNUMYR,MNETOH)	QUNTY UNIT1	ETHANOL QUAN/STEP
	WEMMSEL	(MNPOLL,MNUMYR)	QUNTY UNIT1	UTIL EMISSIONS FROM MSW LBS/MMBTU
	WEMBMEL	(MNPOLL,MNUMYR)	QUNTY UNIT1	UTIL EMISSIONS FROM BIOMASS LBS/MM
	WEMGFEL	(MNPOLL,MNUMYR)	QUNTY UNIT1	UTIL EMISS FROM GEOTH FLASH LBS/MM
	WCAV	(WNTECH)	QUNTY UNIT1	Year Available
	WCSU	(WNTECH,MNUMYR)	PRICE UNIT1	Subsidy (mills/Kwh)
	WCSI	(WNTECH,MNUMYR)	PRICE UNIT1	Subsidy ($/$ invested)
	WCLT	(WNTECH)	QUNTY UNIT1	Construction Lead Time (yr)
	WCPC	(WNTECH, 8)	QUNTY UNIT1	Percent Constucted (fract)
	WPOWIEL	(MNUMYR)	QUNTY UNIT1	Wind Planned Outage (fract of year
	WCRWIEL	(MNUMNR,MNUMYR)	QUNTY UNIT1	Wind Capacity Credit (fract)
	WSCWIEL	(MNUMNR,MNUMYR,MNUMCL)	QUNTY UNIT1	Avail Wind Capacity (MW)
	WSFWIEL	(MNUMNR,MNUMYR,MNUMCL,MNUMWI)	QUNTY UNIT1	Wind Cap Factor (DEC)
	WSSSTEL	(MNUMNR,MNUMYR,MNUMSO)	QUNTY UNIT1	Solar Thermal Supply Shape (by tim
	WSSPVEL	(MNUMNR,MNUMYR,MNUMSO)	QUNTY UNIT1	Photovoltaics Supply Shape (by tim
	WQCMSINEL	(4, 4,MNUMYR)	QUNTY UNIT1	MSW Electricity for Industries (TB
	WQCMSINST	(4, 4,MNUMYR)	QUNTY UNIT1	MSW Steam for Industries (TBtu)
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* Conversion Factors				
*========	================	====== ====== ====== ====== ======	====== ====== ====== ======	==================================
CONVFACT			TYPE UNITS	
	CFASQ	(1)	CONFAC mBTU/B	Asphalt and Road Oil.
	CFBUQ	(1)	CONFAC mBTU/B	Butane.
	CFDSQ	(1)	CONFAC mBTU/B	Distillate.
	CFETQ	(1)	CONFAC mBTU/B	Ethanol.
	CFIBQ	(1)	CONFAC mBTU/B	Isobutane.
	CFJFK	(1)	CONFAC mBTU/B	Jet Fuel. Kerosene
	CFJFN	(1)	CONFAC mBTU/B	Jet Fuel. Naphtha
	CFKSQ	(1)	CONFAC mBTU/B	Kerosene.
	CFLGQ	(MNUMYR)	CONFAC mBTU/B	Liquid Petroleum Gas.
	CFMGQ	(MNUMYR)	CONFAC mBTU/B	Motor Gasoline.
	CFOTQ	(MNUMYR)	CONFAC mBTU/B	Other Petr. (lubes, av gas)
	CFPPQ	(1)	CONFAC mBTU/B	Pentanes Plus.
	CFPFQ	(MNUMYR)	CONFAC mBTU/B	Petrochemical Feedstocks.
	CFPCQ	(1)	CONFAC mBTU/B	Petroleum Coke.

COMMON Block Name	Variable Name	Variable Dimensions	Variable Descriptors	Variable Descriptio
	CFPRQ	(1)	CONFAC mBTU/B	Propane.
	CFRSQ	(1)	CONFAC mBTU/B	Residual Fuel.
	CFSGQ	(1)	CONFAC mBTU/B	Still Gas.
	CFNGU	(1)	CONFAC tBTU/C	Natural Gas. Util - 1034
	CFNGN	(1)	CONFAC tBTU/C	Natural Gas. Nonutil - 1030
	CFNGC	(1)	CONFAC tBTU/C	Natural Gas. Consum/Prod-1031
	CFNGI	(1)	CONFAC tBTU/C	Natural Gas. Imports - 1004
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Appendix B

Alphabetical List of NEMS Variables

Appendix B. Alphabetical List of NEMS Variables

This appendix lists the NEMS Global Data Structure variables in alphabetical order, rather than by COMMON blocks, as shown in Appendix A.

COMMON	**Variable**
NCNTRL	ABSTOL
COALREP	ABSULF
COALREP	ALSULF
INDREP	ALUMCON
APC	APCON
NCNTRL	BASEYR
COALOUT	BBCELNR
COALOUT	BBDELNR
COALOUT	BBHELNR
COALOUT	BBMELNR
COALOUT	BLCELNR
COALOUT	BLDELNR
COALOUT	BLHELNR
COALOUT	BLMELNR
COALOUT	BSCELNR
COALOUT	BSDELNR
COALOUT	BSHELNR
COALOUT	BSMELNR
CAPEXP	CAPECL
CAPEXP	CAPEEL
CAPEXP	CAPENT
CAPEXP	CAPEOG
CAPEXP	CAPERF
INDREP	CEMENTCON
CONVFACT	CFASQ
CONVFACT	CFBUQ
CONVFACT	CFDSQ
CONVFACT	CFETQ
CONVFACT	CFIBQ
CONVFACT	CFJFK
CONVFACT	CFJFN
CONVFACT	CFKSQ
CONVFACT	CFLGQ
CONVFACT	CFMGQ
CONVFACT	CFNGC
CONVFACT	CFNGI
CONVFACT	CFNGN
CONVFACT	CFNGU
CONVFACT	CFOTQ
CONVFACT	CFPCQ
CONVFACT	CFPFQ
CONVFACT	CFPPQ
CONVFACT	CFPRQ
CONVFACT	CFRSQ
CONVFACT	CFSGQ
COGEN	CGCOMCAP
COGEN	CGCOMGEN
COGEN	CGCOMQ
COGEN	CGINDCAP
COGEN	CGINDGEN
COGEN	CGINDQ
COGEN	CGOGCAP
COGEN	CGOGGEN
COGEN	CGOGQ
COGEN	CGOTCAP
COGEN	CGOTGEN
COGEN	CGOTHR
COGEN	CGRECAP
COGEN	CGREGEN
COGEN	CGREQ
COGEN	CGTLCAP
COGEN	CGTLGEN
INDREP	CHEMCON
CKCN	CKCON
COALOUT	CLSYNGPR
COALOUT	CLSYNGQN
NGTDMOUT	CLSYNGWP
COMPARAM	CMmode
COMOUT	CMnuCap
COMOUT	CMnuConBio
COMOUT	CMnuConDS
COMOUT	CMnuConNG
COMOUT	CMnuConRS
COMMON	**Variable**
COMOUT	CMnuConSC
COMOUT	CMnuGen
COMOUT	CMnuGrid
COMOUT	CMrwConBio
COMOUT	CMrwConGeo
COMOUT	CMrwConHyd
COMOUT	CMrwConOth
COMOUT	CMrwConSol
COMOUT	CMrwConWind
COMPARAM	CMBehav_Rule
COMPARAM	CMDSM_Capital
COMPARAM	CMDSM_Rate
COMMREP	CMFinalEndUseCon
COMPARAM	CMLog_Parm_A
COMPARAM	CMLog_Parm_B
COMPARAM	CMMinFuelGrowth
COMMREP	CMNewFlrSpace
COMPARAM	CMNonBldgGrowth
COMPARAM	CMRisk_Prem
COMMREP	CMSurvFloorTot
COMPARAM	CMSTElas
COMPARAM	CMTechPenRate
COMPARAM	CMTechShareOpt
COMMREP	CMUSAvgEff
COMMREP	CMUSConsumption
COMMREP	CMUSNewFloorTot
COMMREP	CMUSSurvFloorTot
NCNTRL	CNVTST
COALREP	COALIMP
COALREP	COALPRICE
COALREP	COALPROD
COALREP	COALPROD2
COALOUT	COCCLG
COALOUT	COCCLQ
COALOUT	COELPRC
COALOUT	COIM
COALOUT	COIMP
CLCN	COOLCN
COALOUT	COPRCLG
COALOUT	COPRCLQ
COALOUT	COSUPC
COALOUT	COTN_TM
COALOUT	CPSB
COALOUT	CQDBFB
COALOUT	CQDBFT
COALOUT	CQSBB
COALOUT	CQSBT
NCNTRL	CTEST
NCNTRL	CURITR
NCNTRL	CURIYR
NCNTRL	DBDUMP
PMMOUT	DCRDWHP
TRANREP	DEGRPT
DRYCN	DRYCON
DSM	DSMQELCM
DSM	DSMQELRS
NCNTRL	DSMSWTCH
OGSMOUT	DVDRYFT
OGSMOUT	DVFTAGE
OGSMOUT	DVGASFT
OGSMOUT	DVOILFT
OGSMOUT	DVSPEND
COMPARAM	EndUseConsump
NCNTRL	ECPSTART
NCNTRL	ELASSW
TRANREP	EMAITAVG
TRANREP	EMAITJET
EMISSION	EMBTAX
TRANREP	EMBUST
EMISSION	EMCARBON
EMISSION	EMCM
EMISSION	EMCMC
EMISSION	EMCP
COMMON	**Variable**
EMISSION	EMCPS
EMISSION	EMCS
TRANREP	EMDSTDES
TRANREP	EMDSTGAS
TRANREP	EMDSTRES
EMISSION	EMEL
EMISSION	EMELC
EMISSION	EMELPSO2
EMISSION	EMEMTAX
EMISSION	EMETAX
TRANREP	EMFRTCNG
TRANREP	EMFRTDES
TRANREP	EMFRTGAS
EMISSION	EMINC
EMISSION	EMINCC
EMISSION	EMINCN
TRANREP	EMISTDES
TRANREP	EMISTRES
TRANREP	EMLDTCNG
TRANREP	EMLDTDES
TRANREP	EMLDTETH
TRANREP	EMLDTGAS
TRANREP	EMLDTHYD
TRANREP	EMLDTLPG
TRANREP	EMLDTMET
EMISSION	EMLIM
TRANREP	EMMILT
EMISSION	EMNT
EMISSION	EMOGC
EMISSION	EMOGCS
EMISSION	EMOGF
EMISSION	EMPMC
EMISSION	EMPMCC
EMISSION	EMPMCN
TRANREP	EMRAILT
TRANREP	EMRECT
EMISSION	EMRFSA
TRANREP	EMRLTDES
TRANREP	EMRLTRES
EMISSION	EMRN
EMISSION	EMRNC
EMISSION	EMRNEC
EMISSION	EMRNET
EMISSION	EMRS
EMISSION	EMRSC
EMISSION	EMTR
EMISSION	EMTRC
EMISSION	EMTRS
EMISSION	EMUMM
NCNTRL	ENDYR
NCNTRL	EXC
OGSMOUT	EXDRYFT
NCNTRL	EXE
OGSMOUT	EXFTAGE
NCNTRL	EXG
OGSMOUT	EXGASFT
NCNTRL	EXI
NCNTRL	EXK
NCNTRL	EXL
NCNTRL	EXM
NCNTRL	EXN
NCNTRL	EXO
OGSMOUT	EXOILFT
NCNTRL	EXR
OGSMOUT	EXSPEND
NCNTRL	EXT
NCNTRL	EXW
NCNTRL	FCRL
NCNTRL	FIRSYR
TRANREP	FLTECHRPT
TRANREP	FLTECHSTKRPT
TRANREP	FLTECHVMTRPT
TRANREP	FLTFCLDVBTU
COMMON	**Variable**
OGSMOUT	FNGEXPORT
OGSMOUT	FNGIMPORT
OGSMOUT	FNGIMPRIC
INDREP	FOODCON
NCNTRL	FRCTOL
FZCN	FRZCON
INDREP	GLASSCON
UGOILOUT	GRATMAX
UGOILOUT	GRATMIN
UGOILOUT	GRATPAR
COGEN	GRIDSHR
UGOILOUT	GSHRMAX
UGOILOUT	GSHRMIN
UGOILOUT	GSHRPAR
NCNTRL	HISTORY
HTCN	HTRCON
HWCN	H2OCON
COALREP	IBSULF
COALREP	ILSULF
INDOUT	INCAELNU
INDOUT	INGNELNU
INDOUT	INQBMNU
INDOUT	INQBMRN
INDOUT	INQCLNU
INDOUT	INQGORN
INDOUT	INQHYRN
INDOUT	INQNGNU
INDOUT	INQOTRN
INDOUT	INQRENU
INDOUT	INQSORN
INDOUT	INQWIRN
INDOUT	INSGELNU
NCNTRL	IRELAX
INTOUT	IT_WOP
INTOUT	ITIMDSSC
INTOUT	ITIMGSSC
INTOUT	ITIMHRSC
INTOUT	ITIMJFSC
INTOUT	ITIMLDSC
INTOUT	ITIMLPSC
INTOUT	ITIMLRSC
INTOUT	ITIMMESC
INTOUT	ITIMMTSC
NCNTRL	ITIMNG
INTOUT	ITIMOTSC
INTOUT	ITIMPFSC
INTOUT	ITIMRGSC
NCNTRL	I4SCNT
NCNTRL	I4SITE
NCNTRL	LASTYR
NCNTRL	LOOPOP
LTC	LTCON
NCNTRL	MACFDBK
MACPARMS	MACINV
MACPARMS	MACLC
MACPARMS	MACRAW
INDREP	MANHP
NCNTRL	MAXITR
MACOUT	MC_COMMFLSP
MACOUT	MC_CONS
MACOUT	MC_CPI
MACOUT	MC_ECIWSPNS
MACOUT	MC_EMPNA
MACOUT	MC_EXCH
MACOUT	MC_EXDN87
MACOUT	MC_EX82
MACOUT	MC_GDP
MACOUT	MC_GFML87
MACOUT	MC_GNP

COMMON	Variable	COMMON	Variable	COMMON	Variable	COMMON	Variable
MACOUT	MC_GOVT	OGSMOUT	OGELSNGOF	EFPOUT	PELTRNR	MPBLK	PRSAS
MACOUT	MC_HUSTS1	OGSMOUT	OGELSNGON	UEFPOUT	PELWH	MPBLK	PRSCM
MACOUT	MC_HUSTS2	OGSMOUT	OGEORCOGC	EFPOUT	PELWHNR	MPBLK	PRSEL
MACOUT	MC_IFIXNR	OGSMOUT	OGEORCOGG	MPBLK	PENAS	MPBLK	PRSIN
MACOUT	MC_IM82	NGTDMREP	OGIMCAN	EFPOUT	PENASNR	MPBLK	PRSTR
MACOUT	MC_INVEST	NGTDMREP	OGIMLNG	MPBLK	PENCM	NCNTRL	PRTDBGC
MACOUT	MC_JULCNF	NGTDMREP	OGIMMEX	EFPOUT	PENCMNR	NCNTRL	PRTDBGE
MACOUT	MC_KQHUSTS1	NGTDMREP	OGIMNGP	MPBLK	PENIN	NCNTRL	PRTDBGG
MACOUT	MC_KQHUSTS2	OGSMOUT	OGNGPRD	EFPOUT	PENINNR	NCNTRL	PRTDBGI
MACOUT	MC_KQMH	OGSMOUT	OGNGRSV	MPBLK	PENRS	NCNTRL	PRTDBGK
MACOUT	MC_MFGI	OGSMOUT	OGNGWHP	EFPOUT	PENRSNR	NCNTRL	PRTDBGL
MACOUT	MC_MFGO	OGSMOUT	OGNOWELL	MPBLK	PENTR	NCNTRL	PRTDBGM
MACOUT	MC_MFGWGRT	OGSMOUT	OGPCRWHP	EFPOUT	PENTRNR	NCNTRL	PRTDBGN
MACOUT	MC_NMFGO	OGSMOUT	OGPNGEXP	MPBLK	PEPAS	NCNTRL	PRTDBGO
MACOUT	MC_NMFGWGRT	OGSMOUT	OGPNGIMP	EFPOUT	PEPASNR	NCNTRL	PRTDBGR
MACOUT	MC_PGDP	OGSMOUT	OGPNGWHP	MPBLK	PEPCM	NCNTRL	PRTDBGT
MACOUT	MC_POPAFO	NGTDMREP	OGPRDNG	EFPOUT	PEPCMNR	NCNTRL	PRTDBGW
MACOUT	MC_POP16	NGTDMOUT	OGPRDNGOF	MPBLK	PEPIN	COALOUT	PSCELNR
MACOUT	MC_REALRMGBLUS	NGTDMOUT	OGPRDNGON	EFPOUT	PEPINNR	COALOUT	PSDELNR
MACOUT	MC_RMGBS3NS	OGSMOUT	OGPRRCAN	MPBLK	PEPRS	COALOUT	PSHELNR
MACOUT	MC_RMMBCNEWNS	OGSMOUT	OGPRRCO	EFPOUT	PEPRSNR	COALOUT	PSMELNR
MACOUT	MC_RMMTGCCNS	OGSMOUT	OGPRRNGOF	MPBLK	PEPTR	MPBLK	PTPAS
MACOUT	MC_RMPUAANS	OGSMOUT	OGPRRNGON	EFPOUT	PEPTRNR	MPBLK	PTPCM
MACOUT	MC_RUC	NGTDMREP	OGPRSUP	MPBLK	PETTR	MPBLK	PTPEL
MACOUT	MC_SHUMBL	NGTDMREP	OGPRSUP3	NGTDMOUT	PGCELGR	MPBLK	PTPIN
MACOUT	MC_SQDTRUCKSL	OGSMOUT	OGQANGTS	MPBLK	PGFAS	MPBLK	PTPRF
MACOUT	MC_SQTRCARS	OGSMOUT	OGQCRREP	MPBLK	PGFCM	MPBLK	PTPRS
MACOUT	MC_SQTRCARSDOM	OGSMOUT	OGQCRRSV	MPBLK	PGFEL	MPBLK	PTPTR
MACOUT	MC_SQTRCARSIMP	OGSMOUT	OGQEORCON	NGTDMOUT	PGFELGR	MPBLK	PUREL
MACOUT	MC_WPI	OGSMOUT	OGQEORNGC	MPBLK	PGFIN	INTOUT	Q_ITIMCRSC
MACOUT	MC_WPI14	OGSMOUT	OGQEORNGP	MPBLK	PGFRS	QBLK	QASIN
MACOUT	MC_WSD	OGSMOUT	OGQEORPR	MPBLK	PGFTR	UEFDOUT	QBCELNR
MACOUT	MC_YD	OGSMOUT	OGQLNGMAX	MPBLK	PGIAS	UEFDOUT	QBDELNR
MACOUT	MC_YP	OGSMOUT	OGQNGEXP	MPBLK	PGICM	UEFDOUT	QBHELNR
MACPARMS	MCADJ	OGSMOUT	OGQNGIMP	MPBLK	PGIEL	QBLK	QBMAS
MACPARMS	MCBIMPRD	OGSMOUT	OGQNGREP	NGTDMOUT	PGIELGR	QBLK	QBMCM
MACPARMS	MCLHISYR	OGSMOUT	OGQNGRSV	MPBLK	PGIIN	QBLK	QBMEL
MACPARMS	MCNELAG	OGSMOUT	OGQNGSAKMX	MPBLK	PGIRS	UEFDOUT	QBMELNR
MACPARMS	MCNMBDRVRS	OGSMOUT	OGRESCAN	MPBLK	PGITR	QBLK	QBMIN
MACPARMS	MCNMDRVRS	OGSMOUT	OGRESCO	MPBLK	PGPTR	QBLK	QBMRF
MACPARMS	MCNMFDVARS	OGSMOUT	OGRESNGOF	MPBLK	PHYTR	QBLK	QBMRS
MACPARMS	MCNMFLTYPE	OGSMOUT	OGRESNGON	MPBLK	PJFTR	QBLK	QBMSN
MACPARMS	MCNMIND	OGSMOUT	OGSPEND	MPBLK	PKSAS	UEFDOUT	QBTELNR
MACPARMS	MCNMMAC	OGSMOUT	OGTECHON	MPBLK	PKSCM	QBLK	QCIIN
MACPARMS	MCNMMACREG	NGTDMREP	OGWPRNG	MPBLK	PKSIN	QBLK	QCLAS
MACPARMS	MCNUMMNF	INTOUT	P_ITIMCRSC	MPBLK	PKSRS	QBLK	QCLCM
MACPARMS	MCNUMNONMFG	INDREP	PAPERCON	COALOUT	PLCELNR	QBLK	QCLEL
MACPARMS	MCNUMREGS	MPBLK	PASIN	COALOUT	PLDELNR	QBLK	QCLIN
MACPARMS	MCNWLAG	COALOUT	PBCELNR	MPBLK	PLGAS	QBLK	QCLRF
MACPARMS	MCRAMPINV	COALOUT	PBDELNR	MPBLK	PLGCM	QBLK	QCLRS
MACPARMS	MCRAMPLC	COALOUT	PBHELNR	MPBLK	PLGIN	QBLK	QCLSN
MACPARMS	MCRAMPRAW	COALOUT	PBMELNR	MPBLK	PLGRS	QBLK	QDSAS
MACPARMS	MCRETCOD	MPBLK	PCLAS	MPBLK	PLGTR	QBLK	QDSCM
MACPARMS	MCTOTIND	MPBLK	PCLCM	COALOUT	PLHELNR	QBLK	QDSEL
INDREP	MISCFD	MPBLK	PCLEL	COALOUT	PLMELNR	QBLK	QDSIN
NCNTRL	MMAC	MPBLK	PCLIN	MPBLK	PLPIN	QBLK	QDSRF
NCNTRL	MODELON	MPBLK	PCLRS	MPBLK	PMCIN	QBLK	QDSRS
NCNTRL	MORDER	MPBLK	PCLSN	MPBLK	PMETR	QBLK	QDSTR
NCNTRL	NCRL	PMMOUT	PCTPLT_PADD	MPBLK	PMGAS	QBLK	QEIEL
NGTDMREP	NGPIPCAP	MPBLK	PDSAS	MPBLK	PMGCM	QBLK	QELAS
NGTDMREP	NGSTRCAP	MPBLK	PDSCM	MPBLK	PMGIN	QBLK	QELCM
INDREP	NONHP	MPBLK	PDSEL	MPBLK	PMGTR	QBLK	QELIN
NCNTRL	NYRS	MPBLK	PDSIN	MPBLK	PNGAS	QBLK	QELRF
OGSMOUT	OGADFACT	MPBLK	PDSRS	MPBLK	PNGCM	QBLK	QELRS
OGSMOUT	OGANGTSMX	MPBLK	PDSTR	MPBLK	PNGEL	QBLK	QELTR
OGSMOUT	OGCNBLOSS	MPBLK	PELAS	MPBLK	PNGIN	QBLK	QENAS
OGSMOUT	OGCNCAP	EFPOUT	PELASNR	MPBLK	PNGRS	QBLK	QENCM
OGSMOUT	OGCNCON	UEFPOUT	PELAV	MPBLK	PNGTR	QBLK	QENIN
OGSMOUT	OGCNDEM	MPBLK	PELCM	MPBLK	POTAS	QBLK	QENRF
OGSMOUT	OGCNDMLOSS	EFPOUT	PELCMNR	MPBLK	POTIN	QBLK	QENRS
OGSMOUT	OGCNEXLOSS	UEFPOUT	PELCP	MPBLK	POTTR	QBLK	QENTR
OGSMOUT	OGCNFLW	EFPOUT	PELCPNR	MPBLK	PPFIN	QBLK	QEPAS
OGSMOUT	OGCNPARM1	UEFPOUT	PELFL	MPBLK	PRHAS	QBLK	QEPCM
OGSMOUT	OGCNPARM2	EFPOUT	PELFLNR	MPBLK	PRHEL	QBLK	QEPIN
OGSMOUT	OGCNPMARKUP	MPBLK	PELIN	UGOILOUT	PRHELCR	QBLK	QEPRF
OGSMOUT	OGCNPPRD	EFPOUT	PELINNR	MPBLK	PRHTR	QBLK	QEPRS
OGSMOUT	OGCNQPRD	UEFPOUT	PELOM	MPBLK	PRLAS	QBLK	QEPTR
OGSMOUT	OGCOPRD	EFPOUT	PELOMNR	MPBLK	PRLCM	QBLK	QETTR
OGSMOUT	OGCORSV	MPBLK	PELRS	MPBLK	PRLEL	UEFDOUT	QGCELGR
OGSMOUT	OGCOWHP	EFPOUT	PELRSNR	UGOILOUT	PRLELCR	QBLK	QGEAS
OGSMOUT	OGDIFWOP	UEFPOUT	PELTL	MPBLK	PRLIN	QBLK	QGEEL
OGSMOUT	OGELSCAN	EFPOUT	PELTLNR	MPBLK	PRLTR	QBLK	QGEIN
OGSMOUT	OGELSCO	MPBLK	PELTR	NGTDMOUT	PRNG_PADD	RESDREP	QGERS

COMMON	Variable
QBLK	QGFAS
QBLK	QGFCM
QBLK	QGFEL
UEFDOUT	QGFELGR
QBLK	QGFIN
QBLK	QGFRF
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QBLK	QLGRS
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UEFDOUT	QLHELNR
UEFDOUT	QLMELNR
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QBLK	QMGIN
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UGOILOUT	QRHELGR
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UGOILOUT	QRLELGR
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QSBLK	QSRSCM
QSBLK	QSRSEL
QSBLK	QSRSIN
QSBLK	QSRSRF
QSBLK	QSRSTR
QSBLK	QSSGIN
QSBLK	QSSGRF
QSBLK	QSSTAS
QSBLK	QSSTCM
QSBLK	QSSTEL
QSBLK	QSSTIN
QSBLK	QSSTRS
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QBLK	QSTEL
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QBLK	QUREL
QBLK	QWIAS
QBLK	QWIEL
QBLK	QWIIN
RFCN	REFCON
INDREP	REFCON
TRANREP	REGSALERPT
INTOUT	REPORT
PMMRPT	RFBDSTCAP
PMMOUT	RFCAPEXP
PMMRPT	RFCGCAPADDPD
PMMRPT	RFCGCAPCD
PMMRPT	RFCGCAPPD
PMMRPT	RFDPRDAST
PMMRPT	RFDPRDCOK
PMMRPT	RFDPRDDSL
PMMRPT	RFDPRDJTA
PMMRPT	RFDPRDKER
PMMRPT	RFDPRDLPG
PMMRPT	RFDPRDN2H
PMMRPT	RFDPRDN6B
PMMRPT	RFDPRDN6I
PMMRPT	RFDPRDOTH
PMMRPT	RFDPRDPCF
PMMRPT	RFDPRDRFG
PMMRPT	RFDPRDRFH
PMMRPT	RFDPRDSTG
PMMRPT	RFDPRDTRG
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PMMRPT	RFIPQCHL
PMMRPT	RFIPQCHV
PMMRPT	RFIPQCLL
PMMRPT	RFIPQCMH
PMMRPT	RFIPQDS
PMMRPT	RFIPQJF
PMMRPT	RFIPQLG
PMMRPT	RFIPQME
PMMRPT	RFIPQMG
PMMRPT	RFIPQMT
PMMRPT	RFIPQRH
PMMRPT	RFIPQRL
PMMRPT	RFPQIPRDT
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PMMRPT	RFPQUFC
PMMRPT	RFQARO
PMMOUT	RFQDCRD
PMMOUT	RFQDINPOT
PMMRPT	RFQDS
PMMRPT	RFQEL
PMMRPT	RFQEXCRD

COMMON	Variable
PMMRPT	RFQEXPRDT
PMMRPT	RFQICRD
PMMRPT	RFQIN
PMMRPT	RFQJF
PMMRPT	RFQKS
PMMRPT	RFQLG
PMMRPT	RFQMG
PMMRPT	RFQOTH
PMMRPT	RFQPCK
PMMRPT	RFQPF
PMMOUT	RFQPRCG
PMMOUT	RFQPRDT
PMMRPT	RFQRC
PMMRPT	RFQRH
PMMRPT	RFQRL
PMMRPT	RFQSECT
PMMRPT	RFQSTG
PMMOUT	RFQTDCRD
PMMRPT	RFQTR
PMMOUT	RFREV
PMMOUT	RFSAL
PMMPARAM	RFSHROR
PMMPARAM	RFSHROX
PMMPARAM	RFSHRRF
PMMPARAM	RFSHRTR
PMMOUT	RFSPRFR
PMMOUT	RFSPRIM
PMMPARAM	RFSWDH
NCNTRL	RLXPC
RESDREP	RSAPCON
RESDREP	RSCKCON
RESDREP	RSCOOK
RESDREP	RSCOOLCN
RESDREP	RSCOOLERS
RESDREP	RSDRY
RESDREP	RSDRYCON
RESDREP	RSEEFCL
RESDREP	RSEEFFZ
RESDREP	RSEEFHT
RESDREP	RSEEFHW
RESDREP	RSEEFRF
RESDREP	RSEH
RESDREP	RSFRZ
RESDREP	RSFRZCON
RESDREP	RSHSEADD
RESDREP	RSHTRCON
RESDREP	RSHTRS
RESDREP	RSH20CON
RESDREP	RSLTCON
RESDREP	RSNEFCL
RESDREP	RSNEFFZ
RESDREP	RSNEFHT
RESDREP	RSNEFHW
RESDREP	RSNEFRF
RESDREP	RSNH
RESDREP	RSREF
RESDREP	RSREFCON
RESDREP	RSWATER
NCNTRL	RUNMOD
COALOUT	SBCELNR
COALOUT	SBDELNR
COALOUT	SBHELNR
COALOUT	SBMELNR
NCNTRL	SCALPR
SHC	SHTCON
COALOUT	SLCELNR
COALOUT	SLDELNR
COALOUT	SLHELNR
COALOUT	SLMELNR
COALOUT	SSCELNR
COALOUT	SSDELNR
COALOUT	SSHELNR
COALOUT	SSMELNR
INDREP	STEELCON
TRANREP	TRAIREFFN
TRANREP	TRAIREFFS
TRANREP	TRAIRSLS
TRANREP	TRAIRSTK
TRANREP	TREFFALTC
TRANREP	TREFFALTT
TRANREP	TREFFCAR
TRANREP	TREFFFLT
TRANREP	TREFFTRK
TRANREP	TREFFTRKF
TRANREP	TRHPCAR
TRANREP	TRHPTRK
TRANREP	TRIMSHIP
TRANREP	TRLDMPGC
TRANREP	TRLDMPGF
TRANREP	TRLDMPGT
TRANREP	TRLDQTEK
TRANREP	TRLDSALC
TRANREP	TRLDSALT
TRANREP	TRLDSTKC
TRANREP	TRLDSTKT
TRANREP	TRLDVMT
TRANREP	TRLDVMTE
TRANREP	TRQAIRT
TRANREP	TRQBOAT
TRANREP	TRQBUS
TRANREP	TRQDOMS
TRANREP	TRQENUSE
TRANREP	TRQFTRK
TRANREP	TRQHWY
TRANREP	TRQINTS
TRANREP	TRQLD
TRANREP	TRQLDV
TRANREP	TRQLUB
TRANREP	TRQMIL
TRANREP	TRQNHWY
TRANREP	TRQRAILR
TRANREP	TRQRRF
TRANREP	TRQRRP
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TRANREP	TRSLSHRT
TRANREP	TRSTMDEM
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TRANREP	TRXAIREFF
TRANREP	TRXFREFF
TRANREP	TRXFRVMT
TRANREP	TRXLDVMT
TRANREP	TRXRAIL
TRANREP	TRXRAILEFF
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TRANREP	TRXSHIPEFF
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UEFDOUT	UGNTLNR
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UEFDOUT	UGNUPCR
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UEFDOUT	UGNWNNR
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UMMOUT	UMQEUM
UMMOUT	UMQNUM
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UEFDOUT	UPRGFNR
UEFDOUT	UPRGINR
UEFDOUT	UPRHONR
UEFDOUT	UPRRHNR
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UEFDOUT	UPRURNR
UEFDOUT	URETTLU
UEFDOUT	UTCO2
UETTOUT	UTDMDE
UETTOUT	UTDMDF
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UETTOUT	UTDMMF
UETTOUT	UTEXDE
UETTOUT	UTEXDF
UETTOUT	UTEXME
UETTOUT	UTEXMF
UETTOUT	UTEXPE
UETTOUT	UTEXPF
UETTOUT	UTIMPE
UETTOUT	UTIMPF
UEFDOUT	UTNOX
UEFDOUT	UTSO2
COALREP	WBSULF
WRENEW	WCABMCM
WRENEW	WCABMEL
WRENEW	WCABMIN
WRENEW	WCABMRS
WRENEW	WCAGBEL
WRENEW	WCAGECM
WRENEW	WCAGERS
WRENEW	WCAGFEL
WRENEW	WCAHYEL
WRENEW	WCAMSCM
WRENEW	WCAMSEL
WRENEW	WCAMSIN
WRENEW	WCAPVCM
WRENEW	WCAPVEL
WRENEW	WCAPVRS
WRENEW	WCASSCM
WRENEW	WCASSRS
WRENEW	WCASTEL
WRENEW	WCASWCM
WRENEW	WCASWRS
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WRENEW	WCCBMEL
WRENEW	WCCBMIN
WRENEW	WCCBMRS
WRENEW	WCCGBEL
WRENEW	WCCGECM
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WRENEW	WHCMSEL
WRENEW	WHCMSIN
WRENEW	WHCPVCM
WRENEW	WHCPVEL
WRENEW	WHCPVRS
WRENEW	WHCSTEL
WRENEW	WHCWIEL
WRENEW	WHRBMCM
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WRENEW	WHRMSCM
WRENEW	WHRMSEL
WRENEW	WHRMSIN
WRENEW	WHRPVCM
WRENEW	WHRPVEL
WRENEW	WHRPVRS
WRENEW	WHRSSCM

COMMON	Variable
WRENEW	WHRSSRS
WRENEW	WHRSTEL
WRENEW	WHRSWCM
WRENEW	WHRSWRS
WRENEW	WHRWIEL
WRENEW	WLIBMCM
WRENEW	WLIBMEL
WRENEW	WLIBMIN
WRENEW	WLIBMRS
WRENEW	WLIGBEL
WRENEW	WLIGECM
WRENEW	WLIGERS
WRENEW	WLIGFEL
WRENEW	WLIHYEL
WRENEW	WLIMSCM
WRENEW	WLIMSEL
WRENEW	WLIMSIN
WRENEW	WLIPVCM
WRENEW	WLIPVEL
WRENEW	WLIPVRS
WRENEW	WLISSCM
WRENEW	WLISSRS
WRENEW	WLISTEL
WRENEW	WLISWCM
WRENEW	WLISWRS
WRENEW	WLIWIEL
COALREP	WLSULF
COALREP	WMCF
WRENEW	WOCBMCM
WRENEW	WOCBMEL
WRENEW	WOCBMIN
WRENEW	WOCBMRS
WRENEW	WOCGBEL
WRENEW	WOCGECM
WRENEW	WOCGERS
WRENEW	WOCGFEL
WRENEW	WOCHYEL
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WRENEW	WOCWIEL
WRENEW	WPETOH
MACREP	WPI05
WRENEW	WPOWIEL
WRENEW	WQCMSINEL
WRENEW	WQCMSINST
WRENEW	WQETOH
COALREP	WSCF
WRENEW	WSCWIEL
WRENEW	WSFWIEL
WRENEW	WSSPVEL
WRENEW	WSSSTEL
COALREP	WSSULF
COALREP	WTCF
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WRENEW	WVCBMEL
WRENEW	WVCBMIN
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WRENEW	WVCGBEL
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WRENEW	WVCPVRS
WRENEW	WVCSSCM
WRENEW	WVCSSRS
WRENEW	WVCSTEL
WRENEW	WVCSWCM
WRENEW	WVCSWRS
WRENEW	WVCWIEL
NCNTRL	WWOP
PMMOUT	XDCRDWHP
MXPBLK	XIT_WOP
MXPBLK	XOGWPRNG
MXPBLK	XPASIN
MXPBLK	XPCLAS
MXPBLK	XPCLCM
MXPBLK	XPCLEL
MXPBLK	XPCLIN
MXPBLK	XPCLRS
MXPBLK	XPCLSN
MXPBLK	XPDSAS
MXPBLK	XPDSCM
MXPBLK	XPDSEL
MXPBLK	XPDSIN
MXPBLK	XPDSRS
MXPBLK	XPDSTR
MXPBLK	XPELAS
UECPOUT	XPELAVN
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MXPBLK	XPELIN
MXPBLK	XPELRS
MXPBLK	XPELTR
MXPBLK	XPENAS
MXPBLK	XPENCM
MXPBLK	XPENIN
MXPBLK	XPENRS
MXPBLK	XPENTR
MXPBLK	XPEPAS
MXPBLK	XPEPCM
MXPBLK	XPEPIN
MXPBLK	XPEPRS
MXPBLK	XPEPTR
MXPBLK	XPETTR
MXPBLK	XPGFAS
MXPBLK	XPGFCM
MXPBLK	XPGFEL
MXPBLK	XPGFIN
MXPBLK	XPGFRS
MXPBLK	XPGFTR
MXPBLK	XPGIAS
MXPBLK	XPGICM
MXPBLK	XPGIEL
MXPBLK	XPGIIN
MXPBLK	XPGIRS
MXPBLK	XPGITR
MXPBLK	XPGPTR
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MXPBLK	XPJFTR
MXPBLK	XPKSAS
MXPBLK	XPKSCM
MXPBLK	XPKSIN
MXPBLK	XPKSRS
MXPBLK	XPLGAS
MXPBLK	XPLGCM
MXPBLK	XPLGIN
MXPBLK	XPLGRS
MXPBLK	XPLGTR
MXPBLK	XPLPIN
MXPBLK	XPMCIN
MXPBLK	XPMETR
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MXPBLK	XPRHAS
MXPBLK	XPRHEL
MXPBLK	XPRHTR
MXPBLK	XPRLAS
MXPBLK	XPRLCM
MXPBLK	XPRLEL
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MXPBLK	XPRLTR
MXPBLK	XPRSAS
MXPBLK	XPRSCM
MXPBLK	XPRSEL
MXPBLK	XPRSIN
MXPBLK	XPRSTR
MXPBLK	XPTPAS
MXPBLK	XPTPCM
MXPBLK	XPTPEL
MXPBLK	XPTPIN
MXPBLK	XPTPRF
MXPBLK	XPTPRS
MXPBLK	XPTPTR
MXPBLK	XPUREL
MXQBLK	XQASIN
MXQBLK	XQBMAS
MXQBLK	XQBMCM
MXQBLK	XQBMEL
MXQBLK	XQBMIN
MXQBLK	XQBMRF
MXQBLK	XQBMRS
MXQBLK	XQBMSN
MXQBLK	XQCIIN
MXQBLK	XQCLAS
MXQBLK	XQCLCM
MXQBLK	XQCLEL
MXQBLK	XQCLIN
MXQBLK	XQCLRF
MXQBLK	XQCLRS
MXQBLK	XQCLSN
MXQBLK	XQDSAS
MXQBLK	XQDSCM
MXQBLK	XQDSEL
MXQBLK	XQDSIN
MXQBLK	XQDSRF
MXQBLK	XQDSRS
MXQBLK	XQDSTR
MXQBLK	XQEIEL
MXQBLK	XQELAS
MXQBLK	XQELCM
MXQBLK	XQELIN
MXQBLK	XQELRF
MXQBLK	XQELRS
MXQBLK	XQELTR
MXQBLK	XQENAS
MXQBLK	XQENCM
MXQBLK	XQENIN
MXQBLK	XQENRF
MXQBLK	XQENRS
MXQBLK	XQENTR
MXQBLK	XQEPAS
MXQBLK	XQEPCM
MXQBLK	XQEPIN
MXQBLK	XQEPRF
MXQBLK	XQEPRS
MXQBLK	XQEPTR
MXQBLK	XQETTR
MXQBLK	XQGEAS
MXQBLK	XQGEEL
MXQBLK	XQGEIN
MXQBLK	XQGFAS
MXQBLK	XQGFCM
MXQBLK	XQGFEL
MXQBLK	XQGFIN
MXQBLK	XQGFRF
MXQBLK	XQGFRS
MXQBLK	XQGFTR
MXQBLK	XQGIAS
MXQBLK	XQGICM
MXQBLK	XQGIEL
MXQBLK	XQGIIN
MXQBLK	XQGIRF
MXQBLK	XQGIRS
MXQBLK	XQGITR
MXQBLK	XQGPTR
MXQBLK	XQHOAS
MXQBLK	XQHOEL
MXQBLK	XQHOIN
MXQBLK	XQHYTR
MXQBLK	XQJFTR
MXQBLK	XQKSAS
MXQBLK	XQKSCM
MXQBLK	XQKSIN
MXQBLK	XQKSRS
MXQBLK	XQLGAS
MXQBLK	XQLGCM
MXQBLK	XQLGIN
MXQBLK	XQLGRF
MXQBLK	XQLGRS
MXQBLK	XQLGTR
MXQBLK	XQLPIN
MXQBLK	XQMCIN
MXQBLK	XQMETR
MXQBLK	XQMGAS
MXQBLK	XQMGCM
MXQBLK	XQMGIN
MXQBLK	XQMGTR
MXQBLK	XQMSAS
MXQBLK	XQMSEL
MXQBLK	XQMSIN
MXQBLK	XQNGAS
MXQBLK	XQNGCM
MXQBLK	XQNGEL
MXQBLK	XQNGELCN
MXQBLK	XQNGELFN
MXQBLK	XQNGELIN
MXQBLK	XQNGIN
MXQBLK	XQNGRF
MXQBLK	XQNGRS
MXQBLK	XQNGTR
MXQBLK	XQOTAS
MXQBLK	XQOTIN
MXQBLK	XQOTRF
MXQBLK	XQOTTR
MXQBLK	XQPCAS
MXQBLK	XQPCEL
MXQBLK	XQPCIN
MXQBLK	XQPCRF
MXQBLK	XQPFIN
MXQBLK	XQPVAS
MXQBLK	XQPVCM
MXQBLK	XQPVEL
MXQBLK	XQPVIN
MXQBLK	XQPVRS
MXQBLK	XQRHAS
MXQBLK	XQRHEL
MXQBLK	XQRHTR
MXQBLK	XQRLAS
MXQBLK	XQRLCM
MXQBLK	XQRLEL
MXQBLK	XQRLIN
MXQBLK	XQRLRF
MXQBLK	XQRLTR
MXQBLK	XQRSAS
MXQBLK	XQRSCM
MXQBLK	XQRSEL
MXQBLK	XQRSIN
MXQBLK	XQRSRF
MXQBLK	XQRSTR
MXQBLK	XQSGIN
MXQBLK	XQSGRF
MXQBLK	XQSTAS
MXQBLK	XQSTCM
MXQBLK	XQSTEL
MXQBLK	XQSTIN
MXQBLK	XQSTRS
MXQBLK	XQTPAS
MXQBLK	XQTPCM
MXQBLK	XQTPEL
MXQBLK	XQTPIN
MXQBLK	XQTPRF
MXQBLK	XQTPRS
MXQBLK	XQTPTR
MXQBLK	XQTRAS
MXQBLK	XQTRCM
MXQBLK	XQTREL
MXQBLK	XQTRIN
MXQBLK	XQTRRS
MXQBLK	XQTRSN
MXQBLK	XQTRTR
MXQBLK	XQTSAS
MXQBLK	XQTSCM
MXQBLK	XQTSEL
MXQBLK	XQTSIN
MXQBLK	XQTSRF
MXQBLK	XQTSRS
MXQBLK	XQTSSN

COMMON	Variable	COMMON	Variable	COMMON	Variable	COMMON	Variable
MXQBLK	XQTSTR						
MXQBLK	XQUREL						
MXQBLK	XQWIAS						
MXQBLK	XQWIEL						
MXQBLK	XQWIIN						
PMMOUT	XRFQDCRD						
NCNTRL	YEARPR						

Appendix C

Bibliography

Appendix C. Bibliography

This appendix gives a detailed list of documents that describe the National Energy Modeling System. All reports listed in this appendix, unless cited otherwise, were produced by the Energy Information Administration.

NEMS System Design Reports

The NEMS System Design Reports were written by the Energy Information Administration as the primary design documents, prior to initial coding of the NEMS modules. The documents in this section were the primary source for most of the information published in the body of this document.

Overall Systems Design and Integration

‘‘Development Plan for the National Energy Modeling System,’’ Office of Integrated Analysis and Forecasting, draft July 21, 1992.

‘‘Integrating Module Component Design Report,’’ National Energy Modeling System Branch, Office of Integrated Analysis and Forecasting, December 21, 1992.

‘‘International Energy Module, World Oil Market, Petroleum Product Supply and Oxygenates Supply Components,’’ Energy Demand and Integration Division, International, Economic and Integrated Forecasting Branch, Office of Integrated Analysis and Forecasting, July 31, 1992.

‘‘Requirements for a National Energy Modeling System,’’ Office of Integrated Analysis and Forecasting, May 18, 1992.

‘‘System Design for the National Energy Modeling System,’’ Office of Integrated Analysis and Forecasting, January 16, 1992.

Macroeconomic Activity

‘‘Interindustry Submodule,’’ International, Economic and Integrated Forecasting Branch, Energy Demand and Integration Division, Office of Integrated Analysis and Forecasting, August 28, 1992.

‘‘National Submodule,’’ International, Economic and Integrated Forecasting Branch, Energy Demand and Integration Division, Office of Integrated Analysis and Forecasting, May 1992.

‘‘Regional Submodule,’’ International, Economic and Integrated Forecasting Branch, Energy Demand and Integration Division, Office of Integrated Analysis and Forecasting, September 18, 1992.

Demand

‘‘Commercial Sector Component Design Report,’’ Energy Demand Analysis Branch, Office of Integrated Analysis and Forecasting, January 21, 1993.

‘‘Industrial Sector Component Design Report,’’ Energy Demand Analysis Branch, Energy Demand and Integration Division, Office of Integrated Analysis and Forecasting, July 7, 1992.

‘‘Residential Sector Component Design Report,’’ Energy Demand Analysis Branch, Office of Integrated Analysis and Forecasting, January 19, 1993.

‘‘Transportation Sector Component Design Report,’’ Energy Demand Analysis Branch, Office of Integrated Analysis and Forecasting, January 21, 1993.

Electricity

‘‘Overview of the Electricity Market Module of the National Energy Modeling System,’’ Energy Supply and Conversion Division, Nuclear and Electricity Analysis Branch, Office of Integrated Analysis and Forecasting.

‘‘Capacity Planning,’’ Nuclear and Electricity Analysis Branch, Energy Supply and Conversion Division, Office of Integrated Analysis and Forecasting, August 1992.

‘‘Finance and Pricing Submodule,’’ Nuclear and Electricity Analysis Branch, Energy Supply and Conversion Division, Office of Integrated Analysis and Forecasting, December 7, 1992.

‘‘Fuel Dispatch,’’ Nuclear and Electricity Analysis Branch, Energy Supply and Conversion Division, Office of Integrated Analysis and Forecasting, May 28, 1992.

‘‘Transmission and Trade,’’ Nuclear and Electricity Analysis Branch, Energy Supply and Conversion Division, Office of Integrated Analysis and Forecasting, January 13, 1993.

‘‘Load and Demand-Side Management Submodule,’’ Nuclear and Electricity Analysis Branch, Energy Supply and Conversion Division, Office of Integrated Analysis and Forecasting, October 1992.

‘‘Nonutility Generation Supply,’’ Nuclear and Electricity Analysis Branch, Energy Supply and Conversion Division, Office of Integrated Analysis and Forecasting, May 11, 1992.

Coal

''Overview of the Coal Market Module of the National Energy Modeling System,'' Energy Supply and Conversion Division, Coal, Uranium and Renewable Fuels Analysis Branch, Office of Integrated Analysis and Forecasting, April 1992.

''Coal Distribution,'' Coal, Uranium and Renewable Fuels Analysis Branch, Energy Supply and Conversion Division, Office of Integrated Analysis and Forecasting, April 1992.

''Coal Production Submodule,'' Coal, Uranium, and Renewable Fuels Analysis Branch, Energy Supply and Conversion Division, Office of Integrated Analysis and Forecasting, May 1992.

''Coal Synthetics Submodule,'' Coal, Uranium and Renewable Fuels Analysis Branch, Energy Supply and Conversion Division, Office of Integrated Analysis and Forecasting, October 1992.

Renewable Fuels

''Overview of the Renewable Fuels Module of the National Energy Modeling System,'' Energy Supply and Conversion Division,Coal, Uranium and Renewable Fuels Analysis Branch, Office of Integrated Analysis and Forecasting, July 2, 1992.

''Biofuels (Ethanol) Supply Submodule,'' Coal, Uranium and Renewable Fuels Analysis Branch, Energy Supply and Conversion Division, Office of Integrated Analysis and Forecasting, July 2, 1992.

''Biomass Supply Submodule of the Renewable Fuels Module,'' Coal, Uranium and Renewable Fuels Analysis Branch, Energy Supply and Conversion Division, Office of Integrated Analysis and Forecasting, January 14, 1993.

''Geothermal Electricity Submodule,'' Coal, Uranium and Renewable Fuels Analysis Branch, Energy Supply and Conversion Division, Office of Integrated Analysis and Forecasting, December 15, 1992.

''Hydropower Submodule,'' Coal, Uranium and Renewable Fuels Analysis Branch, Energy Supply and Conversion Division, Office of Integrated Analysis and Forecasting, June 25, 1992.

Oil and Gas Supply

''Alaska Oil and Gas Supply,'' Oil and Gas Analysis Branch, Energy Supply and Conversion Division, Office of Integrated Analysis and Forecasting, May 7, 1992.

''Basic Framework and Onshore Lower 48 Conventional Oil and Gas Supply,'' Oil and Gas Analysis Branch, Energy Supply and Conversion Division, Office of Integrated Analysis and Forecasting, January 21, 1993.

‘‘Capacity Expansion Module for the Natural Gas Transmission and Distribution Model of the National Energy Modeling System,’’ Oil and Gas Analysis Branch, Energy Supply and Conversion Division, Office of Integrated Analysis and Forecasting, December 29, 1992.

‘‘Detailed NEMS Refinery Model Design Report,’’ Oil and Gas Analysis Branch, Energy Supply and Conversion Division, Office of Integrated Analysis and Forecasting, May 1992.

‘‘Foreign Natural Gas Supply,’’ Oil and Gas Analysis Branch, Energy Supply and Conversion Division, Office of Integrated Analysis and Forecasting, January 27, 1993.

‘‘Natural Gas Annual Flow Module,’’ Oil and Gas Analysis Branch, Energy Supply and Conversion Division, Office of Integrated Analysis and Forecasting, June 24, 1992.

‘‘Offshore Lower 48 Conventional Oil and Gas Supply,’’ Oil and Gas Analysis Branch, Energy Supply and Conversion Division, Office of Integrated Analysis and Forecasting, July 1992.

‘‘Petroleum Market Module,’’ Oil and Gas Analysis Branch, Energy Supply and Conversion Division, Office of Integrated Analysis and Forecasting, December 16, 1992.

‘‘Pipeline Tariff Module for the Natural Gas Transmission and Distribution Model of the National Energy Modeling System,’’ Oil and Gas Analysis Branch, Energy Supply and Conversion Division, Office of Integrated Analysis and Forecasting, December 29, 1992.

‘‘Unconventional Gas Recovery,’’ Oil and Gas Analysis Branch, Energy Supply and Conversion Division, Office of Integrated Analysis and Forecasting, July 1992.

Model Documentation Reports

This section lists the documentation reports for NEMS, planned as of the writing of this edition of this *Integrating Module Documentation Report*. All eventually will be authored by the Energy Information Administration.

Macroeconomic Activity

‘‘Interindustry Submodule,’’ International, Economic and Integrated Forecasting Branch, Energy Demand and Intergration Division, Office of Integrated Analysis and Forecasting, forthcoming December 1993.

‘‘National Submodule,’’ International, Economic and Integrated Forecasting Branch, Energy Demand and Intergration Division, Office of Integrated Analysis and Forecasting, forthcoming December 1993.

‘‘Regional Submodule,’’ International, Economic and Integrated Forecasting Branch, Energy Demand and Integration Division, Office of Integrated Analysis and Forecasting, forthcoming December 1993.

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‘‘Annual Flow Component,’’ Oil and Gas Analysis Branch, Energy Supply and Conversion Division, Office of Integrated Analysis and Forecasting, forthcoming December 1993.

‘‘Capacity Expansion Component,’’ Oil and Gas Analysis Branch, Energy Supply and Conversion Division, Office of Integrated Analysis and Forecasting, forthcoming December 1993.

‘‘Distribution Tariffs Component,’’ Oil and Gas Analysis Branch, Energy Supply and Conversion Division, Office of Integrated Analysis and Forecasting, forthcoming December 1993.

‘‘Petroleum Market Module,’’ Oil and Gas Analysis Branch, Energy Supply and Conversion Divison, Office of Integrated Analysis and Forecasting, forthcoming December 1993.

‘‘Pipeline Tariffs Component,’’ Oil and Gas Analysis Branch, Energy Supply and Conversion Divison, Office of Integrated Analysis and Forecasting, forthcoming December 1993.

Coal

‘‘Coal Distribution Component,’’ Coal, Uranium and Renewable Fuels Analysis Branch, Energy Supply and Conversion Division, Office of Integrated Analysis and Forecasting, forthcoming December 1993.

‘‘Coal Export Component,’’ Coal, Uranium and Renewable Fuels Analysis Branch, Energy Supply and Converison Division, Office of Integrated Analysis and Forecasting, forthcoming December 1993.

‘‘Coal Production Component,’’ Coal, Uranium and Renewable Fuels Analysis Branch, Energy Supply and Converison Division, Office of Integrated Analysis and Forecasting, forthcoming December 1993.

‘‘Coal Synthetics Component,’’ Coal, Uranium and Renewable Fuels Analysis Branch, Energy Supply and Converison Division, Office of Integrated Analysis and Forecasting, forthcoming December 1993.

Electricity Market Module

‘‘Capacity Planning,’’ Nuclear and Electricity Analysis Branch, Energy Supply and Conversion Division, Office of Integrated Analysis and Forecasting, forthcoming December 1993.

‘‘Financial and Pricing Component,’’ Nuclear and Electricity Analysis Branch, Energy Supply and Conversion Division, Office of Integrated Analysis and Forecasting, forthcoming December 1993.

‘‘Fuel Dispatch Component,’’ Nuclear and Electricity Analysis Branch, Energy Supply and Conversion Division, Office of Integrated Analysis and Forecasting, forthcoming December 1993.

‘‘Load and Demand-side Management Component,’’ Nuclear and Electricity Analysis Branch, Energy Supply and Conversion Division, Office of Integrated Analysis and Forecasting, forthcoming December 1993.

‘‘Nonutility Generation Supply Component,’’ Nuclear and Electricity Analysis Branch, Energy Supply and Conversion Division, Office of Integrated Analysis and Forecasting, forthcoming December 1993.

‘‘Transmission and Trade Component,’’ Nuclear and Electricity Analysis Branch, Energy Supply and Conversion Division, Office of Integrated Analysis and Forecasting, forthcoming December 1993.

Demand Components

‘‘Commercial Demand Module,’’ Energy Demand Analysis Branch, Office of Integrated Analysis and Forecasting, forthcoming December 1993.

‘‘Industrial Demand Module,’’ Energy Demand Analysis Branch, Office of Integrated Analysis and Forecasting, forthcoming December 1993.

‘‘Residential Demand Module,’’ Energy Demand Analysis Branch, Office of Integrated Analysis and Forecasting, forthcoming December 1993.

‘‘Transportation Demand Module,’’ Energy Demand Analysis Branch, Office of Integrated Analysis and Forecasting, forthcoming December 1993.

Overall Systems Design and Integration

‘‘NEMS Methodology Summary,’’ National Energy Modeling System Branch, Office of Integrated Analysis and Forecasting, forthcoming in January 1994.

‘‘International Energy Module,’’ Energy Demand and Integration Division, International, Economic and Integrated Forecasting Branch, Office of Integrated Analysis and Forecasting, forthcoming December 1993.

Other Documents

Reports listed in this section describe earlier models. They are listed here because they contain information summarized in this report.

‘‘Documentation of the Integrating Module of the Intermediate Future Forecasting System,’’ Energy Information Administration, Reserves and Natural Gas Division, Office of Oil and Gas, U.S. Department of Energy, May 1991.

‘‘The Integrating Model of the Project Independence Evaluation System, Volume 3: User's Guide,’’ U.S. Department of Energy, Energy Information Administration, Assistant Administrator for Applied Analysis, March 1979.

‘‘The Integrating Model of the Project Independence Evaluation System, Volume 5: Code Documentation,’’ U.S. Department of Energy, Energy Information Administration, Assistant Administrator for Applied Analysis, July 1978.

‘‘The Integrating Model of the Project Independence Evaluation System, Volume 6: Data Documentation, Part 1,’’ U.S. Department of Energy, Energy Information Administration, Assistant Administrator for Applied Analysis, February 1979.

‘‘Model Documentation of the Gas Analysis Modeling System,’’ Energy Information Administration, U.S. Department of Energy, Office of Oil and Gas, May 1991.

‘‘Project Independence Report,’’ Federal Energy Administration, November 1974.

‘‘Research into the Methodology of the LEAP Model,’’ U.S. Department of Energy, Energy Information Administration, Assistant Administrator for Applied Analysis, December 1979.

Appendix D

Model Abstract

Appendix D. Model Abstract

Model Name: National Energy Modeling System

Acronym: NEMS

Description: 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 such 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.

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

Last Model Update: October 1993.

Part of Another Model? No.

Model Interfaces: NEMS integrates the efforts of the following submodels:

Oil and Gas Market Module
Natural Gas Transmission and Distribution Module
Coal Market Module
Renewable Fuels Module
Electricity Market Module
Petroleum Market Module
Residential Sector Demand Module
Commercial Sector Demand Module
Transportation Sector Demand Module
Industrial Sector Demand Module
Macroeconomic Activity Module
International Energy Activity Module

Sponsor: Office of Integrated Analysis and Forecasting, Energy Information Administration; U.S. Department of Energy.

Model Contacts: Ms. Susan H. Shaw (202) 586-4838

Documentation: ‘‘NEMS Methodology Summary,’’ National Energy Modeling System Branch, Office of Integrated Analysis and Forecasting, forthcoming in January 1994.

Archive Media and Installation Manual(s): Forthcoming.

Energy System Described by Model: NEMS is a general equilibrium model of domestic energy supply and demand. It represents the domestic production of oil natural gas, refined petroleum products, coal and electricity. It also represents the two major energy conversion activities, the refining of crude oil into petroleum products and the conversion of fossil fuels, nuclear power, hydropower, and other renewable sources into electricity. Consumption of energy is represented by four end-use sectors: residential, commercial, industrial, and transportation.

Coverage:

- **Geographic:** Nine Bureau of Census Divisions. Some component analytical modules represent energy production or conversion at different levels of regional detail. All equilibration takes place at the Census Division level.
- **Time Unit/Frequency:** Annual through 2015
- **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, 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 condidions 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. Any of these modules can be replaced by a simple representation when detailed results are not required. The modularity also 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.

Inventory of Parameter Estimates: None.

General Description of Output Data: The following are generally used in published reports:

Total Energy Supply and Disposition
Domestic Production by Fuel Type
Imports and Exports by Fuel Type
Electric Utility and Nonutility Fuel Consumption, Generation and Capacity
Electricity Disposition and End-Use Sectoral and Regional Prices
Petroleum Supply, Disposition and End-Use Sectoral and Regional Prices
Natural Gas Supply, Disposition and End-Use Sectoral and Regional Prices
Coal Supply, Disposition and End-Use Sectoral and Regional Prices
Consumption of Energy by Fuel, Sector and Region

Computing Environment:

Hardware Used: IBM 3090QX.
Language Used: FORTRAN 77.
Core Requirement: Over 16,000K, when all modules are being executed.
Estimated Run Time: 24 hours.
Special Features: NEMS is designed to operate in a mainframe computing environment that allows in excess of 16 megabytes of main memory.

Independent Expert Reviews Conducted: None.

Status of Evaluation Efforts by Sponsor: Currently undergoing evaluation.

References: Energy Information Administration, *The National Energy Modeling System: An Overview*, DOE/EIA-0581 (Washington, DC, May 1994).

Appendix E

Carbon Emission Calculations

Appendix E. Carbon Emission Calculations

Overview

NEMS is used by EIA to project the energy, economic, environmental, and security impacts on the United States of various policies and assumptions. In response to concerns over the impact on the climate of greenhouse gases, NEMS develops projections of the total anthropogenic carbon emissions from fossil energy consumption. The Integrating Module calculates carbon emissions from energy production, conversion, and end-use consumption.

Carbon emissions from energy consumption are dependent on the carbon content of the fuel and how completely the fuel is consumed in combustion. In NEMS, carbon emissions are calculated by multiplying fuel consumption by two factors: a carbon emissions coefficient that reflects the carbon content of the fuel, and a combustion fraction that reflects how completely the fuel is burned. The carbon emissions coefficients are presented in Table E1. These coefficients are expressed in millions of metric tons of carbon emitted per quadrillion Btus combusted. The combustion fractions are assumed to be .99 for non-gaseous fuels and .995 for gaseous fuels.[8]

Carbon Emissions of Renewable Fuels

Renewable fuels include hydroelectric power, biomass, photovoltaic, geothermal, and wind energy. Any carbon emitted by the renewable source is considered balanced by the carbon sequestration that occurred in its creation. Therefore, following convention, net emissions of carbon from renewable sources is taken as zero, and no emission coefficient is reported.

Sector Specific Calculations

Table E2 lists the NEMS variables used to calculate the carbon emissions. Sector specific adjustments are listed below.

Residential and Commercial: No major adjustments were needed.

[8]As an example of the carbon emissions calculation, if gasoline consumption was 20 quadrillion Btus, then combustion is assumed to be 19.8 quadrillion Btus, or 20 times .99, and carbon emissions are calculated as 384 million metric tons of carbon, or 19.8 quadrillion Btus times the carbon coefficient of 19.41.

Table E1. Emission Factors

Fuel Type	Million Metric Tons Carbon per Quadrillion Btu	Proportion of Nonfuel Use Sequestered[a]
Petroleum		
Motor Gasoline	19.41	-
Liquefied Petroleum Gas	17.16	0.80
Jet Fuel	19.74	-
Distillate Fuel	19.95	-
Residual Fuel	21.49	-
Asphalt and Road Oil	20.62	1.00
Lubricants	20.24	0.50
Petrochemical Feed	19.37	0.80
Kerosene	19.72	-
Petroleum Coke	27.85	-
Petroleum Still Gas	17.51	-
Other: Waxes and Miscellaneous	19.81	1.00
Coal		
Residential and Commercial	25.92	-
Metallurgical	25.51	-
Industrial Other	25.58	-
Anthracite Coal	28.13	-
Bituminous Coal	25.37	-
Subbituminous Coal	26.24	-
Lignite	26.62	-
Natural Gas		
Natural Gas	14.47	0.33

Table E2. Energy Demands by Sector

Fuel Type by Sector	NEMS Variable Name	Emission Coefficient Name
Residential		
Distillate Fuel	QDSRS	EDSRS
Kerosene	QKSRS	EKSRS
Liquefied Petroleum Gas	QLGRS	ELGRS
Natural Gas	QNGRS	ENGRS
Coal	QCLRS	ECLRS
Commercial		
Motor Gasoline	QMGCN	EMGCN
Liquefied Petroleum Gas	QLGCM	ELGCM
Distillate Fuel	QDSCM	EDSCM
Residual Fuel	QRSCM	ERSCM
Coal	QCLCM	ECLCM
Natural Gas	QNGCM	ENGCM
Industrial		
Distillate Fuel	QDSIN	EDSIN
Kerosene	QKSIN	EKSIN
Liquefied Petroleum Gas	QLGIN	ELGIN
Natural Gas	QNGIN	ENGIN
Lease and Plant Fuel	QLPIN	ELPIN
Steam Coal	QCLIN	ECLIN
Motor Gasoline	QMGIN	EMGIN
Petroleum Feedstock	QPFIN	EPFIN
Petroleum Coke	QPCIN	EPCIN
Still Gas	QSGIN	ESGIN
Asphalt and Road Oil	QASIN	EASIN
Other Petroleum	QOTIN	EOTIN
Metallurgical Coal	QMCIN	EMCIN
Transportation		
Compressed Natural Gas	QNGTR	ENGTR
Pipeline Fuel Natural Gas	QGPTR	EGPTR
Motor Gasoline	QMGTR	EMGTR
Jet Fuel	QJFTR	EJFTR
Distillate	QDSTR	EDSTR
Liquid Petroleum Gas	QLGTR	ELGTR
Methanol	QMETR	EMETR
Other Petroleum	QOTIN	EOTIN
Electric Generators		
Distillate	QDSEL	EDSEL
Petroleum Coke	QPCEL	EPCEL
Natural Gas - Core	QGFEL	EGFEL
Natural Gas - Non-Core	QGIEL	EGIEL
Residual - High Sulfur	QRHEL	ERHEL
Residual - Low Sulfur	QRLEL	ERLEL

Table E2. Energy Demands by Sector (Continued)

Fuel Type by Sector	NEMS Variable Name	Emission Coefficient Name
Electric Generators (cont'd)		
VLS Bit Coal	QBCELNR	EBCELNR
LS Bit Coal	QBDELNR	EBDELNR
MS Bit Coal	QBMELNR	EBMELNR
HS Bit Coal	QBHELNR	EBHELNR
VLS Sub Coal	QSCELNR	ESCELNR
LS Sub Coal	QSDELNR	ESDELNR
MS Sub Coal	QSMELNR	ESMELNR
HS Sub Coal	QSHELNR	ESHELNR
VLS Lig Coal	QLCELNR	ELCELNR
LS Lig Coal	QLDELNR	ELDELNR
MS Lig Coal	QLMELNR	ELMENLR
HS Lig Coall	QLHELNR	ELHELNR

Industrial: The use of fossil fuels for non-fuel use of certain end-use products such as feedstocks for chemical production causes a significant amount of carbon to be sequestered in the product and not released to the atmosphere. Technically, the amount of carbon sequestered depends on product characteristics which are not explicitly defined in NEMS; following standard practice, an average sequestration fraction is used for each nonfuel use.[9] In the Industrial module, the two major feedstocks are Liquified Petroleum Gases (LPG) and natural gas. Consumption of these fuels is divided into feedstock and combustion categories. For the feedstock uses, an appropriate sequestration rate is applied to account for the average proportion of carbon sequestered among products in this category. "Other" petroleum products consist of lubricants and miscellaneous petroleum products.

Transportation: The total consumption of motor gasoline reported by the Transportation module includes both gasoline, gasoline-ethanol mixtures, and gasoline containing oxygenates with ethanol precursors. Since ethanol is considered a renewable fuel with zero net carbon emissions, the total consumption of motor gasoline was reduced by the amount of ethanol used in its production before multiplication by the emission coefficient. This modification represents less than one million metric tons of carbon. Furthermore, since "other" petroleum was considered primarily lubricants, the emission coefficient and sequestration rate for lubricants was used for all of "other" petroleum.

Electricity Generation Market: No major adjustments were needed. However, separate factors were used for each coal rank. This methodology attempted to more accurately reflect carbon emissions as the ratio of consumption of each coal rank changed over the forecast period.

[9] Energy Information Administration, *Emissions of Greenhouse Gases in the United States; 1987-1992*, DOE/EIA-0573 (Washington, DC, 1994), pg 14.

Appendix F

Emission Policy Module Documentation

Appendix F. Emission Policy Module Documentation

The Emissions Policy Module (EPM) addresses market-based approaches for controlling emissions output from the energy sector. The design of the EPM incorporates centralized modeling of market-based emissions constraints. As a first step toward capturing the effects of market-based systems of emission control, the Emissions Policy Module (EPM) facilitates the analysis of policies to limit total carbon production. Specifically, five policy tools are modeled: carbon tax, ad valorem tax, auction of carbon production allowances, distribution of allowances for the various sectors and regions with a secondary auction market, and carbon allowances with the addition of allowing approaches that will offset carbon production.

Model Objectives

The purpose of the EPM is to allow the analysis of market-based options for the control of carbon emissions from the energy sector. The penalty on carbon emissions is modeled as an adjustment on the end-use price of the fuel. Implementation of such a price adjustment to end-use fuels in the NEMS system is done as follows: The carbon penalty, which depends on the policy option chosen, is calculated once per iteration in the EPM. Two distinct variables are created for each of the fuel prices: one containing the original prices and one containing the adjusted prices. The adjusted prices are used by the demand models and the unadjusted prices are used by the supply and conversion models. After each model is executed, the fuel prices are adjusted and copied to the adjusted price arrays based on the carbon penalty. This ensures that the most recent price information is available. Five policy options may be modeled in the EPM:

Carbon Tax

Carbon emission production depends on the interaction of fossil fuel utilization and demand, and is a function of the relationship of energy requirements to the level of economic activity, relative prices of various fossil fuels, the degree of substitutability among fossil fuels, and the energy required at the level of economic activity. Carbon reductions can be induced by encouraging fuel substitution to lower carbon-emitting fossil fuels or non-fossil fuels through adjustments to relative prices. Fuel price adjustments can be made through a tax on the carbon content of the fuel.

Implementation of the carbon tax takes place in the EPM. A modifier is applied to the price of each end-use fuel going to the sector modules to reflect a tax on the carbon produced by that sector using that particular fuel. The model is then executed until convergence occurs. The total national carbon output and fuel substitution policies may then be observed as a function of the tax, with the revenue generated being used as an input to the macroeconomic module.

Ad Valorem Tax

An ad valorem tax on fuels was implemented for the EPM. The ad valorem tax is applied as a fixed percentage so its value will change as energy prices change. The calculation of the effect of the ad valorum tax on fuel price was obtain by multiplying the tax rate by the price of the end-use fuel going to the sector modules. The revenue created by this tax is used as an input to the macroeconomic module.

Auctions

Using an auction strategy, the total carbon goal is set *a priori*. An auction is used to distribute allowances to emit carbon. The total number of allowances sold corresponds to the total carbon emission goal. Several iterations of the other NEMS modules must be done to find the auction clearing price of an allowance (equivalent to a tax on carbon emissions) that will correspond to the carbon goal. Revenue from the auction is reflected in the inputs to the macroeconomic module.

Allowance System

It is assumed that the allowances will be fully transferable nationally but not banked between years. Given these restrictions, the allowance system was implemented as a zero-revenue auction. In other words, the system of marketable permits is modeled as an auction of allowances as in Section **Auctions**. However, each sector receives a fixed share of the resultant revenue from the auction such that the total auction proceeds are returned to the participants. The share of auction proceeds received is equivalent to an initial distribution of "free" allowances. If a source had allocated to it precisely the number of allowances it needed, the model should directly offset payments into the auction with the revenues received, reflecting no net cost to the source.

The initial price and distribution of allowances will be set exogenously. In an efficient, optimal allowance system the price of an allowance must reflect the marginal cost of emission, independent of the initial distribution of allowances. Thus the cost of any carbon emission by a particular sector in a region is reflected in the individual end-use fuel cost for that sector. For those suppliers in which the product prices are based on marginal cost (such as in the Petroleum Marketing Module), the revenue returned from the auction may be ignored; it does not affect the price of products. However, in the regulated suppliers (such as utilities) where the average cost is used to determine price, the revenue stream from the initial (no-cost) allowances must be accounted for.

The model is iterated and the total carbon production for a particular price level of allowances observed. Once the model has converged and the total carbon production determined, the price of an allowance is then adjusted and the model again run until convergence occurs. The price of an allowance will continue to be adjusted until the total carbon produced is within the cap.

Offsets

There is a broad consensus among policy analysts that accompanying any major program for controlling carbon emissions, such as a carbon tax or allowance system, serious consideration should be given to allowing sources to offset their emissions by obtaining quantifiable reductions in other emissions from sources that would be difficult to monitor. Part of a greenhouse gas emission reduction policy may be an offset policy which gives credit to reductions in emissions offsets from sources whose total emissions would be difficult to precisely quantify, such as the capture of coal bed methane, and activities such as reforestation which provide for the additional uptake of carbon by expanding terrestrial carbon sinks.

The EPM includes the option to represent the market for greenhouse gas offsets by using offset "supply curves" developed in models outside of NEMS. Supply curves for two sources of offsets, coal-bed methane capture and reforestation are included in the EPM. These curves indicate the number of offsets available at a given price. Conversion of offsets to allowances will be determined by an exogenously supplied parameter. Thus, offsets may be converted to allowances on a one-for-one basis or more than one offset may be needed to obtain a single allowance.

Input/Output Requirements

The EPM requires input data from exogenous sources and other modules of NEMS. Exogenous data include the policy options to be implemented and emissions factors. If a carbon tax scenario is to be implemented, the tax rate must also be specified. Output from the EPM consists of adjustments of the end-use prices of fuels consumed by the demand and conversion modules. Revenue from the carbon penalty is provided to the Macroeconomic module.

The primary role of the EPM will be to model the effect of market-based policy options on the total carbon emission from each of the various sectors in each region. This is accomplished by applying an adjustment to the end-use price of fuels proportional to the carbon content of the fuel. Adjustment of feedstock prices is calculated separately from the calculation of the carbon penalty for the same fuel used in combustion, reflecting the higher level of carbon sequestration evident with the use of feedstocks. Three common blocks contain all of the end-use fuel prices: MPBLK, NGTDMOUT and COALOUT. These prices are adjusted and stored in the common blocks AMPBLK, ANGTDM, and ACOAL.

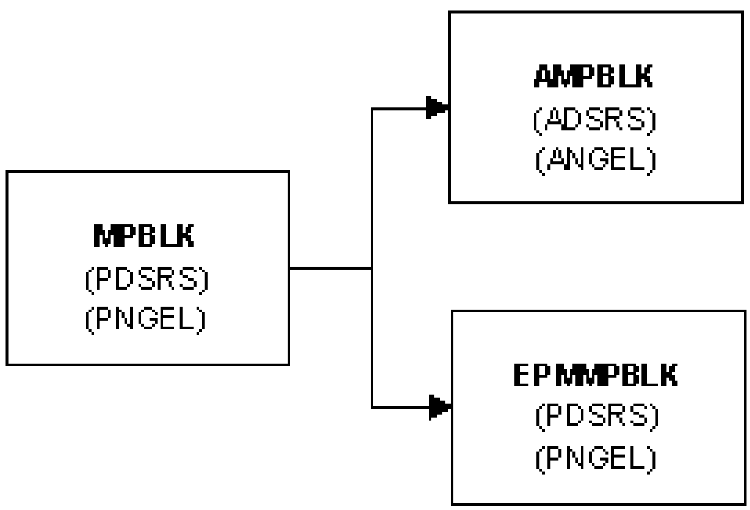
The total carbon emission from both combustion and non-combustion sources is calculated in the EPM from information in the common blocks QBLK and INDOUT. The common QBLK contains the quantities of end-use fuels consumed. A separate break-out of natural gas and liquid petroleum gas feedstocks is found in the common block INDOUT.

Several policy options result in revenue from the carbon penalty flowing to the government. This revenue is furnished to the MACRO module through the EMISSION common block.

Modifications to the Solution Algorithm

After each module is executed, the Integrating Module adjusts the end-use prices generated by the supply and conversion modules by the penalty, and places the result in the adjusted price arrays AMPBLK, ACOAL, and ANGTDM. These arrays are used by the demand modules to calculate consumption. The include files AMPBLK and EPMMPBLK both contain a common block referring to the same memory locations though each variable has a slightly different name. The variables in AMPBLK differ from MPBLK so that both common blocks may be used in the subroutine Price_Adjust. The variable names in EPMMPBLK are the same as in MPBLK. This allows the demand modules to refer to the adjusted prices rather than the unadjusted prices by only changing one statement in the code. Figure F1 shown below demonstrates the relationship between the include files AMPBLK, MPBLK, and EPMMPBLK.

Figure F1. Price Adjustment to Common Block With Representative Variables



Model Structure

The EPM is executed once each iteration to determine total carbon emissions produced, the revenue created by any penalty for carbon emissions, and, depending upon the scenario, the level of offsets produced and a new carbon penalty that will bring the national emissions closer to the desired level. Algorithms for each of the options available are included below.

Policy Algorithms

Carbon Tax

The carbon tax is implemented in a straightforward manner. The level of the carbon tax is provided exogenously and the resulting total carbon production may be examined. Thus we have:

Algorithm I. Determine the effect of the carbon tax.

a. Input the carbon tax in $/metric ton carbon.

b. Determine the price increase of end-use fuels from the carbon tax. The revenue stream will be reported to the macroeconomic module. Algorithms to determine the price, the price adjustment and the revenue created by such a tax are described in the subroutine listing.

c. Run the other NEMS modules with price adjustments from (b).

d. Observe the total carbon output.

Ad Valorem Tax

Algorithm II. Determine the effect of an ad valorem tax.

a. Input the ad valorem tax rate.

b. Determine the revenue generated by implementing an ad valorem tax on end-use fuels going to the sector modules.

c. Run the other NEMS modules.

d. Determine the effect of the ad valorem tax on end-use fuel prices.

Auction

In this case, the total carbon production is specified. A scalar search is required on the auction clearing price (equivalent to the carbon tax) to determine the price level that produces the required carbon emission level. This is shown as follows:

Algorithm III. Determine carbon price that will cap total carbon output.

a. Choose an initial auction price.

b. Execute Algorithm I.

c. Determine a new auction price based on the scalar search algorithm described in the reg_false subroutine. If the carbon output is within the tolerance, report the tax rate and carbon produced and quit.

d. Repeat step b.

Carbon Allowances

An initial set of free allowances is assumed to be distributed to each sector of each region. Additional allowances may be sold or purchased in a secondary market. It is important to note that the allocation of free allowances is the equivalent to a subsidy to a supplier or sector, independent of actual emissions produced. In order to accurately capture the opportunity cost of using an allowance as opposed to selling it, a rational player in the allowance market would equate the total cost of its emissions as the cost of purchasing allowances for all of its emissions, and treat the value of the initial allocation of allowances separately. This is the approach taken in the EPM. The cost of purchasing sufficient allowances for all of the carbon emitted is added to the net cost of end-use fuels; the value of the initial allocation of allowances is handled separately. The total number of allowances outstanding determines the carbon production. The objective here is to determine the market price of an allowance such that the total number of allowances is below some exogenously determined level.

The revenue from initial allocations (price of allowances times the number of allowances) is independent of the consumption of the corresponding sector, and may be considered a rebate to a particular sector. This cannot be reflected in price adjustments of fuels without distorting the breakeven point between capital expenditures and operating expenses. Ignoring such revenue may be economically sound for suppliers (such as refineries) which price their products using marginal costs, but is incorrect for regulated sectors which use average prices. Such revenue is calculated in the EPM, but the appropriate connections to the conversion market have not been implemented.

Algorithm IV. Determine the auction price of an allowance that results from a particular cap on carbon outputs.

a. Determine an initial set of allowances by sector and region. Set a price for additional allowances.

b. Determine the end-use fuel price adjustments for each sector of each region. This algorithm is described in the price_adjust subroutine.

c. Re-run the other NEMS modules with these new price adjustments.

d. Examine the total carbon level. If the carbon output is within the tolerance, report the allowance price and carbon produced and quit. Otherwise, use the scalar search algorithm to choose a new allowance price.

e. Return to step c.

Offsets

The addition of offsets will be treated as increasing the supply of allowances. The revenue from generating offsets will be treated in the same manner as selling allowances. NEMS uses Algorithm III with the addition of one more step.

Algorithm V. Determine the auction price of an allowance that results from a particular cap on carbon outputs, with the inclusion of offsets.

a. Determine an initial set of allowances by sector and region. Set a price for any additional allowances.

b. Determine the end-use fuel price adjustments, using the algorithm described in the price_adjust subroutine, for each sector of each region.

c. Re-run the other NEMS modules with these new price adjustments.

d. For each sector of each region, determine the total offsets that will be created. Offset price/supply curves will be provided exogenously. From these curves, the total offsets created will be the total offsets available costing no more than the price of an allowance. The value of offsets will be treated in the same manner as that of the initial allocations.

e. Examine the total carbon level. If the carbon output is within the tolerance, report the allowance price and carbon produced and quit. Otherwise, use the scalar search algorithm, described in the reg_false subroutine, to choose a new allowance price.

f. Return to step c.

Subroutine List

SUBROUTINE: EPM

Description: This subroutine is the main controlling subroutine for the Emissions Policy Module. Initially, the subroutine reads flags to determine the scenario type: carbon tax, auction of permits, market for permits, and permit market with offsets. Based on these flags, the module calls the appropriate subroutines. If the tax is used, the emissions are summed and revenue accrued is calculated. If the auction is used, the auction revenue and total emissions are calculated. A new auction price for the permit is then calculated as part of an iterative process to match the auction price with its with the *a priori* emissions goal. If the market flag is set, the total emission is calculated and a new market clearing price for the permits is determined. If the offsets flag is set, the offsets subroutine is called to determine the offsets that would be created at the previous market clearing price, and these are added to the emissions goal.

Called By: Main

Calls: ACCNTREV, SUM_EMISSIONS, INITREV,REG_FALSE, OFFSETS, ADVAL_TAX, PRICE_ADJUST

Equations: None.

SUBROUTINE: SUM_EMISSIONS

Description: This subroutines sums total carbon emissions. The end use of a fuel is multiplied by an emissions factor; the total is aggregated by census region and sector. The fuel quantities are found in the common blocks QBLK and EMMOUT.

Called By: EPM

Calls: None

Equations:

$$AMTPOL = \sum_{i} \sum_{j} \sum_{k} Em(ik) * Qf(ijk)$$

where

AMTPOL	=	Total carbon emissions from all fuel i from all regions j in year k,
Em(ik)	=	Emissions from fuel i (MMT carbon /quad BTUs) in year k,
Qf(ijk)	=	Total consumption of fuel i in region j and year k.

SUBROUTINE: ACCNTREV

Description: This subroutine calculates the total revenue raised from each sector by the emissions penalty (tax or permit). Revenue is calculated by multiplying the quantity of end-use fuel by an emissions factor and the penalty level.

Called By: EPM

Calls: None

Equations:

$$REV(l) = \sum_{i \subset l} \sum_{j} \sum_{k} EMTAX(k) Em(ik) Qf(ijk)$$

where

REV(l)	=	Total revenue collected in sector l from all fuel i from all regions j and in year k,
Em(ik)	=	Emission factor for fuel i (MMT carbon /quad BTUs) in year k,
EMTAX(k)	=	Carbon tax ($/ton carbon) in year k
Qf(ijk)	=	Total consumption of fuel i in region j and year k

SUBROUTINE: INITREV

Description: If an allowance system is being modeled, the market clearing price of allowances is determined through the iterative process using the NEMS model. However, it is likely that a certain number of allowances will be issued to the affected sources. This subroutine calculates the value of this initial allocation of allowances by multiplying the number of allowances by their market clearing price.

Called By: EPM

Calls: None.

Equations:

$$CallocInit = Sallocinit * Palloc$$

where

CallocInit	=	Total value of initial allowances (billion $87),
SallocInit	=	Allocation provided (tons carbon)
Palloc	=	Price of an allowance ($/ton carbon).

SUBROUTINE: OFFSETS

Description: Offsets may be used to credit reductions in greenhouse gas emissions against total emissions. This subroutine uses linear interpolation to determine from a set of price-offset curves the total offsets that would be presumed to be offered at a particular price for an allowance.

Called By: EPM

Calls: None.

Equations:

$$OFFST = OFFSET(I) + \frac{OFFSET(I+1) - OFFSET(I)}{PRICE(I+1) - PRICE(I)}$$

where

OFFST	=	Total offsets (MMT Carbon),
PRICE(I)	=	Price of offset less than allowance price,
PRICE(I+1)	=	Price of offset greater than allowance price,
OFFSET(I)	=	Offset level corresponding to PRICE(I),
OFFSET(I+1)	=	Offset level corresponding to PRICE(I+1).

SUBROUTINE: PRICE_ADJUST

Description: If the EPM is turned on (RUNEPM=1), this subroutine modifies the adjusted price of the fuel by the emissions penalty. This is done by multiplying the penalty by a conversion factor and adding the result to the price of the fuel.

Called By: EPM

Calls: None.

Equations:

$$Eadj(ik) = Em(ik) * EMTAX(k)$$

where

Em(ik)	=	Emission factor for fuel i (MMT carbon /quad BTUs) in year k,
EMTAX(k)	=	Carbon tax ($/ton carbon) in year k
Eadj(ik)	=	Price adjustment of fuel i ($/MMBTUs) in year k.

SUBROUTINE: REG_FALSE

Description: This subroutine adjusts the carbon penalty such that the carbon emission goal is met. In particular, let f(x) be the carbon emissions that exceed the carbon goal for a carbon tax of x (f(x) can be negative). Initially, the subroutine must adjust the value of x to find two values of the carbon penalty $x_i < a_{i,}$ such that $f(x_i) < 0$ and $f(a_i) > 0$. Using this algorithm, we find u, a new value of x, from the equation listed below.

Called By: EPM

Calls: None.

Equations:

$$u = \frac{[a_i f(x_i) - x_i f(a_i)]}{f(x_i) - f(a_i)}$$

where

a_i	=	Value of carbon penalty such that $f(a_i) < 0$,
u_i	=	Value of carbon penalty such that $f(u_i) > 0$,
u	=	New value of carbon penalty.

In the next iteration, x_i is replaced with u if f(u) < 0, or a_i is replaced with u if f(u) > 0. Using this procedure, the value of u is found such that f(u) = 0 to some tolerance.

SUBROUTINE: ADVAL_TAX

Description: This subroutine calculates the increase on prices of end-use fuels created by the implementation of the ad valorum tax. The ad valorum tax is calculated by multiplying the price of end-use fuels by the ad valorum tax rate input by the user.

Called By: MAIN

Calls: None.

Equations:

$$Padj(ijk) = Pbase(ijk) * (Advaltax(k) + 1)$$

where

Padj(ijk)	=	Perturbed price of fuel i in region j and year k ($/MMBTUs),
Pbase(ijk)	=	Base price of fuel i ($/MMBTUs) in region j and year k.
Advaltax(k)	=	Ad valorum tax in year k.

SUBROUTINE: COPY_ADJUSTED

Description: This subroutine updates the adjusted price common blocks. The entire price common blocks MPBLK, COALOUT and NGDTMOUT are copied to the adjusted price common blocks AMPBLK, ACOAL and ANGTDM after each iteration in MAIN. Then the adjustments for specific variables calculated in subroutine PRICE_ADJUST are added.

Called By: MAIN

Calls:

Equations:

$$Padj(ijk) = Pbase(ijk) + Eadj(ik)$$

where

Padj(ijk)	=	Perturbed price of fuel i in region j and year k ($/MMBTUs),
Pbase(ijk)	=	Base price of fuel i ($/MMBTUs) in region j and year k.
Eadj(ik)	=	Price adjustment of fuel i ($/MMBTUs) in year k.

SUBROUTINE: EPM_READ

Description: This subroutine reads the initial carbon penalty, emissions factors, and offset curves for the EPM.

Called By: EPM

Calls: None.

Equations: None.

Variable List

EPM Common Block

Description	Variable	Type	Units	indices
Coalbed Recovery Price	PCB	REAL*4	$/MMT Carbon	(MAX_INDEX)
Reforestation Offset Price	PREF4	REAL*4	$/MMT Carbon	(MAX_INDEX)
Offset for coalbed	OFFSETCB	REAL*4	MMT Carbon	(MAX_INDEX)
Offset for Reforestation	OFFSETREF	REAL*4	MMT Carbon	(MAX_INDEX)
Tax or Permit Price	EM TAX	REAL*4	b$	(MNUMYR)
National Emissions by Yr	TOTAL_EMISSIONS	REAL*4	MMT Carbon	(MNUMYR)
Emissions Goal by Yr	EMISSIONS_GOAL	REAL*4	MMT Carbon	(MNUMYR)
Initial permit allocation	INIT_ALLOC	REAL*4	MMT Carbon	(5,MNUMYR)
Number of Coal Regions for each Cen Div	NL_CDNUM	INT		(9)
Mapping of coal Regions to Cen Div	CL_CDMAP	INT		(9,4)

Adjusted Price Common Block

Description	Variable	Type	Units	Indices
Purch. Elec, Peak. Resid	AEPRS	REAL	87$/MMBTU	(MNUMCR,MNUMYR)
Purch. Elec, Peak. Comm	AEPCM	REAL	87$/MMBTU	(MNUMCR,MNUMYR)
Purch. Elec, Peak. Trans	AEPTR	REAL	87$/MMBTU	(MNUMCR,MNUMYR)
Purch. Elec, Peak. Indust	AEPIN	REAL	87$/MMBTU	(MNUMCR,MNUMYR)
Purch. Elec, Peak. Refinery	AEPAS	REAL	87$/MMBTU	(MNUMCR,MNUMYR)
Purch. Elec, Nonpeak. Resid	AENRS	REAL	87$/MMBTU	(MNUMCR,MNUMYR)
Purch. Elec, Nonpeak. Comm	AENCM	REAL	87$/MMBTU	(MNUMCR,MNUMYR)
Purch. Elec, Nonpeak. Trans	AENTR	REAL	87$/MMBTU	(MNUMCR,MNUMYR)
Purch. Elec, Nonpeak. Indust	AENIN	REAL	87$/MMBTU	(MNUMCR,MNUMYR)
Purch. Elec, Nonpeak. All Sect	AENAS	REAL	87$/MMBTU	(MNUMCR,MNUMYR)
Purch. Elec. Resid	AELRS	REAL	87$/MMBTU	(MNUMCR,MNUMYR)
Purch. Elec. Comm	AELCM	REAL	87$/MMBTU	(MNUMCR,MNUMYR)
Purch. Elec. Trans	AELTR	REAL	87$/MMBTU	(MNUMCR,MNUMYR)
Purch. Elec. Indust	AELIN	REAL	87$/MMBTU	(MNUMCR,MNUMYR)
Purch. Elec. All Sectors	AELAS	REAL	87$/MMBTU	(MNUMCR,MNUMYR)
Natural Gas, Core. Resid	AGFRS	REAL	87$/MMBTU	(MNUMCR,MNUMYR)
Natural Gas, Core. Comm	AGFCM	REAL	87$/MMBTU	(MNUMCR,MNUMYR)
Natural Gas, Core. Trans	AGFTR	REAL	87$/MMBTU	(MNUMCR,MNUMYR)
Natural Gas, Core. Indust	AGFIN	REAL	87$/MMBTU	(MNUMCR,MNUMYR)
Natural Gas, Core. Electr	AGFEL	REAL	87$/MMBTU	(MNUMCR,MNUMYR)
Natural Gas, Core. All Sect	AGFAS	REAL	87$/MMBTU	(MNUMCR,MNUMYR)
Natural Gas, Noncore. Resid	AGIRS	REAL	87$/MMBTU	(MNUMCR,MNUMYR)
Natural Gas, Noncore. Comm	AGICM	REAL	87$/MMBTU	(MNUMCR,MNUMYR)
Natural Gas, Noncore. Trans	AGITR	REAL	87$/MMBTU	(MNUMCR,MNUMYR)
Natural Gas, Noncore. Indust	AGIIN	REAL	87$/MMBTU	(MNUMCR,MNUMYR)
Natural Gas, Noncore. Electr	AGIEL	REAL	87$/MMBTU	(MNUMCR,MNUMYR)
Natural Gas, Noncore. All Sect	AGIAS	REAL	87$/MMBTU	(MNUMCR,MNUMYR)
Natural Gas. Residential	ANGRS	REAL	87$/MMBTU	(MNUMCR,MNUMYR)
Natural Gas. Commercial	ANGCM	REAL	87$/MMBTU	(MNUMCR,MNUMYR)
Natural Gas. Transportation	ANGTR	REAL	87$/MMBTU	(MNUMCR,MNUMYR)
Natural Gas. Industrial	ANGIN	REAL	87$/MMBTU	(MNUMCR,MNUMYR)
Natural Gas. Electricity	ANGEL	REAL	87$/MMBTU	(MNUMCR,MNUMYR)
Natural Gas. All Sectors	ANGAS	REAL	87$/MMBTU	(MNUMCR,MNUMYR)
Natural Gas. Pipeline	AGPTR	REAL	87$/MMBTU	(MNUMCR,MNUMYR)
Lease and Plant Fuel	ALPIN	REAL	87$/MMBTU	(MNUMCR,MNUMYR)
Coal. Residential	ACLRS	REAL	87$/MMBTU	(MNUMCR,MNUMYR)
Coal. Commercial	ACLCM	REAL	87$/MMBTU	(MNUMCR,MNUMYR)
Coal. Industrial	ACLIN	REAL	87$/MMBTU	(MNUMCR,MNUMYR)
Coal. Electricity	ACLEL	REAL	87$/MMBTU	(MNUMCR,MNUMYR)
Coal. Synthetics	ACLSN	REAL	87$/MMBTU	(MNUMCR,MNUMYR)
Coal. All Sectors	ACLAS	REAL	87$/MMBTU	(MNUMCR,MNUMYR)
Metallurgical Coal. Industiral	AMCIN	REAL	87$/MMBTU	(MNUMCR,MNUMYR)
Motor Gasoline. Commercial	AMGCM	REAL	87$/MMBTU	(MNUMCR,MNUMYR)
Motor Gasoline. Trans	AMGTR	REAL	87$/MMBTU	(MNUMCR,MNUMYR)
Motor Gasoline. Industrial	AMGIN	REAL	87$/MMBTU	(MNUMCR,MNUMYR)
Motor Gasoline. All Sectors	AMGAS	REAL	87$/MMBTU	(MNUMCR,MNUMYR)
Jet Fuel. Trasnportation	AJFTR	REAL	87$/MMBTU	(MNUMCR,MNUMYR)
Distillate.Residential	ADSRS	REAL	87$/MMBTU	(MNUMCR,MNUMYR)
Distillate.Commercial	ADSCM	REAL	87$/MMBTU	(MNUMCR,MNUMYR)
Distillate.Transportation	ADSTR	REAL	87$/MMBTU	(MNUMCR,MNUMYR)
Distillate.Industrial	ADSIN	REAL	87$/MMBTU	(MNUMCR,MNUMYR)
Distillate.Electric-Petro Coke	ADSEL	REAL	87$/MMBTU	(MNUMCR,MNUMYR)
Distillate.All Sectors	ADSAS	REAL	87$/MMBTU	(MNUMCR,MNUMYR)

Variable	Type	Description
AKSRS	REAL	Kerosene. Residential
AKSCM	REAL	Kerosene. Commercial
AKSIN	REAL	Kerosene. Industrial
AKSAS	REAL	Kerosene. All Sectors
ALGRS	REAL	Liquid Petroleum Gases. Resid
ALGCM	REAL	Liquid Petroleum Gases. Comm
ALGTR	REAL	Liquid Petroleum Gases. Trans
ALGIN	REAL	Liquid Petroleum Gases. Indust
ALGAS	REAL	Liquid Petroleum Gases.All Sect
ARLCM	REAL	Residual Fuel,Low Sulfum. Comm
ARLTR	REAL	Residual Fuel,Low Sulfur.Trans
ARLIN	REAL	Residual Fuel,Low Sulfur.Ind
ARLEL	REAL	Residual Fuel,Low Sulfur.Ele
ARLAS	REAL	Residual Fuel,Low Sul. All Sec
ARHTR	REAL	Residual Fuel,High Sul. Trans
ARHEL	REAL	Residual Fuel,High Sul. Electr
ARHAS	REAL	Residual Fuel,High Sul. All Sec
ARSCM	REAL	Residual Fuel. Commercial
ARSTR	REAL	Residual Fuel. Transportation
ARSIN	REAL	Residual Fuel. Industrial
ARSEL	REAL	Residual Fuel. Electricity
ARSAS	REAL	Residual Fuel. All Sectors
APFIN	REAL	Petrochemical Feedstocks. Ind
AASIN	REAL	Asphalt, Road Oil. Indust
AOTTR	REAL	Other Petroleum. Trans
AOTIN	REAL	Other PEtroleum. Indust
AOTAS	REAL	Other Petroleum. Indust
ATPRS	REAL	Total Petroleum. Resid
ATPCM	REAL	Total Petroleum. Comm
ATPTR	REAL	Total Petroleum. Trans
ATPIN	REAL	Total Petroleum. Indust
ATPRF	REAL	Total Petroleum. Refinery
ATPEL	REAL	Total Petroleum. Electr
ATPAS	REAL	Total Petroleum. All Sectors
AMETR	REAL	Methanol. Transportation
AETTR	REAL	Ethanol. Transportation
AHYTR	REAL	Liquid Hydrogen. Transporation
AUREL	REAL	Uranium. Electricity

REAL	Units	Indices	(MNUMCR,MNUMYR)
REAL			
REAL	87$/MMBTU	(MNUMCR,MNUMYR)	(MNUMCR,MNUMYR)
REAL	87$/MMBTU	(MNUMCR,MNUMYR)	(MNUMCR,MNUMYR)
REAL	87$/MMBTU	(MNUMCR,MNUMYR)	(MNUMCR,MNUMYR)
REAL	87$/MMBTU	(MNUMCR,MNUMYR)	(MNUMCR,MNUMYR)
	87$/MMBTU	(MNUMCR,MNUMYR)	(MNUMCR,MNUMYR)
	87$/MMBTU	(MNUMCR,MNUMYR)	(MNUMCR,MNUMYR)
	87$/MMBTU	(MNUMCR,MNUMYR)	(MNUMCR,MNUMYR)
	87$/MMBTU	(MNUMCR,MNUMYR)	(MNUMCR,MNUMYR)
	87$/MMBTU	(MNUMCR,MNUMYR)	(MNUMCR,MNUMYR)
	87$/MMBTU	(MNUMCR,MNUMYR)	(MNUMCR,MNUMYR)
	87$/MMBTU	(MNUMCR,MNUMYR)	(MNUMCR,MNUMYR)
	87$/MMBTU	(MNUMCR,MNUMYR)	(MNUMCR,MNUMYR)
	87$/MMBTU	(MNUMCR,MNUMYR)	(MNUMCR,MNUMYR)
	87$/MMBTU	(MNUMCR,MNUMYR)	(MNUMCR,MNUMYR)
	87$/MMBTU	(MNUMCR,MNUMYR)	(MNUMCR,MNUMYR)
	87$/MMBTU	(MNUMCR,MNUMYR)	
	87$/MMBTU	(MNUMCR,MNUMYR)	
	87$/MMBTU	(MNUMCR,MNUMYR)	
	87$/MMBTU	(MNUMCR,MNUMYR)	
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	87$/MMBTU		
	87$/MMBTU		
	87$/MMBTU		
	87$/MMBTU		

Emissions Factors Common Block

Description	Variable	Type	Units	Indices
Natural Gas, Core. Residential	EGFRS	REAL	MMT C/QUAD	(MNUMYR)
Natural Gas, Core. Commercial	EGFCM	REAL	MMT C/QUAD	(MNUMYR)
Natural Gas, Core. Transport	EGFTR	REAL	MMT C/QUAD	(MNUMYR)
Natural Gas, Core. Industrial	EGFIN	REAL	MMT C/QUAD	(MNUMYR)
Natural Gas, Core. Electricity	EGFEL	REAL	MMT C/QUAD	(MNUMYR)
Natural Gas, Noncore. Resid	EGIRS	REAL	MMT C/QUAD	(MNUMYR)
Natural Gas, Noncore. Comm	EGICM	REAL	MMT C/QUAD	(MNUMYR)
Natural Gas, Noncore. Transp	EGITR	REAL	MMT C/QUAD	(MNUMYR)
Natural Gas, Noncore. Indust	EGIIN	REAL	MMT C/QUAD	(MNUMYR)
Natural Gas, Noncore. Electr	EGIEL	REAL	MMT C/QUAD	(MNUMYR)
Natural Gas. Residential	ENGRS	REAL	MMT C/QUAD	(MNUMYR)
Natural Gas. Commercial	ENGCM	REAL	MMT C/QUAD	(MNUMYR)
Natural Gas. Transportation	ENGTR	REAL	MMT C/QUAD	(MNUMYR)
Natural Gas. Industrial	ENGIN	REAL	MMT C/QUAD	(MNUMYR)
Natural Gas. Electricity	ENGEL	REAL	MMT C/QUAD	(MNUMYR)
Natural Gas. Pipeline	EGPTR	REAL	MMT C/QUAD	(MNUMYR)
Lease and Plant Fuel	ELPIN	REAL	MMT C/QUAD	(MNUMYR)
Coal. Residential	ECLRS	REAL	MMT C/QUAD	(MNUMYR)
Coal. Commercial	ECLCM	REAL	MMT C/QUAD	(MNUMYR)
Coal. Industrial	ECLIN	REAL	MMT C/QUAD	(MNUMYR)
Coal. Electricity	ECLEL	REAL	MMT C/QUAD	(MNUMYR)
Metallurgical Coal. Industrial	EMCIN	REAL	MMT C/QUAD	(MNUMYR)
Motor Gasoline. Commercial	EMGCM	REAL	MMT C/QUAD	(MNUMYR)
Motor Gasoline. Transportation	EMGTR	REAL	MMT C/QUAD	(MNUMYR)
Motor Gasoline. Industrial	EMGIN	REAL	MMT C/QUAD	(MNUMYR)
Jet Fuel. Transportation	EJFTR	REAL	MMT C/QUAD	(MNUMYR)
Distillate. Residential	EDSRS	REAL	MMT C/QUAD	(MNUMYR)
Distillate. Commercial	EDSCM	REAL	MMT C/QUAD	(MNUMYR)
Distillate. Transportation	EDSTR	REAL	MMT C/QUAD	(MNUMYR)
Distillate. Industrial	EDSIN	REAL	MMT C/QUAD	(MNUMYR)
Distillate. Elect(+Petro Coke)	EDSEL	REAL	MMT C/QUAD	(MNUMYR)
Kerosene. Residential	EKSRS	REAL	MMT C/QUAD	(MNUMYR)
Kerosene. Commercial	EKSCM	REAL	MMT C/QUAD	(MNUMYR)
Kerosene. Industrial	EKSIN	REAL	MMT C/QUAD	(MNUMYR)
Liquid Petroleum Gases. Resid	ELGRS	REAL	MMT C/QUAD	(MNUMYR)
Liquid Petroleum Gases. Comm	ELGCM	REAL	MMT C/QUAD	(MNUMYR)
Liquid Petroleum Gases. Trans	ELGTR	REAL	MMT C/QUAD	(MNUMYR)
Liquid Petroleum Gases. Indust	ELGIN	REAL	MMT C/QUAD	(MNUMYR)

Description

Residual Fuel,Low Sulfur.Comm
Residual Fuel,Low Sulfur.Tran
Residual Fuel,Low Sulfur.Ind
Residual Fuel,Low Sulfur.Ele
Residual Fuel,High Sul.Trans
Residual Fuel,High Sul.Elect
Residual Fuel. Commercial
Residual Fuel. Transportation
Residual Fuel. Industrial
Residual Fuel. Electricity
Methanol. Transporation
Ethanol. Transporation
Pet Feedstocks Industrial

Pet Code Industrial
Still Gas Industrial
Other Pet Industrial
Pet Coke Electricity

VLS Bit Coal Emissions By NERC
LS Bit Coal Emissions By NERC
MS Bit Coal Emissions By NERC
HS Bit Coal Emissions By NERC
VLS Sub Coal Emissions By NERC
LS Sub Coal Emissions By NERC
MS Sub Coal Emissions By NERC
HS Sub Coal Emissions By NERC
VLS Lig Coal Emissions By NERC
LS Lig Coal Emissions By NERC
MS Lig Coal Emissions By NERC
HS Lig Coal Emissions By NERC

E Util Firm NG Emissioins
E Util Inter NG Emissions
E Util Compet NG Emissions

Variable				Type
	EETTR	ESDELN	ELHELNR	
	EPFIN	R		
ERLCM		ESMELN	EGFELGR	REAL
ERLTR	EPCIN	R	EGIELGR	REAL
ERLIN	ESGIN	ESHELN	EGCELGR	REAL
ERLEL	EOTIN	R		REAL
ERHTR	EPCEL	ELCELN		REAL
ERHEL		R		REAL
ERSCM	EBCELNR	ELDELN		REAL
ERSTR	EBDELNR	R		REAL
ERSIN	EBMELNR	ELMELN		REAL
ERSEL	EBHELNR	R		REAL
EMETR	ESCELNR			REAL

REAL	Units	Indices	(MNUMYR)
REAL			(MNUMYR)
	MMT C/QUAD	(MNUMY	
REAL	MMT C/QUAD	R)	
REAL	MMT C/QUAD	(MNUMY	
REAL	MMT C/QUAD	R)	
REAL	MMT C/QUAD	(MNUMY	
	MMT C/QUAD	R)	
REAL	MMT C/QUAD	(MNUMY	
REAL	MMT C/QUAD	R)	
REAL	MMT C/QUAD	(MNUMY	
REAL	MMT C/QUAD	R)	
REAL	MMT C/QUAD	(MNUMY	
REAL	MMT C/QUAD	R)	
REAL	MMT C/QUAD	(MNUMY	
REAL		R)	
REAL	MMT C/QUAD	(MNUMY	
REAL	MMT C/QUAD	R)	
REAL	MMT C/QUAD	(MNUMY	
REAL	MMT C/QUAD	R)	
		(MNUMY	
REAL*4	MMT C/QUAD	R)	
REAL*4	MMT C/QUAD	(MNUMY	
REAL*4	MMT C/QUAD	R)	
	MMT C/QUAD	(MNUMY	
	MMT C/QUAD	R)	
	MMT C/QUAD	(MNUMY	
	MMT C/QUAD	R)	
	MMT C/QUAD		
	MMT C/QUAD	(MNUMY	
	MMT C/QUAD	R)	
	MMT C/QUAD	(MNUMY	
	MMT C/QUAD	R)	
		(MNUMY	
	MMT C/QUAD	R)	
	MMT C/QUAD	(MNUMY	
	MMT C/QUAD	R)	
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		(MNUMY	
		R)	
		(MNUMY	
		R)	

Quantity Common Block

Description	Variable	Type	Units	Indices
Purch Elec, Peak.Residential	QEPRS	REAL	TBTU	(MNUMCR,MNUMYR)
Purch Elec, Peak. Comm	QEPCM	REAL	TBTU	(MNUMCR,MNUMYR)
Purch Elec, Peak. Trans	QEPTR	REAL	TBTU	(MNUMCR,MNUMYR)
Purch Elec, Peak. Industrial	QEPIN	REAL	TBTU	(MNUMCR,MNUMYR)
Purch Elec, Peak. Refinery	QEPRF	REAL	TBTU	(MNUMCR,MNUMYR)
Purch Elec, Peak. All Sectors	QEPAS	REAL	TBTU	(MNUMCR,MNUMYR)
Purch Elec, Nonpeak. Resid	QENRS	REAL	TBTU	(MNUMCR,MNUMYR)
Purch Elec, Nonpeak. Comm	QENCM	REAL	TBTU	(MNUMCR,MNUMYR)
Purch Elec, Nonpeak. Trans	QENTR	REAL	TBTU	(MNUMCR,MNUMYR)
Purch Elec, Nonpeak. Ind	QENIN	REAL	TBTU	(MNUMCR,MNUMYR)
Purch Elec, Nonpeak. Refinery	QENRF	REAL	TBTU	(MNUMCR,MNUMYR)
Purch Elec, Nonpeak. All Sect	QENAS	REAL	TBTU	(MNUMCR,MNUMYR)
Purch Elec. Residential	QELRS	REAL	TBTU	(MNUMCR,MNUMYR)
Purch Elec. Commercial	QELCM	REAL	TBTU	(MNUMCR,MNUMYR)
Purch Elec. Transportation	QELTR	REAL	TBTU	(MNUMCR,MNUMYR)
Purch Elec. Industrial	QELIN	REAL	TBTU	(MNUMCR,MNUMYR)
Purch Elec. Refinery	QELRF	REAL	TBTU	(MNUMCR,MNUMYR)
Purch Elec. All Sectors	QELAS	REAL	TBTU	(MNUMCR,MNUMYR)
Natural Gas Core. Residential	QGFRS	REAL	TBTU	(MNUMCR,MNUMYR)
Natural Gas Core. Commercial	QGFCM	REAL	TBTU	(MNUMCR,MNUMYR)
Natural Gas Core. Trans	QGFTR	REAL	TBTU	(MNUMCR,MNUMYR)
Natural Gas Core. Industrial	QGFIN	REAL	TBTU	(MNUMCR,MNUMYR)
Natural Gas Core. Refinery	QGFRF	REAL	TBTU	(MNUMCR,MNUMYR)
Natural Gas Core. Electr	QGFEL	REAL	TBTU	(MNUMCR,MNUMYR)
Natural Gas Core. All Sect	QGFAS	REAL	TBTU	(MNUMCR,MNUMYR)
Natural Gas Noncore. Resid	QGIRS	REAL	TBTU	(MNUMCR,MNUMYR)
Natural Gas Noncore. Comm	QGICM	REAL	TBTU	(MNUMCR,MNUMYR)
Natural Gas Noncore. Trans	QGITR	REAL	TBTU	(MNUMCR,MNUMYR)
Natural Gas Noncore. Indust	QGIIN	REAL	TBTU	(MNUMCR,MNUMYR)
Natural Gas Noncore. Refinery	QGIRF	REAL	TBTU	(MNUMCR,MNUMYR)
Natural Gas Noncore. Electr	QGIEL	REAL	TBTU	(MNUMCR,MNUMYR)
Natural Gas Noncore. All Sect	QGIAS	REAL	TBTU	(MNUMCR,MNUMYR)
Natural Gas Residential	QNGRS	REAL	TBTU	(MNUMCR,MNUMYR)
Natural Gas Commercial	QNGCM	REAL	TBTU	(MNUMCR,MNUMYR)
Natural Gas Transportation	QNGTR	REAL	TBTU	(MNUMCR,MNUMYR)
Natural Gas Industrial	QNGIN	REAL	TBTU	(MNUMCR,MNUMYR)
Natural Gas Refinery	QNGRF	REAL	TBTU	(MNUMCR,MNUMYR)
Natural Gas Electricity	QNGEL	REAL	TBTU	(MNUMCR,MNUMYR)
Natural Gas All Sectors	QNGAS	REAL	TBTU	(MNUMCR,MNUMYR)
Natural Gas Pipeline	QGPTR	REAL	TBTU	(MNUMCR,MNUMYR)
Lease and Plant Fuel	QLPIN	REAL	TBTU	(MNUMCR,MNUMYR)
Coal. Residential	QCLRS	REAL	TBTU	(MNUMCR,MNUMYR)
Coal. Commercial	QCLCM	REAL	TBTU	(MNUMCR,MNUMYR)
Coal. Industrial	QCLIN	REAL	TBTU	(MNUMCR,MNUMYR)
Coal. Refinery	QCLRF	REAL	TBTU	(MNUMCR,MNUMYR)
Coal. Electricity	QCLEL	REAL	TBTU	(MNUMCR,MNUMYR)
Coal. Synthetics	QCLSN	REAL	TBTU	(MNUMCR,MNUMYR)
Coal. All Sectors	QCLAS	REAL	TBTU	(MNUMCR,MNUMYR)
Metallurgical Coal Industrial	QMCIN	REAL	TBTU	(MNUMCR,MNUMYR)
Motor Gasoline. Commercial	QMGCM	REAL	TBTU	(MNUMCR,MNUMYR)
Motor Gasoline. Transportation	QMGTR	REAL	TBTU	(MNUMCR,MNUMYR)
Motor Gasoline. Industrial	QMGIN	REAL	TBTU	(MNUMCR,MNUMYR)
Motor Gasoline. All Sectors	QMGAS	REAL	TBTU	(MNUMCR,MNUMYR)

Description	Variable	Type	Units	Indices
Jet Fuel Transportation	QJFTR	REAL	TBTU	(MNUMCR,MNUMYR)
Distillate Residential	QDSRS	REAL	TBTU	(MNUMCR,MNUMYR)
Distillate Commercial	QDSCM	REAL	TBTU	(MNUMCR,MNUMYR)
Distillate Transportation	QDSTR	REAL	TBTU	(MNUMCR,MNUMYR)
Distillate Industrial	QDSIN	REAL	TBTU	(MNUMCR,MNUMYR)
Distillate Refinery	QDSRF	REAL	TBTU	(MNUMCR,MNUMYR)
Distillate Electr(+petro coke)	QDSEL	REAL	TBTU	(MNUMCR,MNUMYR)
Distillate All Sectors	QDSAS	REAL	TBTU	(MNUMCR,MNUMYR)
Kerosene. Residential	QKSRS	REAL	TBTU	(MNUMCR,MNUMYR)
Kerosene. Commercial	QKSCM	REAL	TBTU	(MNUMCR,MNUMYR)
Kerosene. Industrial	QKSIN	REAL	TBTU	(MNUMCR,MNUMYR)
Kerosene. All Sectors	QKSAS	REAL	TBTU	(MNUMCR,MNUMYR)
Liquid Petroleum Gases Resid	QLGRS	REAL	TBTU	(MNUMCR,MNUMYR)
Liquid Petroleum Gases Comm	QLGCM	REAL	TBTU	(MNUMCR,MNUMYR)
Liquid Petroleum Gases Trans	QLGTR	REAL	TBTU	(MNUMCR,MNUMYR)
Liquid Petroleum Gases Ind	QLGIN	REAL	TBTU	(MNUMCR,MNUMYR)
Liquid Petroleum Gases Refine	QLGRF	REAL	TBTU	(MNUMCR,MNUMYR)
Liquid Petroleum Gases All Sec	QLGAS	REAL	TBTU	(MNUMCR,MNUMYR)
Residual Fuel Low Sulfur Comm	QRLCM	REAL	TBTU	(MNUMCR,MNUMYR)
Residual Fuel Low Sulfur Trans	QRLTR	REAL	TBTU	(MNUMCR,MNUMYR)
Residual Fuel Low Sulfur Ind	QRLIN	REAL	TBTU	(MNUMCR,MNUMYR)
Residual Fuel Low Sulfur Refine	QRLRF	REAL	TBTU	(MNUMCR,MNUMYR)
Residual Fuel Low Sulfur Electr	QRLEL	REAL	TBTU	(MNUMCR,MNUMYR)
Resid Fuel Low Sulfur All Sec	QRLAS	REAL	TBTU	(MNUMCR,MNUMYR)
Resid Fuel High Sulfur Trans	QRHTR	REAL	TBTU	(MNUMCR,MNUMYR)
Resid Fuel High Sulfur Electr	QRHEL	REAL	TBTU	(MNUMCR,MNUMYR)
Resid Fuel High Sulfur All Sec	QRHAS	REAL	TBTU	(MNUMCR,MNUMYR)
Residual Fuel. Commercial	QRSCM	REAL	TBTU	(MNUMCR,MNUMYR)
Residual Fuel. Transportation	QRSTR	REAL	TBTU	(MNUMCR,MNUMYR)
Residual Fuel. Industrial	QRSIN	REAL	TBTU	(MNUMCR,MNUMYR)
Residual Fuel. Refinery	QRSRF	REAL	TBTU	(MNUMCR,MNUMYR)
Residual Fuel. Electricity	QRSEL	REAL	TBTU	(MNUMCR,MNUMYR)
Residual Fuel. All Sectors	QRSAS	REAL	TBTU	(MNUMCR,MNUMYR)
Petrochemical Feedstocks. Ind	QPFIN	REAL	TBTU	(MNUMCR,MNUMYR)
Still Gas. Industrial	QSGIN	REAL	TBTU	(MNUMCR,MNUMYR)
Still Gas. Refinery	QSGRF	REAL	TBTU	(MNUMCR,MNUMYR)
Petroleum Coke. Industrial	QPCIN	REAL	TBTU	(MNUMCR,MNUMYR)
Petroleum Coke. Refinery	QPCRF	REAL	TBTU	(MNUMCR,MNUMYR)
Petroleum Coke. Electricity	QPCEL	REAL	TBTU	(MNUMCR,MNUMYR)
Petroleum Coke. All Sectors	QPCAS	REAL	TBTU	(MNUMCR,MNUMYR)
Asphalt and Road Oil Ind	QASIN	REAL	TBTU	(MNUMCR,MNUMYR)
Other Petr Trans-lubes,aviat gas	QOTTR	REAL	TBTU	(MNUMCR,MNUMYR)
Other Petroleum. Industrial	QOTIN	REAL	TBTU	(MNUMCR,MNUMYR)
Other Petroleum. Refinery	QOTRF	REAL	TBTU	(MNUMCR,MNUMYR)
Other Petroleum. All Sectors	QOTAS	REAL	TBTU	(MNUMCR,MNUMYR)
Total Petroleum. Residential	QTPRS	REAL	TBTU	(MNUMCR,MNUMYR)
Total Petroleum. Commercial	QTPCM	REAL	TBTU	(MNUMCR,MNUMYR)
Total Petroleum. Trans	QTPTR	REAL	TBTU	(MNUMCR,MNUMYR)
Total Petroleum. Industrial	QTPIN	REAL	TBTU	(MNUMCR,MNUMYR)
Total Petroleum. Refinery	QTPRF	REAL	TBTU	(MNUMCR,MNUMYR)
Total Petroleum. Electricity	QTPEL	REAL	TBTU	(MNUMCR,MNUMYR)
Total Petroleum. All Sectors	QTPAS	REAL	TBTU	(MNUMCR,MNUMYR)

Description

Methanol. Transporation
Ethanol. Transporation
Liquid Hydrogen. Trans
Uranium. Electricity
Hydropower. Industrial
Hydropower. Electricity
Hydropower. All Sectors
Geothermal. Industrial
Geothermal. Electricity
Geothermal. All Sectors
Biomass. Residential
Biomass. Commercial
Biomass. Industrial
Biomass. Refinery
Biomass. Electricity
Biomass. Synthetics
Biomass. All Sectors
Municipal Solid Waste Ind
Municipal Solid Waste Electr
Municipal Solid Waste All Sec
Solar Thermal. Residential
Solar Thermal. Commercial
Solar Thermal. Industrial
Solar Thermal. Electricity
Solar Thermal. All Sectors
Photovoltaic. Residential
Photovoltaic. Commercial
Photovoltaic. Industrial
Photovoltaic. Electricity
Photovoltaic. All Sectors
Wind. Industrial
Wind. Electricity
Wind. All Sectors
Total Renewables. Residential
Total Renewables. Commercial
Total Renewables. Trans
Total Renewables. Industrial
Total Renewables. Electricity
Total Renewables. Synthetics
Total Renewables. All Sectors
Net Electricity Imports Electr
Net Coal Coke Imports Ind
Total Energy Consump. Resid
Total Energy Consump. Comm
Total Energy Consump. Trans
Total Energy Consump. Ind
Total Energy Consump. Refine
Total Energy Consump. Electr
Total Energy Consump. Synthet
Total Energy Consump. All Sec

Breakout of natural gas feedstock
Breakout of LPG feedstock

Variable	QHOIN	QBMRS	QBMAS	QSTIN
	QHOEL	QBMCM	QMSIN	QSTEL
QMETR	QHOAS	QBMIN	QMSEL	QSTAS
QETTR	QGEIN	QBMRF	QMSAS	QPVRS
QHYTR	QGEEL	QBMEL	QSTRS	QPVCM
QUREL	QGEAS	QBMSN	QSTCM	QPVIN

QPVEL	Type	Units	Indices	(MNUMCR,MNUMYR)
QPVAS				(MNUMCR,MNUMYR)
QWIIN	REAL	TBTU	(MNUMCR,MNUMY	(MNUMCR,MNUMYR)
QWIEL	REAL	TBTU	R)	(MNUMCR,MNUMYR)
QWIAS	REAL	TBTU	(MNUMCR,MNUMY	(MNUMCR,MNUMYR)
QTRRS	REAL	TBTU	R)	(MNUMCR,MNUMYR)
QTRCM	REAL	TBTU	(MNUMCR,MNUMY	(MNUMCR,MNUMYR)
QTRTR	REAL	TBTU	R)	(MNUMCR,MNUMYR)
QTRIN	REAL	TBTU	(MNUMCR,MNUMY	(MNUMCR,MNUMYR)
QTREL	REAL	TBTU	R)	(MNUMCR,MNUMYR)
QTRSN	REAL	TBTU	(MNUMCR,MNUMY	(MNUMCR,MNUMYR)
QTRAS	REAL	TBTU	R)	(MNUMCR,MNUMYR)
QEIEL	REAL	TBTU	(MNUMCR,MNUMY	(MNUMCR,MNUMYR)
QCIIN	REAL	TBTU	R)	(MNUMCR,MNUMYR)
QTSRS	REAL	TBTU	(MNUMCR,MNUMY	(MNUMCR,MNUMYR)
QTSCM	REAL	TBTU	R)	(MNUMCR,MNUMYR)
QTSTR	REAL	TBTU	(MNUMCR,MNUMY	(MNUMCR,MNUMYR)
QTSIN	REAL	TBTU	R)	(MNUMCR,MNUMYR)
QTSRF	REAL	TBTU	(MNUMCR,MNUMY	(MNUMCR,MNUMYR)
QTSEL	REAL	TBTU	R)	
QTSSN	REAL	TBTU	(MNUMCR,MNUMY	(MNUMCR,MNUMYR)
QTSAS	REAL	TBTU	R)	(MNUMCR,MNUMYR)
	REAL	TBTU	(MNUMCR,MNUMY	
INQNGPF	REAL	TBTU	R)	
INQLGPF	REAL	TBTU	(MNUMCR,MNUMY	
	REAL	TBTU	R)	
	REAL	TBTU	(MNUMCR,MNUMY	
	REAL	TBTU	R)	
	REAL	TBTU	(MNUMCR,MNUMY	
	REAL	TBTU	R)	
	REAL	TBTU	(MNUMCR,MNUMY	
	REAL	TBTU	R)	
	REAL	TBTU	(MNUMCR,MNUMY	
	REAL	TBTU	R)	
	REAL	TBTU	(MNUMCR,MNUMY	
	REAL	TBTU	R)	
	REAL	TBTU	(MNUMCR,MNUMY	
	REAL	TBTU	R)	
	REAL	TBTU	(MNUMCR,MNUMY	
	REAL	TBTU	R)	
	REAL	TBTU	(MNUMCR,MNUMY	
	REAL	TBTU	R)	
	REAL	TBTU	(MNUMCR,MNUMY	
	REAL	TBTU	R)	
	REAL	TBTU	(MNUMCR,MNUMY	
	REAL	TBTU	R)	
	REAL	TBTU	(MNUMCR,MNUMY	
	REAL	TBTU	R)	
	REAL	TBTU	(MNUMCR,MNUMY	
	REAL	TBTU	R)	
	REAL	TBTU	(MNUMCR,MNUMY	
	REAL	TBTU	R)	
			(MNUMCR,MNUMY	
	REAL	TBTU	R)	
	REAL	TBUT	(MNUMCR,MNUMY	
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			(MNUMCR,MNUMY	
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			(MNUMCR,MNUMY	
			R)	
			(MNUMCR,MNUMY	
			R)	
			(MNUMCR,MNUMY	
			R)	