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The RAMS Coal Model
Volume II – User's Guide

David B. Reister
Jeffrey V. Conopask
Philip E. Mihlmester

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OPERATED BY
MARTIN MARIETTA ENERGY SYSTEMS, INC.
FOR THE UNITED STATES
DEPARTMENT OF ENERGY

Printed in the United States of America. Available from
National Technical Information Service
U.S. Department of Commerce
5285 Port Royal Road, Springfield, Virginia 22161
NTIS price codes—Printed Copy: A04; Microfiche A01

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Engineering Physics and Mathematics Division

THE RAMS COAL MODEL

VOLUME II - USER'S GUIDE

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Date Published: February 1988

Prepared for the
Fossil Energy Program
Office of Fossil Energy
U.S. Department of Energy

OAK RIDGE NATIONAL LABORATORY
Oak Ridge, Tennessee 37831
operated by
Martin Marietta Energy Systems, Inc.
for the
U.S. Department of Energy
under Contract No. DE AC05-84OR21400

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ABSTRACT

The RAMS coal model was developed to aid the planning functions of the Office of Fossil Energy of the Department of Energy. The model was designed to simulate the market penetration of processes that use coal to produce liquid fuels. To simulate market penetration, we assume that the least cost process will have the largest share of the market. To evaluate the future income and costs for a process, we need to estimate the prices of all of the inputs and outputs for all of the coal processes and for all of the competing processes. After a literature review, we identified 26 types of energy, by-products, and factors of production that are potential inputs or outputs for a process. The coal model simulates the supply and demand for the 26 types of goods.

The coal model input-output (I-O) structure has 13 sectors to produce the first 24 goods (the last 2 factors, labor and capital, are exogenous inputs). The first 10 sectors produce the first 10 goods, which are either primary or secondary forms of energy. Sector 11, the liquid fuels sector, produces refined petroleum products and by-products, the goods from 11 to 23. Sector 12 produces good 24, materials. The final sector, sector 13, is the trade sector.

This report is a user's guide for the RAMS coal model. After a discussion of how to install and operate the model, the report provides a guided tour of the five input data sets and the six output data sets. One of the input data sets can be edited using LOTUS 1-2-3. The model has a menu-driven output editor that displays graphical output for all of the variables in the model.

1. INTRODUCTION

This is the second volume of the documentation for the Research and Development Analysis Modeling System (RAMS) coal model. The first volume is an overview of the model and its results. The third volume will provide an introduction to the methodology used to construct the algorithms used by the model. This volume will discuss the input and output data sets for the model.

The RAMS coal model is the third in a series of models that are being developed for the U.S. Department of Energy, Office of Fossil Energy. The first model, RAMSOIL, simulates the penetration of synthetic and unconventional oil into world markets. The second model, RAMSGAS, simulates the penetration of synthetic and unconventional gas into world markets. The RAMS Coal model simulates the penetration of secondary types of energy (clean coal, electricity, and liquid and gaseous fuels) produced from coal into the United States market. RAMSOIL and RAMSGAS simulated the supply and demand for a single form of energy in several regions. The RAMS Coal model simulates the supply and demand for many forms of energy in a single region; imports and exports of energy are simulated by the trade components of the model.

The RAMS family of models is designed to aid the planning functions of the Office of Fossil Energy. The RAMS models are intended to be used to forecast long-term trends in energy supply and demand. They are intended to be flexible models that can be used to easily analyze a wide variety of alternative scenarios. They have a long-term planning horizon (1985-2030) to simulate the future transition from conventional to unconventional fuels. They run on IBM-PC compatible micro-computers and are user-friendly.

RAMSOIL and RAMSGAS were written in LOTUS 1-2-3 to make the key model assumptions and parameters visible to the user. Since a LOTUS version of the coal model would be too large to run on an IBM-PC, the coal model is a hybrid model. LOTUS can be used to allow the user to easily change key parameters; and TURBO Pascal has been used to perform the calculations of the model.

The overall architecture of the RAMS coal model is illustrated in Fig. 1. The core of the model is a general equilibrium model of the supply and demand for 23 types of energy and by-products (see Table 1, page 8). The core model has sectors that produce and transport coal, crude oil, natural gas, electricity, and refined petroleum products. The core model has sectors that consume the 23 types of energy and by-products. Given input and output (I/O) coefficients for each of the sectors, the core model can balance supply and demand and forecast prices and quantity of production for the 23 types of energy and by-products. The I/O coefficients for each sector are forecast by a family of satellite models. Since the supply and demand for energy and by-products in the United States is influenced by international trade, the imports and exports of each of the 23 types of energy and by-products are exogenous inputs.

The design of the coal model allowed a staged development. In the first phase, the core model, the satellite model for the liquid fuels sector, and the supply models for coal, oil, and gas were developed. In the second phase, international trade was added and a satellite model was developed for the end-use demand for coal and other forms of energy. In the future, satellite models could be developed for the production of electricity, clean coal, and high BTU gas.

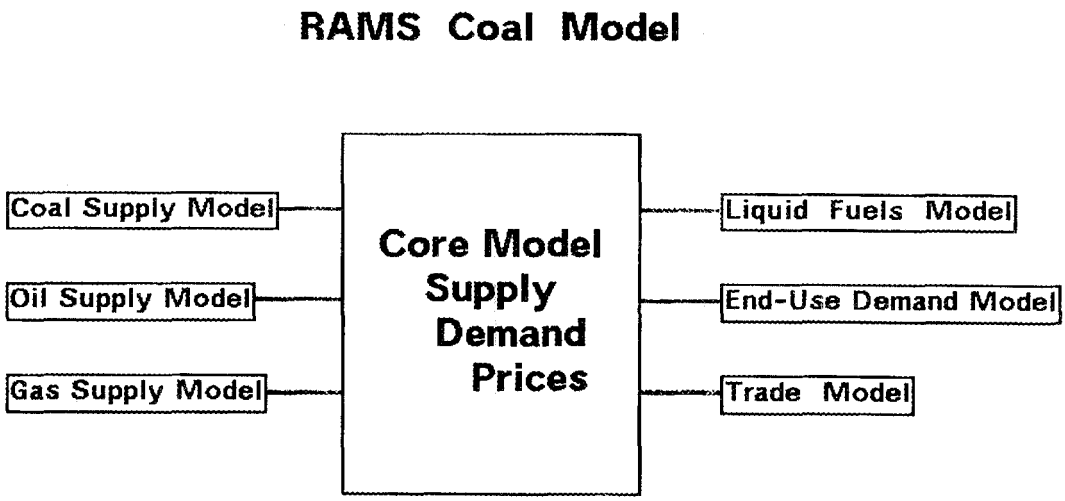

Fig. 1. The Structure of the RAMS Coal Model.

The next section of this report will discuss how to install and operate the model. The RAMS coal model has five input data sets and six output data sets. Section 3 will discuss the input data sets, while section 4 will discuss the output data sets. One of the input data sets can be edited using LOTUS 1-2-3. The other input or output data sets can be viewed or edited by using a text editor. In addition, the model has a menu-driven output editor that displays graphical output.

2. MODEL OPERATION

The RAMS coal model is designed to run on an IBM PC-XT with 640K of RAM, a hard disk, an 8087 coprocessor, and a color graphics card. Since the TURBO Pascal source code is included, the user can tailor the model to other hardware configurations.

The input and output data sets are:

	Input		Output
1.	LotusDat.Prn	1.	CoalSum.Out
2.	Supply.Dat	2.	CoalDet.Out
3.	CoalBase.Dat	3.	EndUse.Out
4.	EndUse.Dat	4.	Editor.Out
5.	Process.Dat	5.	Energy.Out
		6.	Process.Sum

The RAMS coal model is called CoalMod.Com. The LOTUS input editor is called Editor.Wks. The LOTUS input editor can be used to change the parameter values in the data set LotusDat.Prn. A text editor can be used to change the parameter values in any of the five input data sets.

To load the model, create a directory (MD\CoalMod) and copy the input data sets and CoalMod.Com to the directory. To run the model, type CoalMod. The RAMS coal model will read the five input data sets and create the five output data sets.

While the RAMS coal model is running, a graph is displayed with the price and level of production for one of the 26 factors in the model (see Table 1, page 8). Shortly after the model starts, you will be asked to choose a factor for the graph. When the calculations are completed, you will be asked to press any key to continue. If any errors have occurred, a warning message will be printed below the graph.

After you press a key, you enter the output editor section of the RAMS coal model. The output editor allows you to view graphs of the price and production level for all of the factors, energy types, and processes in the model. For each graph you select, the price and quantity data will be saved in the output file Editor.Out. The Graphics command of DOS can be used to print any of the graphs produced by the model.

The LOTUS input editor (Editor.Wks) has three sections that allow you to change the trade data, the driver variables, and the discounted cash flow (DCF) parameters (see Table 2, page 11). When you have made changes to the parameters, you can create a new version of the input data set LotusDat.Prn.

3. THE INPUT DATA SETS

The core of the RAMS coal model is a general equilibrium model of the economy of the United States. The base year values for quantity, price, and value for the 26 factors of production in the coal model are displayed in Table 1. The physical units for the factors of production are given in the table. The price units are billion 1985 dollars per physical unit and the value units are billion 1985 dollars. For example, in 1985 the United States consumed 4.40 billion barrels of crude oil. At an average price of 26.76 dollars per barrel, the value of the oil was 117.83 billion dollars.

For the core model, a convenient set of units for all of the factors of production is the 1985 dollar. If the quantity of production is measured in billions of 1985 dollars, the base price can be used to convert to physical units. For example, if the consumption of crude oil in 2000 is 100 billion 1985 dollars worth, then the consumption is 3.74 billion barrels. We will use both dollar units and physical units in the model. Similarly, we will use both price indexes and prices in physical units. If the price index for crude oil is 1.50, then the price in physical units is 40.14 1985 dollars per barrel.

The input-output table for the model has 26 rows and 13 columns. Most of the cells in the table are zero. The 26 rows are the 26 factors in Table 1. The first ten columns produce the first 11 types of energy in Table 1. The I-O structure for the first 5 columns is very simple--one input and one output. The input is materials and the output is one of the first five types of energy.

Table 1. The Base Year Values for the Factors of Production in the Coal Model.

The physical units are given in the table.
The price units are billion $1985 per physical unit.
The value units are billion 1985 dollars.

	Factor	Quantity	Units	Price	Value
1	Coal 1 - Bituminous	0.57	Billion Tons	41.31	23.68
2	Coal 2 - Subbituminous	0.19	Billion Tons	27.86	5.19
3	Coal 3 - Lignite	0.07	Billion Tons	12.67	0.88
4	Coal 4 - Metallurgical	0.08	Billion Tons	58.50	4.73
5	Crude Oil	4.40	Billion Barrels	26.76	117.83
6	Dry Natural Gas	17.28	Trillion Cu Ft	2.51	43.38
7	Transported Gas	16.31	Trillion Cu Ft	3.81	62.16
8	Distributed Gas	6.87	Trillion Cu Ft	5.90	40.51
9	Bulk Electricity	2.54	Billion MWH	50.47	127.99
10	Distributed Electricity	1.43	Billion MWH	73.72	105.46
11	Liquid Petroleum Gases	1.30	Billion Barrels	23.50	30.55
12	Gasoline	2.50	Billion Barrels	36.48	91.32
13	Kerosene	0.49	Billion Barrels	36.50	17.75
14	Distillate Fuel Oil	1.05	Billion Barrels	31.96	33.46
15	Residual Fuel Oil	0.44	Billion Barrels	24.40	10.71
16	Naphthas	0.16	Billion Barrels	33.00	5.35
17	Lubricants	0.06	Billion Barrels	33.00	1.96
18	Petroleum Coke	0.16	Billion Barrels	33.00	5.44
19	Asphalt	0.16	Billion Barrels	33.00	5.12
20	Alcohol	0.02	Billion Barrels	22.68	0.48
21	Sulfur	0.01	Billion Tons	65.00	0.74
22	Ammonia	0.02	Billion Tons	125.50	2.03
23	Carbon Dioxide	0.07	Trillion Cu Ft	1.00	0.07
24	Materials	4396.05	Billion 1985$	1.00	4396.05
25	Labor	2529.13	Billion 1985$	1.00	2529.13
26	Capital	1468.97	Billion 1985$	1.00	1468.97

The sixth column, the natural gas and natural gas liquids sector, is slightly more complex; it has two outputs (dry natural gas and LPG) and two inputs (dry natural gas and materials). The gas input is the gas consumed at the natural gas liquids extraction plants.

The seventh column, the transported gas sector, produces transported gas from inputs of dry natural gas, transported gas, and materials. The transported gas sector moves dry gas from the wellhead to large customers

(industrial, utility, and gas distributors). The input of transported gas is the gas required to run the compressors on the gas pipelines.

The eighth column, the distributed gas sector, produces distributed gas from inputs of transported gas and materials. Distributed gas is consumed by the residential and commercial customers.

The ninth column, the bulk electricity sector, delivers electricity to industrial customers and to the distributed electricity sector. The inputs to the bulk electricity sector consist of bituminous coal, subbituminous coal, lignite, transported gas, bulk electricity, distillate fuel oil, residual fuel oil, and materials. The input of bulk electricity represents transmission loses.

The tenth column, the distributed electricity sector, delivers electricity to residential and commercial customers. The inputs to the sector are bulk electricity, distributed electricity, and materials. The input of distributed electricity represents distribution losses and self use.

The eleventh column, the liquid fuels sector, is an expanded version of the petroleum refining sector. The liquid fuels sector produces 13 types of energy and by-products (factors 11 to 23) from inputs of bituminous coal, crude oil, transported gas, bulk electricity, LPG, and materials. The liquid fuels sector is the most complex sector in the model. In the sector, liquid fuels and by-products are produced from coal or crude oil. Initially, all liquid fuels are produced from crude oil. Over time, unconventional liquid fuels from coal, oil shale, tar sands, or heavy oil will gradually penetrate into the liquid fuels sector.

The twelfth column, the materials sector, is the demand side of the model. In the model, all goods and services produced by the economy of the

United States (except for the 23 types of energy and by-products) are called materials and are produced by the materials sector. The inputs to the materials sector are capital, labor, materials, and 19 types of energy and by-products. The types of energy that are not inputs are subbituminous coal, lignite, crude oil, and dry natural gas. The materials sector includes the residential, commercial, and transportation sectors and the nonenergy parts of the industrial sector.

The thirteenth column, the trade sector, produces imports and consumes exports. If we add all of the inputs to the thirteen columns, the grand total should match the total outputs for each of the 23 types of energy and by-products. The grand totals for the base year are displayed in Table 1.

The input data set LotusDat.Prn is displayed in Table 2. The first three columns of the first section of Table 2 are the trade data. The units for the trade data are billions of 1985 dollars. A positive value is an import, while a negative value is an export. The user should not change the trade data for the base year (1985). The user can enter trade data for 2000 and 2030; linear interpolation is used to obtain the trade data for 1986 to 1999, and 2001 to 2029.

The imports and exports of crude oil, dry natural gas, and materials are not determined by the data in Table 2. The oil and gas supply models determine the domestic supply of oil and gas. The imports or exports of oil and gas are the difference between consumption and domestic supply. The imports or exports of materials are determined by the requirement that the total value of imports is equal to the total value of the exports.

The fourth column of the first section of Table 2 is the DCF inflation rate. For the data in Table 2, the inflation rate is 5% for all 26 factors of production.

Table 2. The Input Data Set LotusDat.Prn.

		TRADE DATA			DCF
		Units	Billion	Dollars	Inflation
		1985	2000	2030	Rate
1	Coal 1 - Bituminous	-2.1027	-2.30	-2.60	0.05
2	Coal 2 - Subbituminous	0.0000	0.00	0.00	0.05
3	Coal 3 - Lignite	0.0000	0.00	0.00	0.05
4	Coal 4 - Metallurgical	-2.3400	-2.50	-2.70	0.05
5	Crude Oil	29.2697	50.00	25.00	0.05
6	Dry Natural Gas	2.2396	3.00	4.00	0.05
7	Transported Gas	0.0000	0.00	0.00	0.05
8	Distributed Gas	0.0000	0.00	0.00	0.05
9	Bulk Electricity	2.0660	3.00	4.00	0.05
10	Distributed Electricity	0.0000	0.00	0.00	0.05
11	Liquid Petroleum Gases	1.4699	1.50	1.50	0.05
12	Gasoline	4.9425	5.00	5.00	0.05
13	Kerosene	0.4382	0.44	0.44	0.05
14	Distillate Fuel Oil	1.5498	1.70	2.00	0.05
15	Residual Fuel Oil	2.7871	2.90	3.50	0.05
16	Naphthas	0.4281	0.45	0.50	0.05
17	Lubricants	-0.0244	-0.03	-0.03	0.05
18	Petroleum Coke	-2.2493	-2.50	-3.00	0.05
19	Asphalt	0.4233	0.50	0.50	0.05
20	Alcohol	0.0000	0.00	0.00	0.05
21	Sulfur	0.0000	0.00	0.00	0.05
22	Ammonia	0.0000	0.00	0.00	0.05
23	Carbon Dioxide	0.0000	0.00	0.00	0.05
24	Materials	0.0000	0.00	0.00	0.05
25	Labor	0.0000	0.00	0.00	0.05
26	Capital	0.0000	0.00	0.00	0.05

DRIVER	VARIABLES	
Year	World Oil Price	Economic Output
1985	26.76	1.000
1990	23.65	1.232
1995	30.78	1.383
2000	37.98	1.553
2005	48.49	1.740
2010	58.66	1.951
2015	65.00	2.150
2020	70.00	2.350
2025	75.00	2.550
2030	80.00	2.750

Table 2. (Continued).

D C F Parameters	
Debt Fraction	0.50
Debt Rate	0.08
Equity Fraction	0.50
Equity Rate	0.13
Construction Inflation Rate	0.05
Federal Tax Rate	0.40
State Tax Rate	0.10
Investment Tax Credit Rate	0.10
Property Tax Rate	0.02
Insurance Rate	0.03

The second section of Table 2 displays the driver variables: the world oil price and the potential level of the economy. The units of the world oil price are 1985 dollars per barrel. The economic output index is 1.0 in 1985. A value of 2.75 in 2030 will cause the potential GNP in 2030 to be 175% larger than the reference value in 1985. In the model, expensive energy will cause the actual GNP to be lower than the potential GNP.

In the final section of Table 2 are the DCF parameters. Two types of financing are allowed in the model: debt and equity. The sum of the debt fraction and the equity fraction should equal 1.0. The interest rates for debt and equity are not corrected for inflation. If the general inflation rate is 5%, a debt rate of 8% corresponds to a real rate of 3%. As inflation and tax laws change, the DCF parameters can be easily changed to correspond to the new conditions.

The input data set Supply.Dat is displayed in Table 3. Table 3 has three sections: oil data, gas data, and coal data. Many of the parameters in Supply.Dat should not be changed by the user. For the oil, gas, and coal options that are active in 1985, a change in costs or base market share will cause a change in the base year prices and the model will need

to be realigned. The user can change the values for total resource without changing the base year prices. Furthermore, the user can change any of the parameters for the unconventional oil and gas processes (they are not active in 1985).

The input data sets CoalBase.Dat and EndUse.Dat will not be listed, because they do not contain any parameters that the user should change.

The input data set Process.Dat is displayed in Appendix B. Process.Dat consists of detailed descriptions of the 19 processes that produce liquid fuels. The user can change any of the numbers in the data set. Given the data in Appendix B and Table 2, the model performs a discounted cash flow (DCF) analysis of the 19 processes. The results of the DCF analysis depend on the prices of the inputs and outputs. The results of a DCF analysis of the processes for the base prices are contained in the output data set Process.Sum (see Appendix A). Changing a value in Process.Dat will change the process economics and will have an impact on market penetration.

Table 3. The Input Data Set Supply.Dat.

O I L D A T A

Rtype	Resource Type	[Conventional=1 and Unconventional=2]
ps	Initial Price	[Dollars/Barrel]
qf	Total Resource	[Billion Barrels]
styr	Year of Initial Production	
qs	Cumulative Production (1985)	[Billion Barrels]
sb	Base Market Share	[Fraction]

Rtype	ps	qf	styr	qs	sb	Oil Supply Region
1	15.00	250	1970	119	0.90	United States
1	15.00	40	1970	2	0.10	Alaska
2	50.00	200	1992	0	0.05	Oil Generic One
2	60.00	200	1992	0	0.05	Oil Generic Two

G A S D A T A

Rtype	Resource Type	[Conventional=1 and Unconventional=2]
ps	Initial Price	[Dollars/1000 Cu Ft]
qf	Total Resource	[Trillion Cubic Feet]
styr	Year of Initial Production	
qs	Cumulative Production (1985)	[Trillion Cubic Feet]
sb	Base Market Share	[Fraction]

Rtype	ps	qf	styr	qs	sb	Gas Supply Region
1	2.51	1497.	1970	691.	0.95	United States
1	8.00	150.	1970	3.	0.05	Alaska
2	7.00	1000.	2000	0.	0.05	Surface Coal Gas
2	7.00	1000.	2000	0.	0.05	Underground Coal Gas
2	7.00	1000.	2000	0.	0.05	Low BTU Coal Gas
2	5.50	300.	2000	0.	0.05	Blanket Tight Sands
2	6.50	300.	2000	0.	0.05	Lenticular Tight Sands
2	6.50	500.	2000	0.	0.05	Devonian Shales
2	7.00	800.	2000	0.	0.05	Coal Bed Methane
2	8.00	400.	2000	0.	0.05	Geopressured Gas
2	10.00	600.	2015	0.	0.05	Alaskan Gas Hydrates
2	10.00	400.	2015	0.	0.05	Atlantic Gas Hydrates
2	20.00	1000.	2000	0.	0.05	Gas Generic One
2	20.00	1000.	2000	0.	0.05	Gas Generic Two

Table 3. (Continued).

COAL DATA

ps	Initial Price	[Dollars/Ton]
cf	Conversion Factor	[Million Btu/Ton]
qf	Total Resource	[Billion Tons]
qs	Cumulative Production (1985)	[Billion Tons]
sa-e	Base Market Share - East	[Fraction]
sa-w	Base Market Share - West	[Fraction]
Type	Coal Type	

ps	cf	qf	qs	sa-e	sa-w	Type	Coal Supply Region	
31.50	24.00	72.0	12.0	0.25	0.02	1	Appalachia	Deep
29.50	24.00	12.0	2.0	0.25	0.03	1	Appalachia	Surface
48.00	24.00	10.8	1.8	0.40	0.40	4	Appalachia	Deep
46.00	24.00	2.4	0.4	0.20	0.20	4	Appalachia	Surface
31.50	24.00	60.0	10.0	0.15	0.02	1	Midwest	Deep
29.50	24.00	20.0	3.0	0.30	0.03	1	Midwest	Surface
48.00	24.00	9.6	1.6	0.25	0.25	4	Midwest	Deep
46.00	24.00	3.6	0.6	0.15	0.15	4	Midwest	Surface
31.50	24.00	8.4	1.4	0.04	0.85	1	West	Deep
29.50	24.00	1.7	0.1	0.01	0.05	1	West	Surface
13.38	20.00	43.0	7.0	0.20	0.20	2	West	Deep
11.38	20.00	24.0	4.0	0.80	0.80	2	West	Surface
9.57	16.00	39.0	6.0	1.00	1.00	3	West	Surface

TRANSPORTATION COSTS [$/Ton]

Number	East	West	Type	Coal Supply Region	Method
1	10.00	24.00	1	Appalachia	Deep
2	10.00	24.00	1	Appalachia	Surface
3	10.00	24.00	4	Appalachia	Deep
4	10.00	24.00	4	Appalachia	Surface
5	10.00	22.00	1	Midwest	Deep
6	10.00	22.00	1	Midwest	Surface
7	10.00	22.00	4	Midwest	Deep
8	10.00	22.00	4	Midwest	Surface
9	22.00	10.00	1	West	Deep
10	22.00	10.00	1	West	Surface
11	22.00	10.00	2	West	Deep
12	22.00	10.00	2	West	Surface
13	22.00	1.00	3	West	Surface

DEMAND PARAMETERS

Type	East Share
1	0.80
2	0.50
3	0.10
4	0.90

4. THE OUTPUT DATA SETS

The output data set CoalSum.Out is displayed in Table 4. CoalSum.Out is a summary of the results of the core model for 1985, 2000, and 2030. The summary contains prices and quantities for each of the 26 factors in the model. Since the model is properly aligned, all of the prices are equal to 1.0 in the base year (1985). The summary table displays the level of output (x[i]) for the 10 energy supply sectors and the inputs to the materials sector (z[i]) for the 26 factors. For the liquid fuel or processing sector, the price is the parameter rp and the value in the z[i] column is the total amount of materials used by the 10 energy supply sectors.

The output data set CoalDet.Out is displayed in Table 5 for the year 2000. CoalDet.Out is a summary of the results of the oil supply model, the gas supply model, the coal supply model, and the liquid fuels model. For each model and each year, CoalDet.Out displays the price, quantity, and market share for each option. For example, the first coal supply region produces type 1 coal from deep mines in Appalachia. In 2000, the price is $32.60 per ton, the cumulative production is 14.02 billion tons, and the region has 28% of the eastern market and 9% of the western market for type 1 coal.

For the liquid fuels model, the price is the ratio of discounted revenue requirements and the discounted income; the quantity is a measure of installed capacity; and the share is the market share for new capacity. In 1985, conventional products from crude oil and natural gas have 100% of the market. In 2000, conventional products have 88% of the new capacity, while unconventional processes have the remaining 12% of the new capacity.

Table 4. The Output Data Set CoalSum.Out.

Summary Output from the RAMS Coal Model.
Units - Price Indexes = 1.0 in 1985.
Quantity Units are Billions of 1985 Dollars.

x[i] is the Output of Each Sector.
z[i] is the Input to the Materials Sector.

Year = 1985 GNP = 3998.11 Value Added = 3998.10

	Price	x[i]	z[i]	Trade	
1	0.9999	23.67	3.47	-2.10	Coal 1 - Bituminous
2	0.9994	5.19	0.00	0.00	Coal 2 - Subbituminous
3	1.0000	0.88	0.00	0.00	Coal 3 - Lignite
4	1.0005	4.73	2.39	-2.34	Coal 4 - Metallurgical
5	1.0000	88.55	0.00	29.27	Crude Oil
6	1.0000	55.45	0.00	2.24	Dry Natural Gas
7	1.0000	62.16	20.63	0.00	Transported Gas
8	1.0000	40.51	40.51	0.00	Distributed Gas
9	1.0000	125.93	43.78	2.07	Bulk Electricity
10	1.0000	105.47	104.64	0.00	Distributed Electricity
11	1.0000	178.62	359.04		Processing
11	1.0000		14.77	1.47	Liquid Petroleum Gases
12	1.0000		91.32	4.94	Gasoline
13	1.0000		17.75	0.44	Kerosene
14	1.0000		32.99	1.55	Distillate Fuel Oil
15	1.0000		6.79	2.79	Residual Fuel Oil
16	1.0000		5.35	0.43	Naphthas
17	1.0001		1.94	-0.02	Lubricants
18	1.0000		3.19	-2.25	Petroleum Coke
19	1.0000		5.12	0.42	Asphalt
20	0.9999		0.48	0.00	Alcohol
21	0.9999		0.74	0.00	Sulfur
22	1.0000		2.03	0.00	Ammonia
23	1.0002		0.07	0.00	Carbon Dioxide
24	1.0000		3998.10	-38.90	Materials
25	1.0000		2529.13	0.00	Labor
26	1.0000		1468.97	0.00	Capital

Table 4. (Continued).

Year = 2000 GNP = 6134.41 Value Added = 6209.05

	Price	x[i]	z[i]	Trade	
1	1.1417	36.39	5.45	-2.30	Coal 1 - Bituminous
2	1.0659	8.09	0.00	0.00	Coal 2 - Subbituminous
3	1.0461	1.35	0.00	0.00	Coal 3 - Lignite
4	1.0870	5.96	3.46	-2.50	Coal 4 - Metallurgical
5	1.4193	80.79	0.00	60.50	Crude Oil
6	1.3450	51.09	0.00	14.36	Dry Natural Gas
7	1.2390	76.02	22.80	0.00	Transported Gas
8	1.1593	47.55	47.55	0.00	Distributed Gas
9	1.0617	193.67	67.00	3.00	Bulk Electricity
10	1.0469	163.05	161.78	0.00	Distributed Electricity
11	1.0248	217.43	514.37		Processing
11	1.5414		8.07	1.50	Liquid Petroleum Gases
12	1.3612		116.63	5.00	Gasoline
13	1.3102		22.35	0.44	Kerosene
14	1.2598		42.78	1.70	Distillate Fuel Oil
15	1.0921		11.92	2.90	Residual Fuel Oil
16	1.1536		7.27	0.45	Naphthas
17	1.1802		2.57	-0.03	Lubricants
18	1.2006		4.15	-2.50	Petroleum Coke
19	1.1868		6.75	0.50	Asphalt
20	0.9444		0.80	0.00	Alcohol
21	1.3638		0.83	0.00	Sulfur
22	1.3594		2.31	0.00	Ammonia
23	1.0419		0.11	0.00	Carbon Dioxide
24	1.0157		6304.32	-83.01	Materials
25	1.0000		3927.74	0.00	Labor
26	1.0000		2281.31	0.00	Capital

Table 4. (Continued).

Year = 2010 GNP = 7569.59 Value Added = 7800.29

	Price	x[i]	z[i]	Trade	
1	1.2385	48.58	7.89	-2.40	Coal 1 - Bituminous
2	1.1285	10.27	0.00	0.00	Coal 2 - Subbituminous
3	1.0999	1.94	0.00	0.00	Coal 3 - Lignite
4	1.1625	6.70	4.14	-2.57	Coal 4 - Metallurgical
5	2.1921	88.12	0.00	36.69	Crude Oil
6	1.8229	54.30	0.00	9.11	Dry Natural Gas
7	1.5703	72.17	17.68	0.00	Transported Gas
8	1.3803	43.19	43.19	0.00	Distributed Gas
9	1.1405	241.93	82.10	3.33	Bulk Electricity
10	1.1075	204.68	203.08	0.00	Distributed Electricity
11	1.0287	200.84	683.92		Processing
11	1.6688		9.99	1.50	Liquid Petroleum Gases
12	2.0164		107.89	5.00	Gasoline
13	1.8198		20.24	0.44	Kerosene
14	1.6977		38.76	1.80	Distillate Fuel Oil
15	1.4530		10.77	3.10	Residual Fuel Oil
16	1.5545		6.66	0.47	Naphthas
17	1.6032		2.33	-0.03	Lubricants
18	1.7879		3.34	-2.67	Petroleum Coke
19	1.5991		6.16	0.50	Asphalt
20	1.0569		0.91	0.00	Alcohol
21	1.8259		0.75	0.00	Sulfur
22	1.9500		1.90	0.00	Ammonia
23	1.0972		0.14	0.00	Carbon Dioxide
24	1.0359		8069.21	-54.27	Materials
25	1.0000		4934.33	0.00	Labor
26	1.0000		2865.96	0.00	Capital

Table 4. (Continued).

Year = 2030 GNP = 10429.51 Value Added = 10994.78

	Price	x[i]	z[i]	Trade	
1	1.5437	76.92	12.17	-2.60	Coal 1 - Bituminous
2	1.2895	15.31	0.00	0.00	Coal 2 - Subbituminous
3	1.2770	4.00	0.00	0.00	Coal 3 - Lignite
4	1.3234	7.90	5.20	-2.70	Coal 4 - Metallurgical
5	2.9895	88.55	0.00	28.19	Crude Oil
6	2.9180	55.45	0.00	-0.02	Dry Natural Gas
7	2.3227	62.75	8.42	0.00	Transported Gas
8	1.8750	28.86	28.86	0.00	Distributed Gas
9	1.3017	345.07	110.58	4.00	Bulk Electricity
10	1.2264	294.13	291.84	0.00	Distributed Electricity
11	1.0103	216.01	995.66		Processing
11	1.9800		13.50	1.50	Liquid Petroleum Gases
12	2.7787		113.54	5.00	Gasoline
13	2.5410		19.53	0.44	Kerosene
14	2.3514		37.26	2.00	Distillate Fuel Oil
15	1.7314		14.48	3.50	Residual Fuel Oil
16	2.1290		6.49	0.50	Naphthas
17	2.2078		2.24	-0.03	Lubricants
18	2.6967		2.78	-3.00	Petroleum Coke
19	2.1971		5.95	0.50	Asphalt
20	1.0669		1.31	0.00	Alcohol
21	1.9313		1.02	0.00	Sulfur
22	2.6424		1.83	0.00	Ammonia
23	1.0492		0.20	0.00	Carbon Dioxide
24	1.0597		11621.46	-37.28	Materials
25	1.0000		6955.11	0.00	Labor
26	1.0000		4039.67	0.00	Capital

Table 5. A Section of the Output Data Set CoalDet.Out.

Detailed Output from the RAMS Coal Model for the Year 2000.

Oil Details

The Units for the Cost are 1985 Dollars per Barrel.
The Quantity is Cumulative Production Measured in Billions of Barrels.

	Cost	Quantity	Share	
1	20.84	155.7044	0.777077	United States
2	18.51	9.2039	0.222923	Alaska
3	50.00	0.0000	0.000000	Oil Generic One
4	60.00	0.0000	0.000000	Oil Generic Two

Gas Details

The Units for the Cost are 1985 Dollars per Cubic Foot.
The Quantity is Cumulative Production Measured in Trillions of Cubic Feet.

	Cost	Quantity	Share	
1	3.38	897.7546	1.000000	United States
2	8.00	3.0000	0.000000	Alaska
3	7.00	0.0000	0.000000	Surface Coal Gas
4	7.00	0.0000	0.000000	Underground Coal Gas
5	7.00	0.0000	0.000000	Low BTU Coal Gas
6	5.50	0.0000	0.000000	Blanket Tight Sands
7	6.50	0.0000	0.000000	Lenticular Tight Sand
8	6.50	0.0000	0.000000	Devonian Shales
9	7.00	0.0000	0.000000	Coal Bed Methane
10	8.00	0.0000	0.000000	Geopressured Gas
11	10.00	0.0000	0.000000	Alaskan Gas Hydrates
12	10.00	0.0000	0.000000	Atlantic Gas Hydrates
13	20.00	0.0000	0.000000	Gas Generic One
14	20.00	0.0000	0.000000	Gas Generic Two

Table 5. (Continued).

Detailed Output from the RAMS Coal Model for the Year 2000.

Coal Details

The Units for the Cost are 1985 Dollars per Ton.
The Quantity is Cumulative Production Measured in Billions of Tons.

	Cost	Quantity	Share-E	Share-W	Type		
1	32.69	14.1917	0.281643	0.100395	1	Appalachia	Deep
2	37.32	4.0944	0.172408	0.065596	1	Appalachia	Surface
3	50.14	2.1844	0.278454	0.244175	4	Appalachia	Deep
4	54.53	0.7128	0.194953	0.181314	4	Appalachia	Surface
5	32.83	12.0236	0.275015	0.132218	1	Midwest	Deep
6	34.64	5.5243	0.241416	0.114924	1	Midwest	Surface
7	50.15	1.9424	0.275844	0.298809	4	Midwest	Deep
8	51.86	0.9390	0.250748	0.275702	4	Midwest	Surface
9	38.74	2.7084	0.020925	0.447641	1	West	Deep
10	52.27	0.7970	0.008593	0.139227	1	West	Surface
11	13.85	8.2299	0.424588	0.390675	2	West	Deep
12	12.90	6.3518	0.575412	0.609325	2	West	Surface
13	9.97	7.3260	1.000000	1.000000	3	West	Surface

Coal Liquid Details

The Price is the Ratio of Discounted Cost and Revenue.
The Quantity is Cumulative Capacity Measured in Billions of 1985 Dollars.

	Price	Quantity	Share	
1	1.00	199.13	0.882241	Products from Crude Oil
2	2.09	0.00	0.000000	H-Coal
3	2.59	0.00	0.000000	EDS - Wyoming
4	2.21	0.00	0.000000	EDS - Illinois #6
5	2.02	0.00	0.000000	EDS - Texas Lignite
6	2.15	0.00	0.000000	EDS - Pittsburgh #8
7	0.94	0.00	0.000000	Undergnd Coal Gas to Gasoline
8	0.83	0.00	0.000000	Undergnd Coal Gas to Methanol
9	1.60	0.00	0.000000	Products from Oil Shale
10	1.72	0.00	0.000000	Products from Tar Sands
11	1.84	0.00	0.000000	Products from Heavy Oil
12	1.29	17.69	0.115442	Coprocessing of Coal & Crude
13	1.31	0.08	0.000297	Methanol from Natural Gas
14	1.80	0.29	0.001889	Methanol from Coal - Case 2
15	1.64	0.02	0.000132	Methanol from Coal - Case 4
16	2.47	0.00	0.000000	Generic One
17	2.40	0.00	0.000000	Generic Two
18	2.55	0.00	0.000000	Generic Three
19	2.63	0.00	0.000000	Generic Four

The unconventional process with the largest market share is the coprocessing of coal and crude oil.

In the model, two processes influence the demand for energy and by-products: conservation and fuel switching. Conservation occurs when supply and demand balance in the core model. Fuel switching is determined by the end-use model. As the prices change, the end-use model changes the input-output (I-O) coefficients for the materials sector. Given a set of prices, the end-use model forecasts optimum I-O coefficients. The average I-O coefficients track the optimum coefficients with a lag. The data set EndUse.Out displays the optimum coefficients and the product of the optimum coefficients and the base year output for 1985, 2000, 2010, and 2030.

A summary of the output data set EndUse.Out is presented in Table 6. Table 6 displays the product of the optimum coefficients and the base year output for 1985 and 2030. Thus, the fuel switching forecast by the end-use model is exhibited in Table 6. The end-use model does not allow fuel switching for all 23 types of energy and by-products. In Table 6, 10 of the 26 factors have changes; the changes range from +96% for bituminous coal to -38% for transported gas. The end-use model does not have any substitute for gasoline. A more elaborate end-use model could simulate choices between vehicles fueled by gasoline, distillate fuel oil, alcohol, electricity, LPG, and natural gas.

The data set Energy.Out is a summary of the primary energy consumption and the consumption of electricity (see Table 7). The units are quadrillion BTU for primary energy (oil, gas, coal, other, and total) and billion MWH for electricity. For the case displayed in Table 7, the consumption of oil and gas increases slightly before declining, while coal, other, total, and electricity have substantial growth from 1985 to 2030.

Table 6. Summary of the Output Data Set EndUse.Out.

Inputs to the Materials Sector Required to Produce the Base Year Output of the Materials Sector. The Units for the Inputs are Millions of 1985 Dollars.

	Goods	Inputs 1985	Inputs 2030	Change %
1	Coal 1 - Bituminous	3469	6809	+96
2	Coal 2 - Subbituminous	0	0	0
3	Coal 3 - Lignite	0	0	0
4	Coal 4 - Metallurgical	2393	2393	0
5	Crude Oil	0	0	0
6	Dry Natural Gas	0	0	0
7	Transported Gas	20625	12718	-38
8	Distributed Gas	40497	29597	-27
9	Bulk Electricity	43779	50315	+15
10	Distributed Electricity	104652	124863	+19
11	Liquid Petroleum Gases	14763	10311	-30
12	Gasoline	91320	91320	0
13	Kerosene	17750	17201	-3
14	Distillate Fuel Oil	32991	29442	-11
15	Residual Fuel Oil	6786	8375	+23
16	Naphthas	5349	5349	0
17	Lubricants	1940	1940	0
18	Petroleum Coke	3184	3184	0
19	Asphalt	5118	5118	0
20	Alcohol	478	478	0
21	Sulfur	737	737	0
22	Ammonia	2033	2033	0
23	Carbon Dioxide	74	74	0
24	Materials	3998104	4003931	+0
25	Labor	2529130	2529130	0
26	Capital	1468970	1468970	0

When the calculations of the coal model are completed, the user can examine the detailed results using a menu-driven output editor. Each time the user selects a result for display, the result is displayed on the screen and recorded on an output file Editor.Out. Sample output from Editor.Out is presented in Table 8. For each time series in Table 8, the price and quantity units are defined in the table.

Table 7. The Output Data Set Energy.Out

Primary Energy Consumption Summary.
The Units are Quadrillion BTU and Billion MWH for Electricity.

Year	Oil	Gas	Coal	Other	Total	Electric
1985	30.920	17.849	17.480	7.710	73.960	2.536
1990	37.100	20.604	21.526	9.522	88.752	3.132
1995	36.821	21.501	24.191	10.629	93.141	3.496
2000	36.083	21.807	27.385	11.847	97.121	3.897
2005	34.343	21.452	31.301	13.200	100.296	4.342
2010	32.538	20.495	36.545	14.774	104.352	4.860
2015	31.526	18.616	42.154	16.299	108.595	5.361
2020	31.220	16.908	47.981	17.886	113.995	5.883
2025	31.033	16.484	53.685	19.531	120.734	6.424
2030	30.851	16.865	58.473	21.027	127.217	6.916

Table 8. Sample Output from the File Editor.Out.

Output (x[i]) for Crude Oil.
The Price Indexes are = 1.0 in 1985.
The Quantity Units are Billions of Dollars.

Year	Price	Quantity
1985	1.0000	88.5542
1990	0.8838	81.9430
1995	1.1502	76.7592
2000	1.4193	80.7941
2005	1.8120	84.8290
2010	2.1921	88.1250
2015	2.4290	88.5542
2020	2.6158	88.5542
2025	2.8027	88.5542
2030	2.9895	88.5542

Table 8. (Continued).

Output (x[i]) for Dry Natural Gas.
The Price Indexes are = 1.0 in 1985.
The Quantity Units are Billions of Dollars.

Year	Price	Quantity
1985	1.0000	55.4460
1990	1.0889	52.2082
1995	1.1917	49.4936
2000	1.3450	51.0948
2005	1.5496	52.6961
2010	1.8229	54.2973
2015	2.1954	55.3834
2020	2.5973	55.4460
2025	2.8197	55.4460
2030	2.9180	55.4460

Output (x[i]) for Coal 1 - Bituminous.
The Price Indexes are = 1.0 in 1985.
The Quantity Units are Billions of Dollars.

Year	Price	Quantity
1985	0.9999	23.6717
1990	1.0384	28.7241
1995	1.0917	32.1641
2000	1.1417	36.3927
2005	1.1885	41.5362
2010	1.2385	48.5773
2015	1.2938	56.1044
2020	1.3583	63.7911
2025	1.4388	71.0915
2030	1.5437	76.9207

Appendix A

This appendix displays the output data set Process.Sum. The values in this appendix were calculated from the process descriptions displayed in Appendix B. For each of the 19 processes, the discounted present values of the income, operating costs, and revenue requirements are displayed for the base prices. Furthermore, the revenue and cost shares are the input-output coefficients for each process. The cost shares are with respect to income. For a process where the revenue requirements are larger than the income, the sum of the cost shares will be more than 1.0. The cost share for capital is the difference between the revenue requirements and operating costs divided by the income.

1. Process Name - Products from Crude Oil.

Income = 3858.657 Operating Costs = 2954.958

Revenue Requirements = 3858.682

Revenue and Cost Shares

Factor	Revenue	Costs
Crude Oil		0.6597
Transported Gas		0.0105
Bulk Electricity		0.0080
Liquid Petroleum Gases		0.0313
Gasoline	0.5146	
Kerosene	0.1009	
Distillate Fuel Oil	0.1927	
Residual Fuel Oil	0.0702	
Naphthas	0.0315	
Lubricants	0.0120	
Petroleum Coke	0.0306	
Asphalt	0.0288	
Ammonia	0.0114	
Materials		0.0563
Capital		0.2342

2. Process Name - H-Coal.

Income = 3505.083 Operating Costs = 3538.419

Revenue Requirements = 8944.488

Revenue and Cost Shares

Factor	Revenue	Costs
Coal 1 - Bituminous		0.6636
Dry Natural Gas	0.0484	
Bulk Electricity		0.1248
Liquid Petroleum Gases	0.0929	
Gasoline	0.4305	
Residual Fuel Oil	0.3899	
Sulfur	0.0236	
Ammonia	0.0147	
Materials		0.2211
Capital		1.5424

3. Process Name - EDS - Wyoming.

Income = 4292.756 Operating Costs = 3843.944

Revenue Requirements = 14175.752

Revenue and Cost Shares

Factor	Revenue	Costs
Coal 2 - Subbituminous		0.3932
Dry Natural Gas	0.1080	
Bulk Electricity		0.3179
Liquid Petroleum Gases	0.1454	
Gasoline	0.3859	
Residual Fuel Oil	0.3438	
Sulfur	0.0068	
Ammonia	0.0101	
Materials		0.1843
Capital		2.4068

4. Process Name - EDS - Illinois #6.

Income = 4196.289 Operating Costs = 3858.014

Revenue Requirements = 11909.517

Revenue and Cost Shares

Factor	Revenue	Costs
Coal 1 - Bituminous		0.4758
Dry Natural Gas	0.1274	
Bulk Electricity		0.2876
Liquid Petroleum Gases	0.1521	
Gasoline	0.4383	
Residual Fuel Oil	0.2423	
Sulfur	0.0299	
Ammonia	0.0099	
Materials		0.1560
Capital		1.9187

5. Process Name - EDS - Texas Lignite.

Income = 4196.289 Operating Costs = 2945.190

Revenue Requirements = 11003.316

Revenue and Cost Shares

Factor	Revenue	Costs
Coal 3 - Lignite		0.1837
Dry Natural Gas	0.0968	
Bulk Electricity		0.3274
Liquid Petroleum Gases	0.1676	
Gasoline	0.4386	
Residual Fuel Oil	0.2749	
Sulfur	0.0070	
Ammonia	0.0151	
Materials		0.1908
Capital		1.9203

6. Process Name - EDS - Pittsburgh #8.

Income = 4196.289 Operating Costs = 3690.005

Revenue Requirements = 11395.001

Revenue and Cost Shares

Factor	Revenue	Costs
Coal 1 - Bituminous		0.4521
Dry Natural Gas	0.1262	
Bulk Electricity		0.2756
Liquid Petroleum Gases	0.1548	
Gasoline	0.3709	
Residual Fuel Oil	0.3138	
Sulfur	0.0245	
Ammonia	0.0098	
Materials		0.1517
Capital		1.8361

7. Process Name - Undergnd Coal Gas to Gasoline.

Income = 3876.008 Operating Costs = 3357.435

Revenue Requirements = 4899.908

Revenue and Cost Shares

Factor	Revenue	Costs
Bulk Electricity		0.0207
Gasoline	1.0000	
Materials		0.8455
Capital		0.3980

8. Process Name - Undergnd Coal Gas to Methanol.

Income = 3876.008 Operating Costs = 2114.112

Revenue Requirements = 3001.898

Revenue and Cost Shares

Factor	Revenue	Costs
Bulk Electricity		0.0135
Alcohol	1.0000	
Materials		0.5319
Capital		0.2290

9. Process Name - Products from Oil Shale.

Income = 3858.657 Operating Costs = 417.043

Revenue Requirements = 7913.418

Revenue and Cost Shares

Factor	Revenue	Costs
Transported Gas		0.0107
Bulk Electricity		0.0081
Liquid Petroleum Gases		0.0319
Gasoline	0.5244	
Kerosene	0.1028	
Distillate Fuel Oil	0.1964	
Residual Fuel Oil	0.0715	
Naphthas	0.0321	
Lubricants	0.0122	
Petroleum Coke	0.0312	
Asphalt	0.0294	
Materials		0.0573
Capital		1.9427

10. Process Name - Products from Tar Sands.

Income = 3858.657 Operating Costs = 417.043

Revenue Requirements = 8513.128

Revenue and Cost Shares

Factor	Revenue	Costs
Transported Gas		0.0107
Bulk Electricity		0.0081
Liquid Petroleum Gases		0.0319
Gasoline	0.5244	
Kerosene	0.1028	
Distillate Fuel Oil	0.1964	
Residual Fuel Oil	0.0715	
Naphthas	0.0321	
Lubricants	0.0122	
Petroleum Coke	0.0312	
Asphalt	0.0294	
Materials		0.0573
Capital		2.0982

11. Process Name - Products from Heavy Oil.

Income = 3858.657 Operating Costs = 417.043

Revenue Requirements = 9112.838

Revenue and Cost Shares

Factor	Revenue	Costs
Transported Gas		0.0107
Bulk Electricity		0.0081
Liquid Petroleum Gases		0.0319
Gasoline	0.5244	
Kerosene	0.1028	
Distillate Fuel Oil	0.1964	
Residual Fuel Oil	0.0715	
Naphthas	0.0321	
Lubricants	0.0122	
Petroleum Coke	0.0312	
Asphalt	0.0294	
Materials		0.0573
Capital		2.2536

12. Process Name - Coprocessing of Coal & Crude.

Income = 3858.657 Operating Costs = 2907.563

Revenue Requirements = 5456.331

Revenue and Cost Shares

Factor	Revenue	Costs
Coal 1 - Bituminous		0.0502
Crude Oil		0.5379
Transported Gas		0.0107
Bulk Electricity		0.0081
Liquid Petroleum Gases		0.0319
Gasoline	0.5244	
Kerosene	0.1028	
Distillate Fuel Oil	0.1964	
Residual Fuel Oil	0.0715	
Naphthas	0.0321	
Lubricants	0.0122	
Petroleum Coke	0.0312	
Asphalt	0.0294	
Materials		0.1147
Capital		0.6605

13. Process Name - Methanol from Natural Gas.

Income = 4389.222 Operating Costs = 3455.808

Revenue Requirements = 4703.874

Revenue and Cost Shares

Factor	Revenue	Costs
Transported Gas		0.6836
Bulk Electricity		0.0051
Alcohol	1.0000	
Materials		0.0986
Capital		0.2843

14. Process Name - Methanol from Coal - Case 2.

Income = 4099.823 Operating Costs = 4245.467

Revenue Requirements = 7661.810

Revenue and Cost Shares

Factor	Revenue	Costs
Coal 2 - Subbituminous		0.4265
Dry Natural Gas	0.1946	
Bulk Electricity		0.1023
Distillate Fuel Oil	0.0632	
Naphthas	0.0231	
Alcohol	0.6149	
Ammonia	0.0070	
Carbon Dioxide	0.0973	
Materials		0.5067
Capital		0.8333

15. Process Name - Methanol from Coal - Case 4.

Income = 4099.823 Operating Costs = 2908.716

Revenue Requirements = 6253.958

Revenue and Cost Shares

Factor	Revenue	Costs
Coal 1 - Bituminous		0.3513
Bulk Electricity		0.0722
Alcohol	0.8472	
Sulfur	0.0187	
Carbon Dioxide	0.1341	
Materials		0.2860
Capital		0.8159

16. Process Name - Generic One.

Income = 3245.448 Operating Costs = 3276.313

Revenue Requirements = 9877.269

Revenue and Cost Shares

Factor	Revenue	Costs
Coal 1 - Bituminous		0.6636
Dry Natural Gas	0.0484	
Bulk Electricity		0.1248
Liquid Petroleum Gases	0.0929	
Gasoline	0.4305	
Residual Fuel Oil	0.3899	
Sulfur	0.0236	
Ammonia	0.0147	
Materials		0.2211
Capital		2.0339

17. Process Name - Generic Two.

Income = 3245.448 Operating Costs = 3276.313

Revenue Requirements = 9555.198

Revenue and Cost Shares

Factor	Revenue	Costs
Coal 1 - Bituminous		0.6636
Dry Natural Gas	0.0484	
Bulk Electricity		0.1248
Liquid Petroleum Gases	0.0929	
Gasoline	0.4305	
Residual Fuel Oil	0.3899	
Sulfur	0.0236	
Ammonia	0.0147	
Materials		0.2211
Capital		1.9347

18. Process Name - Generic Three.

Income = 3245.448 Operating Costs = 3276.313

Revenue Requirements = 10199.341

Revenue and Cost Shares

Factor	Revenue	Costs
Coal 1 - Bituminous		0.6636
Dry Natural Gas	0.0484	
Bulk Electricity		0.1248
Liquid Petroleum Gases	0.0929	
Gasoline	0.4305	
Residual Fuel Oil	0.3899	
Sulfur	0.0236	
Ammonia	0.0147	
Materials		0.2211
Capital		2.1332

19. Process Name - Generic Four.

Income = 3245.448 Operating Costs = 3276.313

Revenue Requirements = 10521.413

Revenue and Cost Shares

Factor	Revenue	Costs
Coal 1 - Bituminous		0.6636
Dry Natural Gas	0.0484	
Bulk Electricity		0.1248
Liquid Petroleum Gases	0.0929	
Gasoline	0.4305	
Residual Fuel Oil	0.3899	
Sulfur	0.0236	
Ammonia	0.0147	
Materials		0.2211
Capital		2.2324

APPENDIX B

This appendix displays the input data set Process.Dat. Process.Dat contains all of the details for the 19 processes for producing liquid fuels. The RAMS Coal Model reads Process.Dat and produces the data set Process.Sum (see Appendix A).

1. Process Name - Products from Crude Oil.

Plant Size - 4,381 Barrels of Crude Oil per Day.

Reference - ORNL - DBR

Instantaneous Construction Cost	61.425	E6 1985$
Introduction Year	1970	
Leadtime	5	Years
Lifetime	25	Years
Taxlife	15	Years
Booklife	25	Years
Load Factor	80	%
Salvage Value	0	E6 1985$
Startup Cost	0	E6 1985$

INPUTS and OUTPUTS

	Factor	Units	Base Price	Daily Output
1	Coal 1 - Bituminous	Tons	41.31	-0.2
2	Coal 2 - Subbituminous	Tons	27.86	0
3	Coal 3 - Lignite	Tons	12.67	0
4	Coal 4 - Metallurgical	Tons	58.50	0
5	Crude Oil	Barrels	26.76	-4380.7
6	Dry Natural Gas	1000 Cu Ft	2.51	0
7	Transported Gas	1000 Cu Ft	3.81	-488.0
8	Distributed Gas	1000 Cu Ft	5.90	0
9	Bulk Electricity	MWH	50.47	-28.1
10	Distributed Electricity	MWH	73.72	0
11	Liquid Petroleum Gases	Barrels	23.50	-237
12	Gasoline	Barrels	36.48	2506.8
13	Kerosene	Barrels	36.50	491.3
14	Distillate Fuel Oil	Barrels	31.96	1071.4
15	Residual Fuel Oil	Barrels	24.40	510.9
16	Naphthas	Barrels	33.00	169.6
17	Lubricants	Barrels	33.01	64.7
18	Petroleum Coke	Barrels	33.02	164.7
19	Asphalt	Barrels	33.03	155.3
20	Alcohol	Barrels	22.68	21.1
21	Sulfur	Tons	65.00	11.3
22	Ammonia	Tons	125.50	16.2
23	Carbon Dioxide	1000 Cu Ft	1.00	73.8
24	Materials	1985$	1.00	-10000

2. Process Name - H-Coal.

Plant Size - 26,497 Tons of Coal per Day.
Reference - Mitre - DOE/ET/13800-5

Instantaneous Construction Cost	3258	E6 1985$
Introduction Year	1992	
Leadtime	9	Years
Lifetime	18	Years
Taxlife	15	Years
Booklife	18	Years
Load Factor	86.4	%
Salvage Value	300	E6 1985$
Startup Cost	100	E6 1985$

INPUTS and OUTPUTS

	Factor	Units	Base Price	Daily Output
1	Coal 1 - Bituminous	Tons	41.31	-26497
2	Coal 2 - Subbituminous	Tons	27.86	0
3	Coal 3 - Lignite	Tons	12.67	0
4	Coal 4 - Metallurgical	Tons	58.50	0
5	Crude Oil	Barrels	26.76	0
6	Dry Natural Gas	1000 Cu Ft	2.51	31780
7	Transported Gas	1000 Cu Ft	3.81	0
8	Distributed Gas	1000 Cu Ft	5.90	0
9	Bulk Electricity	MWH	50.47	-4080
10	Distributed Electricity	MWH	73.72	0
11	Liquid Petroleum Gases	Barrels	23.50	6524
12	Gasoline	Barrels	36.48	19466
13	Kerosene	Barrels	36.50	0
14	Distillate Fuel Oil	Barrels	31.96	0
15	Residual Fuel Oil	Barrels	24.40	26359
16	Naphthas	Barrels	33.00	0
17	Lubricants	Barrels	33.01	0
18	Petroleum Coke	Barrels	33.02	0
19	Asphalt	Barrels	33.03	0
20	Alcohol	Barrels	22.68	0
21	Sulfur	Tons	65.00	598
22	Ammonia	Tons	125.50	193
23	Carbon Dioxide	1000 Cu Ft	1.00	0
24	Materials	1985$	1.00	-364631

3. Process Name - EDS - Wyoming.

Plant Size - 33,150 Tons of Coal per Day.
Reference - Exxon - DOE/ET/10069-T117

Instantaneous Construction Cost	9161	E6 1985$
Introduction Year	1992	
Leadtime	5	Years
Lifetime	25	Years
Taxlife	15	Years
Booklife	25	Years
Load Factor	89	%
Salvage Value	300	E6 1985$
Startup Cost	100	E6 1985$

INPUTS and OUTPUTS

	Factor	Units	Base Price	Daily Output
1	Coal 1 - Bituminous	Tons	41.31	0
2	Coal 2 - Subbituminous	Tons	27.86	-33150
3	Coal 3 - Lignite	Tons	12.67	0
4	Coal 4 - Metallurgical	Tons	58.50	0
5	Crude Oil	Barrels	26.76	0
6	Dry Natural Gas	1000 Cu Ft	2.51	101094
7	Transported Gas	1000 Cu Ft	3.81	0
8	Distributed Gas	1000 Cu Ft	5.90	0
9	Bulk Electricity	MWH	50.47	-14797
10	Distributed Electricity	MWH	73.72	0
11	Liquid Petroleum Gases	Barrels	23.50	14530
12	Gasoline	Barrels	36.48	24850
13	Kerosene	Barrels	36.50	0
14	Distillate Fuel Oil	Barrels	31.96	0
15	Residual Fuel Oil	Barrels	24.40	33100
16	Naphthas	Barrels	33.00	0
17	Lubricants	Barrels	33.01	0
18	Petroleum Coke	Barrels	33.02	0
19	Asphalt	Barrels	33.03	0
20	Alcohol	Barrels	22.68	0
21	Sulfur	Tons	65.00	244
22	Ammonia	Tons	125.50	189
23	Carbon Dioxide	1000 Cu Ft	1.00	0
24	Materials	1985$	1.00	-433000

4. Process Name - EDS - Illinois #6.

Plant Size - 31,960 Tons of Coal per Day.
Reference - Exxon - DOE/ET/10069-T117

Instantaneous Construction Cost	8424	E6 1985$
Introduction Year	1992	
Leadtime	5	Years
Lifetime	25	Years
Taxlife	15	Years
Booklife	25	Years
Load Factor	87	%
Salvage Value	300	E6 1985$
Startup Cost	100	E6 1985$

INPUTS and OUTPUTS

	Factor	Units	Base Price	Daily Output
1	Coal 1 - Bituminous	Tons	41.31	-31960
2	Coal 2 - Subbituminous	Tons	27.86	0
3	Coal 3 - Lignite	Tons	12.67	0
4	Coal 4 - Metallurgical	Tons	58.50	0
5	Crude Oil	Barrels	26.76	0
6	Dry Natural Gas	1000 Cu Ft	2.51	140866
7	Transported Gas	1000 Cu Ft	3.81	0
8	Distributed Gas	1000 Cu Ft	5.90	0
9	Bulk Electricity	MWH	50.47	-15810
10	Distributed Electricity	MWH	73.72	0
11	Liquid Petroleum Gases	Barrels	23.50	17960
12	Gasoline	Barrels	36.48	33340
13	Kerosene	Barrels	36.50	0
14	Distillate Fuel Oil	Barrels	31.96	0
15	Residual Fuel Oil	Barrels	24.40	27560
16	Naphthas	Barrels	33.00	0
17	Lubricants	Barrels	33.01	0
18	Petroleum Coke	Barrels	33.02	0
19	Asphalt	Barrels	33.03	0
20	Alcohol	Barrels	22.68	0
21	Sulfur	Tons	65.00	1276
22	Ammonia	Tons	125.50	220
23	Carbon Dioxide	1000 Cu Ft	1.00	0
24	Materials	1985$	1.00	-433000

5. Process Name - EDS - Texas Lignite.

Plant Size - 32,900 Tons of Coal per Day.

Reference - Exxon - DOE/ET/10069-T117

Instantaneous Construction Cost	6874	E6 1985$
Introduction Year	1992	
Leadtime	5	Years
Lifetime	25	Years
Taxlife	15	Years
Booklife	25	Years
Load Factor	87	%
Salvage Value	300	E6 1985$
Startup Cost	100	E6 1985$

INPUTS and OUTPUTS

	Factor	Units	Base Price	Daily Output
1	Coal 1 - Bituminous	Tons	41.31	0
2	Coal 2 - Subbituminous	Tons	27.86	0
3	Coal 3 - Lignite	Tons	12.67	-32900
4	Coal 4 - Metallurgical	Tons	58.50	0
5	Crude Oil	Barrels	26.76	0
6	Dry Natural Gas	1000 Cu Ft	2.51	87523
7	Transported Gas	1000 Cu Ft	3.81	0
8	Distributed Gas	1000 Cu Ft	5.90	0
9	Bulk Electricity	MWH	50.47	-14725
10	Distributed Electricity	MWH	73.72	0
11	Liquid Petroleum Gases	Barrels	23.50	16190
12	Gasoline	Barrels	36.48	27290
13	Kerosene	Barrels	36.50	0
14	Distillate Fuel Oil	Barrels	31.96	0
15	Residual Fuel Oil	Barrels	24.40	25570
16	Naphthas	Barrels	33.00	0
17	Lubricants	Barrels	33.01	0
18	Petroleum Coke	Barrels	33.02	0
19	Asphalt	Barrels	33.03	0
20	Alcohol	Barrels	22.68	0
21	Sulfur	Tons	65.00	244
22	Ammonia	Tons	125.50	273
23	Carbon Dioxide	1000 Cu Ft	1.00	0
24	Materials	1985$	1.00	-433000

6. Process Name - EDS - Pittsburgh #8.

Plant Size - 31,240 Tons of Coal per Day.

Reference - Exxon - DOE/ET/10069-T117

Instantaneous Construction Cost	8291	E6 1985$
Introduction Year	1992	
Leadtime	5	Years
Lifetime	25	Years
Taxlife	15	Years
Booklife	25	Years
Load Factor	87	%
Salvage Value	300	E6 1985$
STartup Cost	100	E6 1985$

INPUTS and OUTPUTS

	Factor	Units	Base Price	Daily Output
1	Coal 1 - Bituminous	Tons	41.31	-31240
2	Coal 2 - Subbituminous	Tons	27.86	0
3	Coal 3 - Lignite	Tons	12.67	0
4	Coal 4 - Metallurgical	Tons	58.50	0
5	Crude Oil	Barrels	26.76	0
6	Dry Natural Gas	1000 Cu Ft	2.51	143505
7	Transported Gas	1000 Cu Ft	3.81	0
8	Distributed Gas	1000 Cu Ft	5.90	0
9	Bulk Electricity	MWH	50.47	-15586
10	Distributed Electricity	MWH	73.72	0
11	Liquid Petroleum Gases	Barrels	23.50	18800
12	Gasoline	Barrels	36.48	29020
13	Kerosene	Barrels	36.50	0
14	Distillate Fuel Oil	Barrels	31.96	0
15	Residual Fuel Oil	Barrels	24.40	36710
16	Naphthas	Barrels	33.00	0
17	Lubricants	Barrels	33.01	0
18	Petroleum Coke	Barrels	33.02	0
19	Asphalt	Barrels	33.03	0
20	Alcohol	Barrels	22.68	0
21	Sulfur	Tons	65.00	1078
22	Ammonia	Tons	125.50	224
23	Carbon Dioxide	1000 Cu Ft	1.00	0
24	Materials	1985$	1.00	-433000

7. Process Name - Undergnd Coal Gas to Gasoline.

Plant Size - 9,600 Barrels per Day.
Reference - Pritchard - 1982

Instantaneous Construction Cost	223.1	E6 1985$
Introduction Year	2040	
Leadtime	3	Years
Lifetime	20	Years
Taxlife	10	Years
Booklife	15	Years
Load Factor	90	%
Salvage Value	0	E6 1985$
Startup Cost	27.5	E6 1985$

INPUTS and OUTPUTS

	Factor	Units	Base Price	Daily Output
1	Coal 1 - Bituminous	Tons	41.31	0
2	Coal 2 - Subbituminous	Tons	27.86	0
3	Coal 3 - Lignite	Tons	12.67	0
4	Coal 4 - Metallurgical	Tons	58.50	0
5	Crude Oil	Barrels	26.76	0
6	Dry Natural Gas	1000 Cu Ft	2.51	0
7	Transported Gas	1000 Cu Ft	3.81	0
8	Distributed Gas	1000 Cu Ft	5.90	0
9	Bulk Electricity	MWH	50.47	-143.6
10	Distributed Electricity	MWH	73.72	0
11	Liquid Petroleum Gases	Barrels	23.50	0
12	Gasoline	Barrels	36.48	9600
13	Kerosene	Barrels	36.50	0
14	Distillate Fuel Oil	Barrels	31.96	0
15	Residual Fuel Oil	Barrels	24.40	0
16	Naphthas	Barrels	33.00	0
17	Lubricants	Barrels	33.01	0
18	Petroleum Coke	Barrels	33.02	0
19	Asphalt	Barrels	33.03	0
20	Alcohol	Barrels	22.68	0
21	Sulfur	Tons	65.00	0
22	Ammonia	Tons	125.50	0
23	Carbon Dioxide	1000 Cu Ft	1.00	0
24	Materials	1985$	1.00	-296106

8. Process Name - Undergnd Coal Gas to Methanol.

Plant Size - 24,000 Barrels per Day.
Reference - Pritchard - 1982

Instantaneous Construction Cost	201.3	E6 1985$
Introduction Year	2040	
Leadtime	3	Years
Lifetime	20	Years
Taxlife	10	Years
Booklife	15	Years
Load Factor	90	%
Salvage Value	0	E6 1985$
Startup Cost	22.7	E6 1985$

INPUTS and OUTPUTS

	Factor	Units	Base Price	Daily Output
1	Coal 1 - Bituminous	Tons	41.31	0
2	Coal 2 - Subbituminous	Tons	27.86	0
3	Coal 3 - Lignite	Tons	12.67	0
4	Coal 4 - Metallurgical	Tons	58.50	0
5	Crude Oil	Barrels	26.76	0
6	Dry Natural Gas	1000 Cu Ft	2.51	0
7	Transported Gas	1000 Cu Ft	3.81	0
8	Distributed Gas	1000 Cu Ft	5.90	0
9	Bulk Electricity	MWH	50.47	-145.5
10	Distributed Electricity	MWH	73.72	0
11	Liquid Petroleum Gases	Barrels	23.50	0
12	Gasoline	Barrels	36.48	0
13	Kerosene	Barrels	36.50	0
14	Distillate Fuel Oil	Barrels	31.96	0
15	Residual Fuel Oil	Barrels	24.40	0
16	Naphthas	Barrels	33.00	0
17	Lubricants	Barrels	33.01	0
18	Petroleum Coke	Barrels	33.02	0
19	Asphalt	Barrels	33.03	0
20	Alcohol	Barrels	22.68	24000
21	Sulfur	Tons	65.00	0
22	Ammonia	Tons	125.50	0
23	Carbon Dioxide	1000 Cu Ft	1.00	0
24	Materials	1985$	1.00	-289548

9. Process Name - Products from Oil Shale.

Plant Size - 4,381 Barrels of Oil Shale per Day.

Reference - ORNL - DBR

Instantaneous Construction Cost	500	E6 1985$
Introduction Year	2040	
Leadtime	5	Years
Lifetime	25	Years
Taxlife	15	Years
Booklife	25	Years
Load Factor	80	%
Salvage Value	0	E6 1985$
Startup Cost	0	E6 1985$

INPUTS and OUTPUTS

	Factor	Units	Base Price	Daily Output
1	Coal 1 - Bituminous	Tons	41.31	0
2	Coal 2 - Subbituminous	Tons	27.86	0
3	Coal 3 - Lignite	Tons	12.67	0
4	Coal 4 - Metallurgical	Tons	58.50	0
5	Crude Oil	Barrels	26.76	0
6	Dry Natural Gas	1000 Cu Ft	2.51	0
7	Transported Gas	1000 Cu Ft	3.81	-488.0
8	Distributed Gas	1000 Cu Ft	5.90	0
9	Bulk Electricity	MWH	50.47	-28.1
10	Distributed Electricity	MWH	73.72	0
11	Liquid Petroleum Gases	Barrels	23.50	-237
12	Gasoline	Barrels	36.48	2506.8
13	Kerosene	Barrels	36.50	491.3
14	Distillate Fuel Oil	Barrels	31.96	1071.4
15	Residual Fuel Oil	Barrels	24.40	510.9
16	Naphthas	Barrels	33.00	169.6
17	Lubricants	Barrels	33.01	64.7
18	Petroleum Coke	Barrels	33.02	164.7
19	Asphalt	Barrels	33.03	155.3
20	Alcohol	Barrels	22.68	0
21	Sulfur	Tons	65.00	0
22	Ammonia	Tons	125.50	0
23	Carbon Dioxide	1000 Cu Ft	1.00	0
24	Materials	1985$	1.00	-10000

10. Process Name - Products from Tar Sands.

Plant Size - 4,381 Barrels of Tar Sands per Day.

Reference - ORNL - DBR

Instantaneous Construction Cost	540	E6 1985$
Introduction Year	2040	
Leadtime	5	Years
Lifetime	25	Years
Taxlife	15	Years
Booklife	25	Years
Load Factor	80	%
Salvage Value	0	E6 1985$
Startup Cost	0	E6 1985$

INPUTS and OUTPUTS

	Factor	Units	Base Price	Daily Output
1	Coal 1 - Bituminous	Tons	41.31	0
2	Coal 2 - Subbituminous	Tons	27.86	0
3	Coal 3 - Lignite	Tons	12.67	0
4	Coal 4 - Metallurgical	Tons	58.50	0
5	Crude Oil	Barrels	26.76	0
6	Dry Natural Gas	1000 Cu Ft	2.51	0
7	Transported Gas	1000 Cu Ft	3.81	-488.0
8	Distributed Gas	1000 Cu Ft	5.90	0
9	Bulk Electricity	MWH	50.47	-28.1
10	Distributed Electricity	MWH	73.72	0
11	Liquid Petroleum Gases	Barrels	23.50	-237
12	Gasoline	Barrels	36.48	2506.8
13	Kerosene	Barrels	36.50	491.3
14	Distillate Fuel Oil	Barrels	31.96	1071.4
15	Residual Fuel Oil	Barrels	24.40	510.9
16	Naphthas	Barrels	33.00	169.6
17	Lubricants	Barrels	33.01	64.7
18	Petroleum Coke	Barrels	33.02	164.7
19	Asphalt	Barrels	33.03	155.3
20	Alcohol	Barrels	22.68	0
21	Sulfur	Tons	65.00	0
22	Ammonia	Tons	125.50	0
23	Carbon Dioxide	1000 Cu Ft	1.00	0
24	Materials	1985$	1.00	-10000

11. Process Name - Products from Heavy Oil.

Plant Size - 4,381 Barrels of Heavy Oil per Day.

Reference - ORNL - DBR

Instantaneous Construction Cost	580	E6 1985$
Introduction Year	2040	
Leadtime	5	Years
Lifetime	25	Years
Taxlife	15	Years
Booklife	25	Years
Load Factor	80	%
Salvage Value	0	E6 1985$
Startup Cost	0	E6 1985$

INPUTS and OUTPUTS

	Factor	Units	Base Price	Daily Output
1	Coal 1 - Bituminous	Tons	41.31	0
2	Coal 2 - Subbituminous	Tons	27.86	0
3	Coal 3 - Lignite	Tons	12.67	0
4	Coal 4 - Metallurgical	Tons	58.50	0
5	Crude Oil	Barrels	26.76	0
6	Dry Natural Gas	1000 Cu Ft	2.51	0
7	Transported Gas	1000 Cu Ft	3.81	-488.0
8	Distributed Gas	1000 Cu Ft	5.90	0
9	Bulk Electricity	MWH	50.47	-28.1
10	Distributed Electricity	MWH	73.72	0
11	Liquid Petroleum Gases	Barrels	23.50	-237
12	Gasoline	Barrels	36.48	2506.8
13	Kerosene	Barrels	36.50	491.3
14	Distillate Fuel Oil	Barrels	31.96	1071.4
15	Residual Fuel Oil	Barrels	24.40	510.9
16	Naphthas	Barrels	33.00	169.6
17	Lubricants	Barrels	33.01	64.7
18	Petroleum Coke	Barrels	33.02	164.7
19	Asphalt	Barrels	33.03	155.3
20	Alcohol	Barrels	22.68	0
21	Sulfur	Tons	65.00	0
22	Ammonia	Tons	125.50	0
23	Carbon Dioxide	1000 Cu Ft	1.00	0
24	Materials	1985$	1.00	-10000

12. Process Name - Coprocessing of Coal & Crude.
Plant Size - 3,505 Barrels of Crude Oil per Day.
Reference - ORNL - DBR

Instantaneous Construction Cost	170	E6 1985$
Introduction Year	1992	
Leadtime	5	Years
Lifetime	25	Years
Taxlife	15	Years
Booklife	25	Years
Load Factor	80	%
Salvage Value	0	E6 1985$
Startup Cost	0	E6 1985$

INPUTS and OUTPUTS

	Factor	Units	Base Price	Daily Output
1	Coal 1 - Bituminous	Tons	41.31	-212
2	Coal 2 - Subbituminous	Tons	27.86	0
3	Coal 3 - Lignite	Tons	12.67	0
4	Coal 4 - Metallurgical	Tons	58.50	0
5	Crude Oil	Barrels	26.76	-3505
6	Dry Natural Gas	1000 Cu Ft	2.51	0
7	Transported Gas	1000 Cu Ft	3.81	-488.0
8	Distributed Gas	1000 Cu Ft	5.90	0
9	Bulk Electricity	MWH	50.47	-28.1
10	Distributed Electricity	MWH	73.72	0
11	Liquid Petroleum Gases	Barrels	23.50	-237
12	Gasoline	Barrels	36.48	2506.8
13	Kerosene	Barrels	36.50	491.3
14	Distillate Fuel Oil	Barrels	31.96	1071.4
15	Residual Fuel Oil	Barrels	24.40	510.9
16	Naphthas	Barrels	33.00	169.6
17	Lubricants	Barrels	33.01	64.7
18	Petroleum Coke	Barrels	33.02	164.7
19	Asphalt	Barrels	33.03	155.3
20	Alcohol	Barrels	22.68	0
21	Sulfur	Tons	65.00	0
22	Ammonia	Tons	125.50	0
23	Carbon Dioxide	1000 Cu Ft	1.00	0
24	Materials	1985$	1.00	-20000

13. Process Name - Methanol from Natural Gas.

Plant Size - 2,500 Tons of Methanol per Day.
Reference - ORNL - 6091

Instantaneous Construction Cost	200.00	E6 1985$
Introduction Year	1982	
Leadtime	3	Years
Lifetime	25	Years
Taxlife	15	Years
Booklife	25	Years
Load Factor	91	%
Salvage Value	8.29	E6 1985$
Startup Cost	4.14	E6 1985$

INPUTS and OUTPUTS

	Factor	Units	Base Price	Daily Output
1	Coal 1 - Bituminous	Tons	41.31	0
2	Coal 2 - Subbituminous	Tons	27.86	0
3	Coal 3 - Lignite	Tons	12.67	0
4	Coal 4 - Metallurgical	Tons	58.50	0
5	Crude Oil	Barrels	26.76	0
6	Dry Natural Gas	1000 Cu Ft	2.51	0
7	Transported Gas	1000 Cu Ft	3.81	-73100
8	Distributed Gas	1000 Cu Ft	5.90	0
9	Bulk Electricity	MWH	50.47	-41.5
10	Distributed Electricity	MWH	73.72	0
11	Liquid Petroleum Gases	Barrels	23.50	0
12	Gasoline	Barrels	36.48	0
13	Kerosene	Barrels	36.50	0
14	Distillate Fuel Oil	Barrels	31.96	0
15	Residual Fuel Oil	Barrels	24.40	0
16	Naphthas	Barrels	33.00	0
17	Lubricants	Barrels	33.01	0
18	Petroleum Coke	Barrels	33.02	0
19	Asphalt	Barrels	33.03	0
20	Alcohol	Barrels	22.68	17965
21	Sulfur	Tons	65.00	0
22	Ammonia	Tons	125.50	0
23	Carbon Dioxide	1000 Cu Ft	1.00	0
24	Materials	1985$	1.00	-40193

14. Process Name - Methanol from Coal - Case 2.

Plant Size - 30,209 Tons of Coal per Day.
Reference - ORNL - 6091

Instantaneous Construction Cost	2500	E6 1985$
Introduction Year	1992	
Leadtime	5	Years
Lifetime	25	Years
Taxlife	15	Years
Booklife	25	Years
Load Factor	85	%
Salvage Value	300	E6 1985$
Startup Cost	50	E6 1985$

INPUTS and OUTPUTS

	Factor	Units	Base Price	Daily Output
1	Coal 1 - Bituminous	Tons	41.31	0
2	Coal 2 - Subbituminous	Tons	27.86	-30209
3	Coal 3 - Lignite	Tons	12.67	0
4	Coal 4 - Metallurgical	Tons	58.50	0
5	Crude Oil	Barrels	26.76	0
6	Dry Natural Gas	1000 Cu Ft	2.51	153000
7	Transported Gas	1000 Cu Ft	3.81	0
8	Distributed Gas	1000 Cu Ft	5.90	0
9	Bulk Electricity	MWH	50.47	-4000
10	Distributed Electricity	MWH	73.72	0
11	Liquid Petroleum Gases	Barrels	23.50	0
12	Gasoline	Barrels	36.48	0
13	Kerosene	Barrels	36.50	0
14	Distillate Fuel Oil	Barrels	31.96	3900
15	Residual Fuel Oil	Barrels	24.40	0
16	Naphthas	Barrels	33.00	1380
17	Lubricants	Barrels	33.01	0
18	Petroleum Coke	Barrels	33.02	0
19	Asphalt	Barrels	33.03	0
20	Alcohol	Barrels	22.68	53500
21	Sulfur	Tons	65.00	0
22	Ammonia	Tons	125.50	110
23	Carbon Dioxide	1000 Cu Ft	1.00	192000
24	Materials	1985$	1.00	-1000000

15. Process Name - Methanol from Coal - Case 4.

Plant Size - 23,782 Tons of Coal per Day.

Reference - ORNL - 6091

Instantaneous Construction Cost	3500	E6 1985$
Introduction Year	1992	
Leadtime	5	Years
Lifetime	25	Years
Taxlife	15	Years
Booklife	25	Years
Load Factor	85	%
Salvage Value	300	E6 1985$
Startup Cost	50	E6 1985$

INPUTS and OUTPUTS

	Factor	Units	Base Price	Daily Output
1	Coal 1 - Bituminous	Tons	41.31	-23782
2	Coal 2 - Subbituminous	Tons	27.86	0
3	Coal 3 - Lignite	Tons	12.67	0
4	Coal 4 - Metallurgical	Tons	58.50	0
5	Crude Oil	Barrels	26.76	0
6	Dry Natural Gas	1000 Cu Ft	2.51	0
7	Transported Gas	1000 Cu Ft	3.81	0
8	Distributed Gas	1000 Cu Ft	5.90	0
9	Bulk Electricity	MWH	50.47	-4000
10	Distributed Electricity	MWH	73.72	0
11	Liquid Petroleum Gases	Barrels	23.50	0
12	Gasoline	Barrels	36.48	0
13	Kerosene	Barrels	36.50	0
14	Distillate Fuel Oil	Barrels	31.96	0
15	Residual Fuel Oil	Barrels	24.40	0
16	Naphthas	Barrels	33.00	0
17	Lubricants	Barrels	33.01	0
18	Petroleum Coke	Barrels	33.02	0
19	Asphalt	Barrels	33.03	0
20	Alcohol	Barrels	22.68	104475
21	Sulfur	Tons	65.00	806
22	Ammonia	Tons	125.50	0
23	Carbon Dioxide	1000 Cu Ft	1.00	375000
24	Materials	1985$	1.00	-800000

16. Process Name - Generic One.

Plant Size - 26,497 Tons of Coal per Day.
Reference - ORNL - DBR

Instantaneous Construction Cost	4000	E6 1985$
Introduction Year	1992	
Leadtime	9	Years
Lifetime	18	Years
Taxlife	15	Years
Booklife	18	Years
Load Factor	80	%
Salvage Value	300	E6 1985$
Startup Cost	100	E6 1985$

INPUTS and OUTPUTS

	Factor	Units	Base Price	Daily Output
1	Coal 1 - Bituminous	Tons	41.31	-26497
2	Coal 2 - Subbituminous	Tons	27.86	0
3	Coal 3 - Lignite	Tons	12.67	0
4	Coal 4 - Metallurgical	Tons	58.50	0
5	Crude Oil	Barrels	26.76	0
6	Dry Natural Gas	1000 Cu Ft	2.51	31780
7	Transported Gas	1000 Cu Ft	3.81	0
8	Distributed Gas	1000 Cu Ft	5.90	0
9	Bulk Electricity	MWH	50.47	-4080
10	Distributed Electricity	MWH	73.72	0
11	Liquid Petroleum Gases	Barrels	23.50	6524
12	Gasoline	Barrels	36.48	19466
13	Kerosene	Barrels	36.50	0
14	Distillate Fuel Oil	Barrels	31.96	0
15	Residual Fuel Oil	Barrels	24.40	26359
16	Naphthas	Barrels	33.00	0
17	Lubricants	Barrels	33.01	0
18	Petroleum Coke	Barrels	33.02	0
19	Asphalt	Barrels	33.03	0
20	Alcohol	Barrels	22.68	0
21	Sulfur	Tons	65.00	598
22	Ammonia	Tons	125.50	193
23	Carbon Dioxide	1000 Cu Ft	1.00	0
24	Materials	1985$	1.00	-364631

17. Process Name - Generic Two.

Plant Size - 26,497 Tons of Coal per Day.
Reference - ORNL - DBR

Instantaneous Construction Cost	3800	E6 1985$
Introduction Year	1992	
Leadtime	9	Years
Lifetime	18	Years
Taxlife	15	Years
Booklife	18	Years
Load Factor	80	%
Salvage Value	300	E6 1985$
Startup Cost	100	E6 1985$

INPUTS and OUTPUTS

	Factor	Units	Base Price	Daily Output
1	Coal 1 - Bituminous	Tons	41.31	-26497
2	Coal 2 - Subbituminous	Tons	27.86	0
3	Coal 3 - Lignite	Tons	12.67	0
4	Coal 4 - Metallurgical	Tons	58.50	0
5	Crude Oil	Barrels	26.76	0
6	Dry Natural Gas	1000 Cu Ft	2.51	31780
7	Transported Gas	1000 Cu Ft	3.81	0
8	Distributed Gas	1000 Cu Ft	5.90	0
9	Bulk Electricity	MWH	50.47	-4080
10	Distributed Electricity	MWH	73.72	0
11	Liquid Petroleum Gases	Barrels	23.50	6524
12	Gasoline	Barrels	36.48	19466
13	Kerosene	Barrels	36.50	0
14	Distillate Fuel Oil	Barrels	31.96	0
15	Residual Fuel Oil	Barrels	24.40	26359
16	Naphthas	Barrels	33.00	0
17	Lubricants	Barrels	33.01	0
18	Petroleum Coke	Barrels	33.02	0
19	Asphalt	Barrels	33.03	0
20	Alcohol	Barrels	22.68	0
21	Sulfur	Tons	65.00	598
22	Ammonia	Tons	125.50	193
23	Carbon Dioxide	1000 Cu Ft	1.00	0
24	Materials	1985$	1.00	-364631

18. Process Name - Generic Three.

Plant Size - 26,497 Tons of Coal per Day.
Reference - ORNL - DBR

Instantaneous Construction Cost	4200	E6 1985$
Introduction Year	1992	
Leadtime	9	Years
Lifetime	18	Years
Taxlife	15	Years
Booklife	18	Years
Load Factor	80	%
Salvage Value	300	E6 1985$
Startup Cost	100	E6 1985$

INPUTS and OUTPUTS

	Factor	Units	Base Price	Daily Output
1	Coal 1 - Bituminous	Tons	41.31	-26497
2	Coal 2 - Subbituminous	Tons	27.86	0
3	Coal 3 - Lignite	Tons	12.67	0
4	Coal 4 - Metallurgical	Tons	58.50	0
5	Crude Oil	Barrels	26.76	0
6	Dry Natural Gas	1000 Cu Ft	2.51	31780
7	Transported Gas	1000 Cu Ft	3.81	0
8	Distributed Gas	1000 Cu Ft	5.90	0
9	Bulk Electricity	MWH	50.47	-4080
10	Distributed Electricity	MWH	73.72	0
11	Liquid Petroleum Gases	Barrels	23.50	6524
12	Gasoline	Barrels	36.48	19466
13	Kerosene	Barrels	36.50	0
14	Distillate Fuel Oil	Barrels	31.96	0
15	Residual Fuel Oil	Barrels	24.40	26359
16	Naphthas	Barrels	33.00	0
17	Lubricants	Barrels	33.01	0
18	Petroleum Coke	Barrels	33.02	0
19	Asphalt	Barrels	33.03	0
20	Alcohol	Barrels	22.68	0
21	Sulfur	Tons	65.00	598
22	Ammonia	Tons	125.50	193
23	Carbon Dioxide	1000 Cu Ft	1.00	0
24	Materials	1985$	1.00	-364631

19. Process Name - Generic Four.

Plant Size - 26,497 Tons of Coal per Day.
Reference - ORNL - DBR

Instantaneous Construction Cost	4400	E6 1985$
Introduction Year	1992	
Leadtime	9	Years
Lifetime	18	Years
Taxlife	15	Years
Booklife	18	Years
Load Factor	80	%
Salvage Value	300	E6 1985$
Startup Cost	100	E6 1985$

INPUTS and OUTPUTS

	Factor	Units	Base Price	Daily Output
1	Coal 1 - Bituminous	Tons	41.31	-26497
2	Coal 2 - Subbituminous	Tons	27.86	0
3	Coal 3 - Lignite	Tons	12.67	0
4	Coal 4 - Metallurgical	Tons	58.50	0
5	Crude Oil	Barrels	26.76	0
6	Dry Natural Gas	1000 Cu Ft	2.51	31780
7	Transported Gas	1000 Cu Ft	3.81	0
8	Distributed Gas	1000 Cu Ft	5.90	0
9	Bulk Electricity	MWH	50.47	-4080
10	Distributed Electricity	MWH	73.72	0
11	Liquid Petroleum Gases	Barrels	23.50	6524
12	Gasoline	Barrels	36.48	19466
13	Kerosene	Barrels	36.50	0
14	Distillate Fuel Oil	Barrels	31.96	0
15	Residual Fuel Oil	Barrels	24.40	26359
16	Naphthas	Barrels	33.00	0
17	Lubricants	Barrels	33.01	0
18	Petroleum Coke	Barrels	33.02	0
19	Asphalt	Barrels	33.03	0
20	Alcohol	Barrels	22.68	0
21	Sulfur	Tons	65.00	598
22	Ammonia	Tons	125.50	193
23	Carbon Dioxide	1000 Cu Ft	1.00	0
24	Materials	1985$	1.00	-364631

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