COAL MARKET MODULE

The coal market module (CMM) represents the mining, transportation, and pricing of coal, subject to end–use demand. Coal supplies are differentiated by heat and sulfur content. CMM also determines the minimum cost pattern of coal supply to meet exogenously defined U.S. coal export demands as a part of the world coal market. Coal supply is projected on a cost–minimizing basis, constrained by existing contracts. Twelve different coal types are differentiated with respect to thermal grade, sulfur content, and underground or surface mining. The domestic production and distribution of coal is forecast for 13 demand regions and 11 supply regions (Figures 19 and 20).

The CMM components are solved simultaneously. The sequence of solution among components can be summarized as follows. Coal supply curves are produced by the coal production submodule and input to the coal distribution submodule. Given the coal supply curves, distribution costs, and coal demands, the coal distribution submodule projects delivered coal prices. The module is iterated to convergence with respect to equilibrium prices to all demand sectors. The structure of the CMM is shown in Figure 21.

Coal Production Submodule

This submodule produces annual coal supply curves, relating annual production to minemouth prices. The supply curves are constructed from an econometric analysis of prices as a function of productive capacity, capacity utilization, and costs. A separate supply curve is provided for surface and underground mining for all significant production by coal rank (bituminous, subbituminous and lignite), coal grade (steam or metallurgical), and sulfur level in each supply region. Constructing curves for the coal types available in each region yields a total of 36 curves that are used as inputs to the coal distribu-

tion submodule. Supply curves are updated for each year in the forecast period.

The factors accounted for in constructing the supply curves are labor productivity and the costs of factor inputs (mining equipment, mine labor, and fuel). Labor productivity projections are developed and applied to each supply curve, based on historical data. The projections incorporate an assumption that the rate of improvement will decline as the rate of technology penetration slows. Labor costs are tied to labor productivity and wage rates. It is assumed, in the reference case, that wage rates keep pace with inflation.

Coal Distribution Submodule

The coal distribution submodule is a linear program that determines the least–cost supplies of coal for a given set of coal demands by demand region and sector, accounting for transportation costs from the different supply curves, heat and sulfur content, existing coal supply contracts, technical limitations of older boiler types, and sulfur allowance costs under the Clean Air Act Amendments of 1990. Existing supply contracts between coal producers and utilities are incorporated in the model as minimum flows between specific supply curves and region–sulfur level combinations. The minimum flows are generally assumed to remain in effect for the duration of the contract and then be replaced by market–determined flows.

Coal transportation costs are simulated using interregional coal transportation costs derived by subtracting reported minemouth costs for each supply curve from reported delivered costs for each demand type in each demand region. Transportation rates are assumed to change in response to railroad labor productivity, labor costs, diesel fuel costs, and equipment costs. In recent years, railroad rates have de-

CMM Outputs	Inputs from NEMS	Exogenous Inputs
Coal production and distribution	Coal demand	Base year productive capacity, capacity
Minemouth coal prices	Interest rates	utilization, prices, and coal quality parameters
End-use coal prices	Price indices and deflators	Contract quantities
Coal exports	Diesel fuel prices	Labor productivity
Transportation rates	Electricity prices	Labor costs
Coal quality by source, destination, and end-use sector		Labor cost escalators
World coal flows		Domestic transportation costs
		International transportation costs
		International supply curves
		International coal import demands
		Demand for U.S. coal imports

Figure 19. Coal Market Module Demand Regions
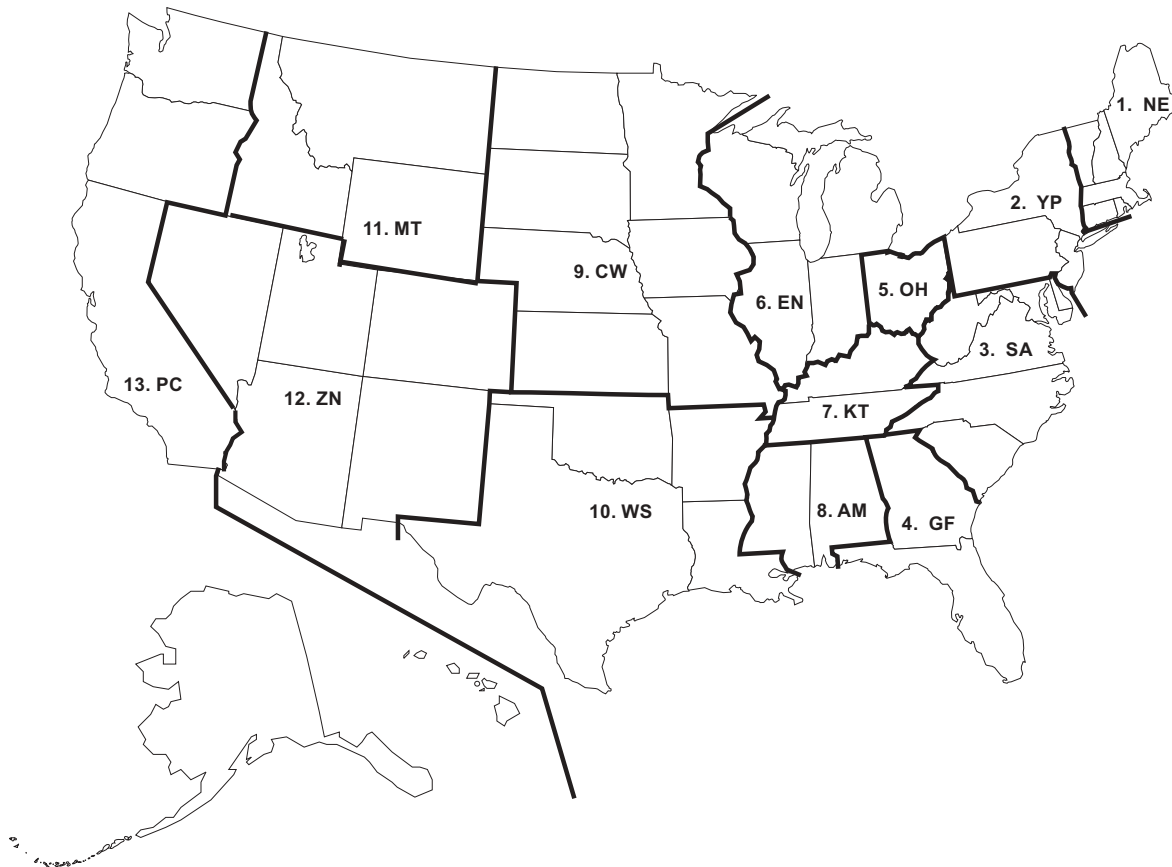
Region Code	Region Content
1	New England
2	Middle Atlantic
3	South Atlantic
4	Georgia and Florida
5	Ohio
6	East North Central
7	Kentucky and Tennessee

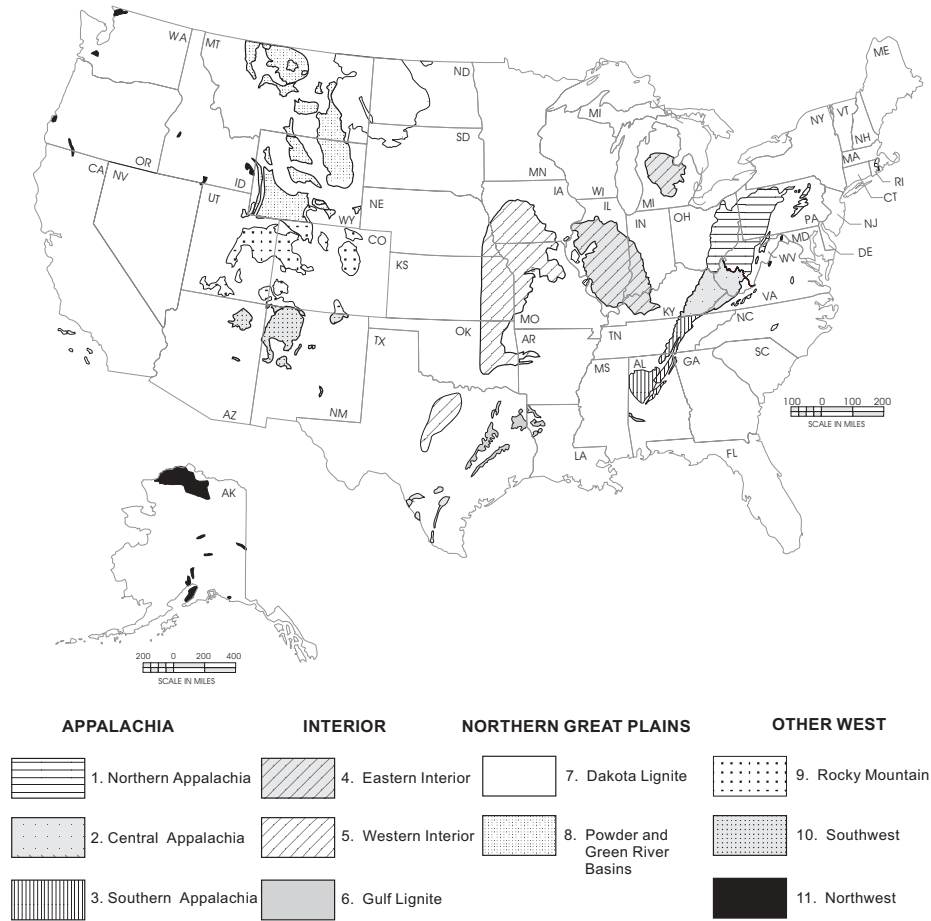| Region Code	Region Content
8	Alabama and Mississippi
9	West North Central
10	West South Central
11	Montana, Wyoming, and Idaho
12	Mountain
13	Pacific

clined because of operating efficiencies from such measures as improved scheduling and lower fuel cost per ton–mile that have resulted from low crude oil prices, more efficient diesel engines, and larger and lighter aluminum cars.

Coal Export Component

The coal export component of the coal distribution submodule projects quantities of coal imported and exported from the United States. The quantities are determined within a world trade context, based on assumed characteristics of foreign coal supply and demand. The component disaggregates coal into 16 export regions and 20 import regions, as shown on the following page.

The export component is a part of the linear program that optimizes domestic coal supply. It determines world coal trade distribution by minimizing overall costs for coal, subject to U.S. coal supply prices and a number of constraints. Supply costs (mining and preparation plus transportation) for each coal export region, coal type, and end use compete in two demand sectors (coking and steam). The component also incorporates within the model structure supply diversity constraints that reflect the observed tendency of coal–importing countries to avoid excessive dependence upon one source of supply, even at a somewhat higher cost.

Figure 20. Coal Market Module Supply Regions

APPALACHIA	INTERIOR	NORTHERN GREAT PLAINS	OTHER WEST
1. Northern Appalachia	4. Eastern Interior	7. Dakota Lignite	9. Rocky Mountain
2. Central Appalachia	5. Western Interior	8. Powder and Green River Basins	10. Southwest
3. Southern Appalachia	6. Gulf Lignite		11. Northwest

Coal Export Regions	Coal Import Regions
U.S. East Coast	U.S. East Coast
U.S. Gulf Coast	U.S. Gulf Coast
U.S. Southwest and West	U.S. Northern Interior
U.S. Northern Interior	U.S. Noncontiguous
U.S. Noncontiguous	Eastern Canada
Australia	Interior Canada
Western Canada	Scandinavia
Interior Canada	United Kingdom and Ireland
South Africa	Germany and Austria
Poland	Other Northwestern Europe
CIS (Europe)	Iberia
CIS (Asia)	Italy
China	Mediterranean and Eastern Europe
Colombia	Mexico
Indonesia	South America
Venezuela	Japan
	East Asia
	China and Hong Kong
	ASEAN (Association of Southeast Asian Nations)
	India and South Asia

COAL MARKET MODULE

Figure 21. Coal Market Module Structure