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Transportation and Energy Through 2000: Changing Patterns of Supply, Demand, Price and Movement

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INTRODUCTION

THIS PAPER REPORTS findings developed by the National Transportation Policy Study Commission (NTPSC) forecasting and energy efforts.[1] First projected trends in energy production are examined, with special attention to production shifts that will affect movements and petroleum production. Consumption trends next are discussed, from the point of view of the transportation sector, but other sectors are considered as well because they also determine the level of energy demand and availability. The second half of the paper examines coal movement and usage in finer detail. We foresee coal production growing immensely for direct usage and conversion to synthetic fuels. These developments will have major ramifications on the transportation network (especially the railroads), causing an upsurge in flows and also posing challenges to capacity and the physical plant.

PRIMARY ENERGY PRODUCTION AND PRICE

Primary energy resource production encompasses the total quantity of domestic energy resources and fuel imports required to supply projected domestic energy demand and coal export demand. Primary Energy Production is forecasted (for Scenario III) to increase from a level of about 71.6 quads in 1975 to over 138 quads in 2000. The near doubling of energy during the 25 year forecast period translates into an average annual growth rate of 2.7 percent. This rate of growth is slower than the historical trend; between 1947 and 1973 primary energy production grew at an average annual rate of 3.0 percent.

The projected slower but steady growth in aggregate primary energy production masks substantial shifts in the makeup of the primary energy supply. As shown in Figure I, the share of the primary energy market accounted for by domestically produced oil and natural gas shrinks from 52 percent in 1975 to 24 percent in 2000 while coal and nuclear power grow from 23 percent to 48 percent. Primary domestic production of oil remains constant and gas declines between 1975 and 2000. The role played by imported fuels—primarily oil with small amounts of gas—is expected to decline; although, the absolute amount imported is projected to increase at an average annual rate of 1.4 percent. In 1975 imported fuels represented 18 percent of U.S. primary energy supply, their share is projected to peak in the first half of the 1980s at around 24 percent, but by 2000 will have fallen to only 13 percent.

The gap left in the primary energy supply by the diminished role for domestic oil and gas and imported fuels is projected to be filled by surging coal and nuclear production. Coal alone is expected to increase at an average annual growth at a rate of 5.3 percent from 1975 to 2000. Coal and nuclear fuels will be utilized very differently from the primary energy sources (oil and gas) that they are projected to supplement. This includes increased usage of coal and uranium for uses that can directly utilize these fuels (such as electrical generation or certain industrial processes), and also the development of a synthetic fuel industry based on transforming coal into synthetic oil and gas. During the last decade of this century tremendous growth in synthetic fuel production is expected. In 2000, over 11 quads of synthetic liquids and gas are produced, (mostly from coal) representing 18 percent of the total domestic supplies of these fuels. With the development of a large synthetic fuel industry, the availability of liquid petroleum and gaseous fuels in the economy does not shrink to the extent indicated by their diminished share of primary energy production.

PETROLEUM PRODUCTION AND PRICE

Petroleum availability is of prime importance to transportation. The signifi-

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PRODUCTION OF PRINCIPAL PRIMARY ENERGY RESOURCES
SCENARIO III

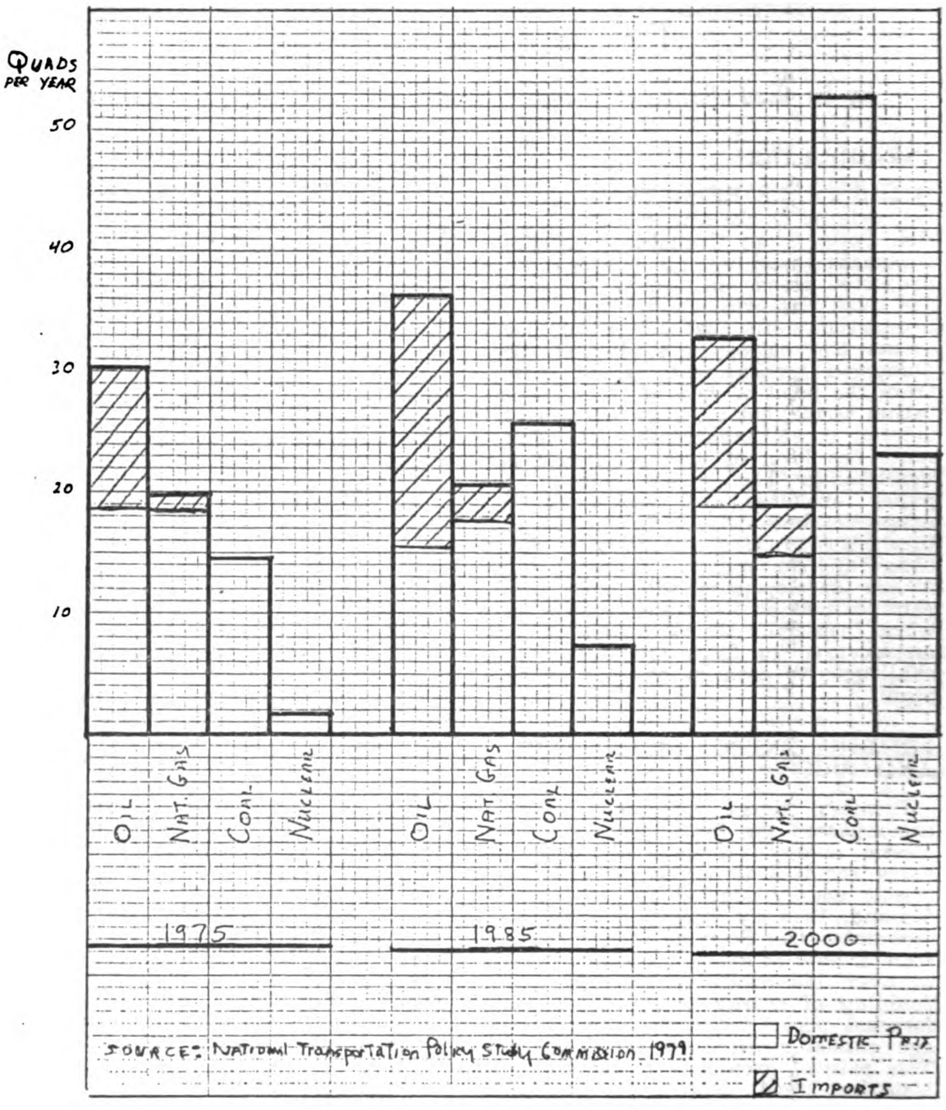

FIGURE 1

cant results for the petroleum sector are:

- The prices of crude oil and petroleum products will increase faster than the rate of inflation. In constant dollars the price of domestic crude at the wellhead is projected to increase 50 percent between 1975 and 2000, representing a real annual average increase of 1.9 percent.
- Domestic production of crude oil will continue to decrease until after 1985, in spite of increased prices, and will be at approximately the 1975 production level in 2000.

- Demand for petroleum products will exceed domestic production, even though nuclear and coal will supply increasing amounts of the nation's energy. Through the 1980s these shortfalls will be met by increasing levels of imports; in the last decade of this century significant production of syncrudes from coal and oil shale will be available and will reduce the volume of crude imports. These synthetic liquids will require a minimum **investment** of $80-90 billion over the forecast period (in 1975 dollars).

- Changing sites of domestic crude production, imports, and the advent of synthetic production will alter the nation's needs for petroleum transport.

DOMESTIC PETROLEUM PRODUCTION

The leading sources of liquid fuels are displayed in Table I. The quantities produced by various resource regions are expected to change dramatically over the forecast period. Key among those changes are an extreme decline in production in the presently paramount Gulf Coast and West Texas regions (in 1975 these areas produced 65 percent of all domestic crude oil). Annual production from these two regions is expected to decline by 8.19 quads by the year 2000, in spite of an 82 percent increase in the average wellhead price for these region's crude. The picture of sharply declining production in the lower 48 states is counterbalanced by huge gains in production of Alaskan oil. In 1975, production was under .5 quads. This is expected to surge to over 10.5 quads in 2000, offsetting the production losses experienced in the lower 48 states.

IMPORTED CRUDE

Annual imports of crude oil increase sharply from their 1975 level of 11.73 quads and reach 20.42 quads in 1990. By 2000, imports have dropped off to 14.10 quads. Between 1975 and 1990, crude oil import prices are forecast to increase 2 percent annually in real terms, whereas between 1990 and 2000 the annual average increase is 1.5 percent.

Through 1990, greater volumes of imports serve as a ceiling for the market price of crude oil. Imports act both to meet the demand for energy types derived from oil, especially important to transportation which is dependent on refined petroleum products, and as a check on the development of more expensive sources of domestic crude.

SYNTHETIC PRODUCTION

In the final decade of this century, a rival for the markets presently belonging to domestic and imported oil is forecast to appear: the production of synthetic oil from coal and shale oil. In 2000, 6.2 quads of crude oil and residual fuel from coal and 2.2 quads of shale syncrude will be produced. These 8.4 quads will represent 20 percent of the crude oil available to refineries from all sources — crude oil production, imports, and synthetics.

TABLE 1

SOURCES OF LIQUID FUELS
(Quadrillion Btu per year)

RESOURCE	1975	1985	2000
Domestic Crude	18.60	15.47	18.80
Gulf Coast	7.56	6.29	2.42
West Texas	4.48	1.92	1.43
Pacific Coast	1.92	2.71	2.92
Other Lower 48	4.19	2.21	2.92
Alaska	.45	2.34	10.58
Crude Imports*	11.73	20.51	13.76
Coal Liquids	—	.01	6.34
Great Plains Synthetics	—	—	4.90
Rocky Mtn. Shale Oil Syncrude	—	.04	2.22
Methanol Imports	—	.18	.34
Total	30.33	36.21	41.46

* Including petroleum products.

Source: NTPSC, 1979.

LOCATIONAL SHIFTS

The production of syncrude from coal (and most other synthetic production) is projected to occur near the mines, while oil from shale will come from Colorado. Most of the coal utilized will be from the Northern Great Plains. Coupled with the changes outlined for the sites of domestic oil production and for imports, the origin point of crude flows to refineries are forecast to change dramatically. Flows from Alaska will increase with the forecasted volumes exceeding the capacity of the Alaska pipeline; the Great Plains will emerge as a major new source of supply, requiring complementary development of a transport system; flows from West Texas and the Gulf Coast, presently the origin of the major pipelines will shrink (this developmennt will be exacerbated by parallel decreases in gas production from these regions); and imports, also handled through the existing pipeline systems, will decrease by 2000.

ENERGY CONSUMPTION: PROJECTED TRENDS TO 2000

During the forecast period, aggregate consumption of distributed energy products increases from almost 54 quads in 1975 to 90.3 quads in 2000, an annual average increase of 2.1 percent. Consumption can be divided among three end-use sectors: transportation, residential/commercial, and industrial.

Energy growth in the transportation sector is forecast at an average annual rate of 1 percent over the forecast period, well below its historical average growth rate of 2.7 percent between 1947 and 1975. However, no significant steps towards reducing transportation's dependence on petroleum are foreseen. Although increasing use of alcohol fuels and electricity are forecasted, their contribution is limited over the forecast period.

The slower growth in transportation fuel consumption is due in large part to projected efficiency gains for automobiles and aircraft. This is due to the mandated EPCA fuel efficiency standards for passenger vehicles as well as responses to higher than historical fuel prices for all modes. By 2000, diesel autos and local trucks are widespread and represent a significant fraction of these fleets.

With increased fuel efficiency projected for gasoline powered vehicles and their declining share of the automobile and local truck market, absolute gasoline consumption is forecast to drop during the forecast period. The average annual growth rate during the forecast period will be —1.5 percent, leading to over a 30 percent decrease in gasoline consumption between 1975 and 2000. Gasoline prices are forecast to increase at an average annual rate of .9 percent, with 2000 prices 28 percent higher in real terms than in 1975. Significant increases in the amount of air travel are forecast, as air is expected to capture a greater fraction of the growing intercity personal travel market. This growth will overshadow the efficiency gains built into the energy consumption projection, but these efficiency improvements will contribute to the declining transportation sector fuel growth rate. Jet fuel usage is forecast to grow at an annual rate of 3.7 percent, well below its historical growth rate of 5.2 percent annually between 1965 and 1975. Jet fuel prices are forecast to increase at an average annual rate of 1.8 percent in real terms between 1975 and 2000, with 2000 prices 51 percent greater than 1975.

Diesel fuel consumption is expected to show the greatest rate of average growth annually over the forecast period. Actual diesel fuel consumption will increase by 340 percent. The sharp rise in fuel consumption is due to significant growth in diesel usage by automobiles and local trucks. Intercity truck, rail, and marine usage of diesel also are forecast to grow rapidly. These sectors show an annual average growth in diesel fuel consumption of 3.4 percent, and testify to the continually growing fuel needs in the intercity goods market. However, the projected diesel fuel consumption is lower than the historical increase of 7.4 percent annually between 1947 and 1975. Diesel fuel prices are expected to rise by 40 percent in real terms over the forecast period. This is an average annual increase of 1.3 percent.

The residential/commercial sector is forecasted to show the slowest annual average rate of growth in energy consumption, 0.7 percent between 1975 and 2000, a sharp decline from the sector's historical average annual growth of 31 percent. This slowdown is based on expectations of improved end-use efficiencies and slower population growth. Due to these trends and a shift to electricity, absolute consumption of petroleum products in this sector will fall.

Industrial sector consumption is expected to show the greatest rate of sectoral growth, an average of 3.5 percent annually over the course of the forecast period. This rate is based upon expected rapid growth in energy-intensive industrial sectors, particularly chemicals and primary metals; increased usage of coal with low end-use efficiencies; and a rapid increase in the value added in industrial products (mainly feedstocks).

Petroleum product consumption is expected to keep pace with the upswing in fuel consumption, and increasingly transportation will compete with this sector for petroleum.

Although the residential and commercial sectors are expected to reduce their absolute consumption of petroleum products, the transportation and industrial will increasingly compete for petroleum-based fuels with the competition sharpest in the regions where industries requiring petroleum-based feedstocks are concentrated. Transportation fuel consumption per capita shows little regional variation among regions and over the course of the forecast period. Growth of industrial use of petroleum products is concentrated in the East South Central and West South Central regions where less than half of the year 2000 projected petroleum consumption occurs in the transportation sector.

DEMAND FOR COAL

As was discussed earlier, the use of coal enhances the domestic fuel availability for the transportation sector because:

- coal can be made into synthetic liquids that can be refined into transportation fuels.
- coal can be directly burned to generate electricity for utility and industrial use.
- coal can be made into other synthetic gases and solids that can be used as fuels in other end-use sectors.
- coal can be used as both an industrial fuel and as a feedstock.

The growing role for coal can be seen from the changes in usage projected by the forecasters:

The forecacst in Table 2 basically reflects an economic, unregulated environment with little regard for external factors. It should be noted that coal production is significantly affected by non-economic factors which place some degree of uncertainty on the forecast.

Key among these factors are:

Federal and state land reclamation requirements; Federal leasing requirements for Federally owned coal lands; worker mine health and safety requirements; Federal and state environmental standards aimed at curbing air and water pollution which affect both production, conversion, and utilization of coal (key among them are the New Source Performance Standards for coal fixed utility boilers (to generate electricity) and the non-degradation and non-attainment requirements for site location); and, coal conversion requirements of Federal energy policy.

Other factors affecting the coal market are: Taxation policies administered by Federal, state, local and Indian nation jurisdictions including severance taxes, production and ad-valorem taxes, environmental taxes, and possessory interest taxes; ownership and divestiture concerns as they affect coal venture formation (including foreign ownership concerns): socio-economic impacts and disruptions that will occur in mining locales; labor and industrial relations in the mining of coal; U.S. export-import policies as they affect the export potential of U.S. coal; utilization of local lignite and peat deposits to meet localized energy demand; annd capital availability and cost.

TABLE 2

END USES OF COAL — SCENARIO III
(Quadrillion Btu per year)

Destination	1975	1980	1985	1990	1995	2000
Electric Power Generation	8.141	12.317	14.883	17.153	18.718	19.558
Synthetic Liquids	—	—	.005	.013	2.477	9.671
Synthetic Gases	—	—	—	.133	0.833	3.155
Miscellaneous Synthetics	—	—	—	.024	0.153	.325
Feedstocks	0.190	0.345	0.563	1.048	1.601	2.189
Metallurgical Coal*	2.221	2.833	3.404	3.987	4.570	5.167
Coal Exports*	1.800	2.057	2.334	2.707	3.103	3.507
Industrial Fuel	2.250	3.338	4.695	6.187	7.722	9.294
Total	14.602	20.890	25.884	31.252	39.177	52.866

Source: National Transportation Policy Study Commission, 1979.

NTPSC REGIONAL COAL FORECASTS

The NTPSC regional coal forecasts are presented in Table 3. Through 1985 the Appalachian Region is expected to maintain its substantial share of total production with 60 percent while the Great Plains Region will experience rapid production increases rising to a 19 percent share of national coal production.

By the year 2000, however, a significant change is expected to occur in that Great Plains production will surpass that of Appalachia, resulting in a 43 percent share for the Great Plains and a 37 percent share for Appalachia.

In order to assess transport needs the coal production forecasts were further distributed between coal which must be moved beyond the local area defined as a Bureau of Economic Analysis zone and coal which is consumed locally. The former category is referred to as "transported" tonnage and excludes short distance hauls mainly by truck but also by rail and water way. From Table 3 transported coal, is expected to increase from 400 million tons in 1975 to 830 million tons in 1985 and 1.4 billion tons in the year 2000.

Transported coal from Appalachia is anticipated to almost double between 1975 and 1985, rising from 228 to 429 million tons Great Plains-transported coal is forecast to almost quadruple, from 48 to 184 million tons during the same period. From 1985 to 2000 Appalachian transported coal is projected to increase by less than 60 million tons, while Great Plains coal transport grows to over 500 million tons.

Another important aspect of the NTPSC's projection is that transported coal from the Interior Region, which is expected to increase by only 35 million tons from 1975 to 1985, will increase by more than 120 million tons to a total of 262 million from 1985 to 2000.

The demand for projected coal output has been determined on the basis of consumption regions which correspond to the nine U.S. Census Regions. The major demand region for transported coal is the East North Central Region, including Wisconsin, Illinois, Michigan, Indiana, and Ohio, with an expected 28 percent share of national demand in 1985. The next highest demand region (with an 18 percent share in 1985) is the South Atlantic Region, stretching from Delaware to Florida along the Atlantic Coast.

One of the fastest growing demand regions is the West South Central Region encompassing Texas, Louisiana, Oklahoma, and Arkansas. From a base tonnage of 9 million annually in 1975, demand is expected to grow to 97 million tons in 1985 and reach 257 million tons in the year 2000, becoming the second highest demand region in the last forecast year.

Prior to estimating the modal split for transported coal tonnage, the forecasts were converted to traffic flows between Region pairs. This step gives a clearer illustration of the forecast trends as they relate to the nation's transport network. In 1975 the largest interregional flow was 100 million tons between the Interior production region and the East North Central Region. By 1985 the flow from Appalachia to the South Atlantic Region is expected to reach 147 million tons. By 2000 the largest single flow is expected to be from the Great Plains to the West South Central Region with 211 million tons.

Significant growth in coal flows should occur along the following corridors (See Table 4).

Appalachia — Middle Atlantic;
Appalachia — South Atlantic;
Appalachia — East North Central;

TABLE 3

NTPSC COAL PROJECTIONS — SCENARIO III
(millions of short tons)

Forecast Type	Year	Regions: Appalachia	Interior	Great Plains	Rocky Mountain	Total
Total Production	1975	447	134	60	19	660
	1985	719	166	228	84	1197
	2000	968	371	1122	160	2621
Transported Production	1975	228	106	48	18	400
(Only Inter-BEA flows)	1985	429	140	184	77	830
	2000	486	262	504	147	1399

Source: NTPSC, 1979.

TABLE 4

NTPSC INTER-REGIONAL COAL FLOWS[1] — SCENARIO III
(millions of short tons)

DEMAND REGIONS	YEAR	PRODUCTION REGIONS: APPALACHIA	INTERIOR	GREAT PLAINS	ROCKY MOUNTAIN	TOTAL
NE	1975	2.2				2.2
	1985	13.1				13.1
	2000	16.0		0.1		16.1
MA	1975	42.6				42.6
	1985	103.7				103.7
	2000	146.8		0.7		147.5
SA	1975	90.9				90.9
	1985	146.9				146.9
	2000	202.8	0.1	0.3		203.2
ENC	1975	31.0	100.4			131.4
	1985	116.5	102.4	16.1		235.0
	2000	78.0	163.5	133.7		375.2
ESC	1975	60.8				60.8
	1985	48.4	26.0	0.8		75.2
	2000	42.4	65.4	16.4		124.2
WNC	1975			48.3		48.3
	1985			91.8		93.0
	2000		3.0	136.6		139.6
WSC	1975		5.2		4.0	9.2
	1985		10.7	73.3	13.1	97.1
	2000		30.0	211.2	16.0	257.2
M	1975				13.3	13.3
	1985			1.8	36.7	38.5
	2000			3.9	73.4	77.3
P	1975				1.1	1.1
	1985			0.5	27.3	27.8
	2000			1.1	57.3	58.4
TOTAL	1975	227.5	105.6	48.2	18.4	399.8
	1985	428.6	140.3	184.3	77.1	830.3
	2000	486.0	262.0	504.0	146.7	1398.7

1 Only Inter-BEA coal flows.

Source: National Transportation Policy Study Commission, 1979.

Interior — East North Central;
Great Plains — East North Central;
Great Plains — West North Central; and
Great Plains — West South Central.

In only one instance is there expected to be a major shift in the traditional relationship between a source and demand region. By the year 2000, the East North Central Region is expected to shift from Appalachia to Great Plains and Interior sources to meet new coal needs.

MODAL FORECAST

Based on the flow of coal between BEA pairs, the most appropriate transport mode was selected and the tonnage was distributed by the NTPSC between either railroads or waterways, and in a combined rail-water movement.

The resultant modal forecast for coal (Scenario III) is presented in Table 5. By only including inter-BEA flows, the coal volumes in the base year will vary from reported statistics for each mode. In the case of waterways, the underestimate of coal volumes is more significant. Waterway statistics show 153 million tons of coal carried in 1975, excluding exported coal across the Great Lakes to Canada. This discrepancy is due to two factors: first, intra-BEA movements which are not included in the NTPSC estimates; and second, there is apparently more transshipment of coal which could not be isolated without a more detailed evaluation of current coal flows.

The comparisons of the NTPSC rail forecasts with projections used in other

TABLE 5

MODAL DISTRIBUTION OF NTPSC COAL FLOW FORECAST[1] SCENARIO III (millions of short tons)

Mode	1975	Year 1985	2000
Rail	351	753	1285
Waterway[2]	52	101	199

1 Excludes local movements and mine mouth generation.
2 Includes transhipped coal from rail to water.

Source: NTPSC, 1979.

studies (Table 6) show the Commission's estimates to be reasonable with the extremes represented by the Manalytics[2] study using an "extreme case" high forecast and the DOTs[3] relatively low forecast.

One of the most significant conclusions which can be drawn from the NTPSC regional forecasts is that to judge energy transport needs on the basis of 1985 flows would result in short-sighted policies. The critical shift in coal movements after 1985 from eastern to western coal sources will change the relative balance of flows over different segments of the coal rail network. Also the increase in coal tonnages and the concentration of some flows could justify the use of alternative modes such as slurry pipelines.

To further verify this conclusion the NTPSC assigned each flow (projected rail tonnage) of more than 500,000 tons annually between BEA pairs to the rail segments which would most likely carry such tonnage. In general the current network, conditions and shipper practices were used to select the appropriate routing with the exception of new segments in the west which are presently being considered. Capacity constraints were not applied to the assignments unless in extreme cases it was obvious that a parallel routing on an existing line was more logical than assuming extensive improvements to the primary line. The results are for the lines which are primarily affected summarized in Table 7.

As of 1976 there were six main coal hauling railroads with over 40 million tons annually (originating and interlines). By 1985 nine more lines, some of which traditionally carried minimal coal volumes will carry over 40 million tons of coal annually. Four of those lines will carry more than 100 million tons each. Furthermore by the year 2000, 17 lines will carry over 40 million tons per year, eight of which will carry over 100 million tons each.

It is clear that by 1985 many segments of the nation's rail system will experience some degree of deficiency. The key corridors which will require investment are those which connect the Great Plains coal region to the West North Central, and West South Central Census Regions and the corridor which connects the Appalachian coal region,

TABLE 6

COMPARISON OF COAL BY RAIL FORECASTS 1985/2000 (millions of short tons)

Study	Railway Tonnage 1985	2000
NTPSC—1978	753	1285
Department of Transportation—1978[2]	675	——
Office of Technology Assessment—1978[5]	766	1274
Manalytics, Inc.—1976[2]	1200-1500	——
Barber Associates,[4] Inc.—1977[1]	690- 837	

1 The High represents the implementation of the "National Energy Plan: (1977) and the low represents the flow without the "Plan."

Source: NTPSC, 1979.

TABLE 7

DISTRIBUTION OF COAL BY RAIL
(millions of short tons)[1]

Rail Carrier	1976[2] Originating	Other	1985[3] Originating	Other	2000[3] Originating	Other
Conrail	41.3	40.1	65.2	38.6	83.4	80.5
Southern	26.5	8.8	23.1	23.1	38.9	28.7
Louisville & Nashville	56.7	2.7	68.1	4.0	98.1	7.5
Baltimore & Ohio	23.2	19.2	35.9	39.0	35.3	53.7
Chesapeake & Ohio	48.2	10.4	71.0	33.8	80.5	39.3
Norfolk & Western	67.0	8.4	100.9	5.1	115.4	13.5
Seaboard Coastline	—	16.4	0.6	30.2	1.1	44.6
Illinois Central Gulf	21.2	2.6	31.7	4.1	64.7	14.0
Chicago, Milw., St. Paul & Pac.	5.0	4.0	9.5	8.6	15.9	54.9
Chicago & North Western	3.4	12.3	7.1	23.6	62.3	46.1
Burlington Northern	42.9	2.9	123.6	4.3	374.1	7.8
Atchison, Topeka & Santa Fe	1.7	3.3	8.0	22.0	44.5	57.5
Colorado Southern	—	3.8	—	26.6	—	93.8
Missouri Pacific	11.2	3.4	0.9	7.4	3.3	48.6
Fort Worth & Denver	—	1.0	—	25.8	—	71.2
Denver & Rio Grande Western	12.3	2.0	47.2	—	81.7	—
Union Pacific	14.1	3.2	18.6	22.0	54.0	95.5
TOTAL	374.7	144.5	611.4	318.2	1156.2	757.2

Source: NTPSC estimates

1 Assumptions made generally without regard for capacity constraints.
2 Includes all tonnage carried, local and inter-BEA movements from National Coal Association, Coal Traffic Annual, 1977, pp. 3-5.
3 Includes only tonnage carried between BEA regions and excludes local tonnage movements.

especially Kentucky and Tennessee to the south Atlantic Census Region. The elimination of these deficiencies is not expected to require a significant amount of new rail infrastructure (new rail line including double tracking) by 1985 but rather improvements to existing lines in the form of more efficient signalization, shorter spacing between sidings, and better maintenance.

By the year 2000, the dramatic changes are expected to occur. Based on the existing infrastructure and shipper practices, the concentration of coal production in the southern Power River Basin in southeastern Montana and northern Wyoming results in the growth of Burlington Northern coal traffic from 46 million tons in 1976 to over 380 million tons in 2000 moving towards Duluth, Minnesota, across North Dakota; towards St. Louis across Nebraska; and south towards Texas through Colorado.

Other significant but less dramatic traffic increases are expected to occur on the Chicago & North Western, The Atchison, Topeka & Santa Fe, The Colorado Southern, the Missouri Pacific, the Fort Worth & Denver, The Denver & Rio Grande Western and the Union Pacific railroads in the west. In the east Conrail will continue to be critical to coal movements with large increases on the Louisville & Nashville and the Illinois Central Gulf.

A review of individual line segments reveals the severe impact of coal traffic on line haul capacity. The most extreme cases are on Burlington Northern (BN) lines. Across North Dakota (Bismark to Fargo) the BN line, currently a single track line with automatic bloc signals, will be expected to handle over 80 million tons of coal annually by 2000. Similarly from Alliance to Grand Island, Nebraska, over 116 million tons of coal annually are projected. The line currently is a single track with centralized traffic control. To illustrate the effect on capacity, it has been estimated that a single track system with automatic block signals could handle about 60 million tons annually (actual capacity will depend on many factors, including the traffic mix and the proportion represented by the unit train movements).

In addition to considerations of line

haul capacity, increasing rail coal traffic raises the issue of the availability of hopper cars. This is especially of concern for small mine operators, and coal users for which unit train service or privately owned cars are not feasible. Will they be able to compete for rail service?

● WATERWAY CAPACITY

According to the NTPSC forecast based on (Scenario III), by 1985, the Mississippi River south of St. Louis and the Ohio River system will experience significant increases in coal tonnage with volumes more than doubling on most segments. By the year 2000, with the dramatic shift to western coal, a large rise in the Interior region's coal production, and the stabilizing of Appalachian production, the trend on the Ohio River changes such that only from Louisville, Kentucky, westward are there significant increases in coal movements. The Mississippi River, south of St. Louis, will continue to experience unprecedented traffic volumes with a tripling of 1985 coal flows, due to the transshipment of western coal from rail to barge near St. Louis, which is expected to rise from 14 million tons in 1985 to 53 million tons in 2000.

In the case of the **Great Lakes**, the NTPSC forecast projects the directional shift in coal movements which has already begun to occur. The flow of western coal from the rail to lake carrier transshipment terminal at Duluth, Minnesota, on Lake Superior, to Detroit Edison power plants on the St. Clair River is expected to expand to other lake facilities such that by the year 2000 over 5 million tons of western coal will be shipped from the Duluth-Superior area. In contrast, traditional coal sources on Lake Erie will increase shipments until 1985 after which time western coal will meet most additional demand. In both cases, on the Inland Waterways and on the Great Lakes the traffic forecasts suggest a continued strain on capacity at locks that have already been identified by the Corps of Engineers and the Mid America Ports Study.[6]

IMPACTS AND POLICY ISSUES IDENTIFIED FROM THE PROJECTED MOVEMENT OF COAL

The following impacts and policy issues have been identified from the projected movement of coal:

1. Capacity

The overriding concern is whether the U.S. transport system is and will be capable of moving coal between the various origins and destinations at a level of service acceptable to different types of coal users. Can the system provide the necessary physical capacity to handle coal traffic at a reasonable cost including the social and environmental costs of hauling coal? Specifically:

(i) Is there sufficient infrastructure including adequate rail trackage, uncongested locks on the waterways, properly maintained roadways and efficient loading and unloading (including transshipment) facilities?

(ii) Is there a sufficient amount of hauling equipment including rail hopper cars, locomotives, barges, towboats, lake carriers and trucks?

(iii) Do present operating practices permit an efficient utilization of infrastructure and equipment?

A second is to assess the capability of the national system to respond effectively to capacity deficiencies and to improve capacity while mitigating any adverse impacts of coal transportation. The issues which have already arisen in this respect and which will be of crucial importance in future years include the following:

2. Community Disruption

These consist of **Community Disruption**—due to Large-Scale Train Movements through communities and **Highway Impacts and Disturbance**—these consist of environmental impacts upon the highway system brought about by coal movemennt—dust, noise, and safety—as well as premature deterioration of highways. The issues here are the social and physical environmental costs associated with developing and using additional transport capacity so great that more innovative approaches to providing transport service must be found?

3. Transportation Rail Rates

Since transportation is the largest portion of delivered price of western coal, transportation rates have significant impact on energy costs in other regions. This raises the following issues:

- Should railroad coal rates be self-supporting or also allow them to "cross subsidize" their transport services to other, less profitable commodities?
- What rate of return on investment should coal-hauling railroads reasonable be allowed to earn?

4. Financial capability of Railroad to Meet Expected Demand

The nearly unprecedented capital building program of the railroad industry required to meet coal haul demands may exceed railroads ability to finance due to:

- The scale of (non-recurring) costs of these outlays for track, signaling, and rolling stock needed before revenue is realized.
- The weak earnings position and balance sheets of the combined Class I railroads.

5. Potential Monopolistic Practices

Concentration of future coal shipments in certain corridors would constitute a significant monopolistic situation for carriers in the event of deregulation of railroads.

6. Abandonment of Rail Lines

The potential abandonment of both branch lines and parallel routes presents problem of timing. These are underutilized today and cannot support adequate maintenance (or even mothballing). In the future they will be required or desirable to handle excess loads on other lines and highways—in some cases perhaps not for 15 or more years.

- How can these resources be kept in reserve for future needs without requiring unreasonable burdens on private firms.
- Is it desirable from the future viewpoints of economics and civil defense to permit a high concentration of the movement of a basic energy resource to a single transportation mode and corridor?
- Can gathering branch lines in coal reserve districts (principally in the East) be extended, upgraded and maintained for less cost than building new highways to absorb the traffic increases and maintaining seriously overloaded highways?

7. Level of Government Funding

What will be the type and level of government for the modes which haul coal? Will Conrail funding and other current types of Federal rail financing programs be continued? Will waterway investment continue to be funded mainly from the Treasury? How will states and localities pay for the maintenance of major coal roads?

8. Coal Slurry Pipelines

Due to the potential need for coal slurry pipelines to help move the vast quantities of coal that are projected to be moved, the following issues are raised:

- Will development of the coal slurry pipeline damage the economic viability of coal-hauling railroads? The issue raises questions concerning the unequal regulatory frameworks that govern rail and pipeline rate-setting.
- Should railroads be permitted or encouraged to enter into long-term contracts with coal shippers (as pipelines would do)?

- Should Federal power of eminent domain be extended to coal slurry pipelines projects? This question contains a host of issues which must be weighed before a decision whether or not to grant the power is made. Some of the prominent issues include:
  - Water availability for pipeline use.
  - Environmental impacts of pipelines, particularly at sources and destinations.
  - Traffic and revenue impacts on competing railroads.
  - Comparative costs of pipeline versus unit train service.
  - Large coal slurry pipelines, being "one-stop" movers of coal, may pose potential distribution capability limitations.

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