Externality Issues and Coal Transportation

PHILIP R. SMITH

The search for domestic energy sources capable of meeting current and expected energy demand has led to a reexamination of the potential use of U.S. coal resources. The changes expected in coal production and patterns of coal transport during the 1980s is examined, existing and expected constraints on the road and rail transportation of coal are identified, and criteria for the development of taxing and allocative mechanisms to mitigate transport-related externality problems are proposed. The problems associated with coal transportation are seemingly neither complex nor difficult to remedy because they do not involve insurmountable physical, technological, environmental, or economic obstacles. But closer scrutiny reveals that the coal-transport issue comprises several unique societal problem sets that are without a single policy solution that does not generate additional problems. To date, neither market nor state financial and allocative mechanisms have provided a satisfactory answer to the politically charged question of who pays and who benefits from the transport of coal. It is concluded that (a) allocative mechanisms can and should be tailored to the scope and character of each particular public coal-transport need; (b) the realization of national policy objectives of increased coal production and energy efficiency is more likely if the total cost of producing, transporting, and converting coal is passed through to the ultimate consumer; and (c) the political acceptability of separate highway and rail allocative mechanisms will tend to be reinforced by distinct modal-related taxes even if the same tax mechanism is used in each of the two types of coal-transport problems.

During the past decade the United States has experienced disruptive changes in the supply of fossil fuels: Domestic production of oil and gas began to decline, the importation of crude oil grew from about one-eighth to one-half of total domestic oil consumption, and the price of imported crude oil grew about 15-fold. Although the nation's response to the growing vulnerability to supply constraints and the rising cost of fuel has been slow, new patterns of energy supply and demand are expected to emerge during the coming decade. The search for domestic energy sources capable of meeting current and expected energy demand has led to a reexamination of the potential use of U.S. coal resources. Whether coal can be a viable substitute for oil and gas will depend ultimately on its acceptability and price per comparable unit of usable energy. Because coal is bulky, transportation costs represent a significant part of the delivered price. Thus, this paper focuses on the role of the nation's highways and trains in either accommodating or constraining the use of the abundant domestic stock of coal.

A comprehensive systems analysis of the role of coal as an energy substitute for oil and gas would raise such fundamental questions as (a) Does the United States need coal and, if so, in what quantities? and (b) What, if any, responsibility does government have in fulfilling the need for coal? While such analyses should be undertaken before any serious commitment to increasing coal production, a complete systems analysis is beyond the scope of this paper. The focus here is the consideration of selected problem sets associated with the transportation of coal. More specifically, the question to be investigated may be stated as follows (1): If it is determined that increased coal production is in the national interest, then what existing and potential limitations do U.S. highways and railroads place on the movement of coal, and what are the possible policy resolutions? In an effort to address such questions, I will review the changes expected in coal production and transportation patterns during 1980-1990, characterize existing and expected highway and rail transportation externalities, survey policy options for alleviating coal-transportation bottlenecks, and advance policy criteria for the development of taxing and allocative mechanisms to mitigate coal-transportation externalities.

Externalities may exist where the price system fails to register all of the costs or benefits associated with the production and consumption of certain goods and services. This analysis seeks to highlight societal costs associated with the transportation of coal and not directly borne by either the suppliers or consumers of coal.

EXPECTED SHIFTS IN ENERGY-USE PATTERNS

An analysis of the capacity of the nation's transportation network to distribute coal must take into account changes expected in the patterns of energy use as well as regional shifts in the production and consumption of energy. According to a 1980 preliminary report to the President by the U.S. Departments of Energy and Transportation (2), significant changes in the patterns of energy use are expected over the next 10-15 years. Of the 73 quadrillion British thermal units (BTUs) of energy consumed in 1975, 45 percent were consumed as oil, 21 percent as coal, 28 percent as natural gas, and the remainder were derived from other sources (e.g., nuclear and hydroelectric). By 1990 energy use is expected to increase to 104 quadrillion BTUs, with oil accounting for 39 percent, coal for 30 percent, and natural gas for 19 percent.

Although coal production is expected to increase in both the eastern and western regions of the United States, the biggest increases are forecast for the West. This has significant implications for road and rail capacity within each coal-producing region and along coal-transportation corridors. The increased transportation of western coal, which is moved by rail and water, is forecast to increase sixfold between 1975 and 1990, while Appalachian coal traffic will just about double.

Although only minor domestic western coal transportation limitations are forecast before 1990, rail capacity can be expected to be more strained in the Powder River Basin in Wyoming and Montana on through Nebraska to Missouri; from Montana and Wyoming to Superior, Wisconsin; and from Utah east and south. The most serious constraints on the transportation of eastern coal are expected to result from further deterioration of coal-haul roads in Pennsylvania, Kentucky, and West Virginia.

POTENTIAL COAL-TRANSPORTATION CONSTRAINTS

Given the regional patterns expected in coal production and movement, the greatest coal-traffic congestion over the next decade is likely to occur in the western and midwestern regions of the United States because of inadequate rail capacity and the externalities of increased coal-train traffic. Although the supply of rail capacity is beyond the scope of this paper, note that the capacity issue primarily turns on whether the major coal-hauling railroads will have adequate incentives to meet required net investments in rolling stock, track, and fixed plant.

Rail-Related Externality Issues

Notwithstanding the potential for rail-capacity constraints on increasing coal traffic, the most serious limitations on expanded coal-train traffic are expected to result from the negative effects

experienced by communities the coal trains will pass through. The greatest public outcry can be expected along the rail corridors for western coal. Although the 1990 volume of coal traffic that originates in the West will be only slightly higher than the coal traffic that originates in the East, the coal-haul patterns of the West will affect western and midwestern communities more than communities east of the Mississippi. Most western coal moves the greatest distances by rail, whereas eastern coal moves by modal combinations of truck, barge, and rail. Although at present total units and volume of coal that move by train are greater in the East than in the West, by 1990 total coal ton miles by rail are expected to be about 2.5 times greater in the West than in the East. Western coal will also tend to travel fewer rail corridors for longer distances and more frequently than eastern coal, on unit trains of 100 cars.

It coal-traffic projections for 1990 become a reality, then community life for western and midwestern towns could be negatively affected in a variety of ways. These include the impedance of highway traffic, the impedance of emergency vehicles, more road and rail accidents, the severance of community services, fewer possibilities of economic growth, and environmental deterioration that results from increased noise, dust, and vibration. In the absence of viable policy resolutions, the affected communities might take action that would impede the flow of coal traffic and thus reduce the efficiency of coal movement (3).

Coal-Haul Road Issues

Although railroads and barges dominate long-distance coal moving, trucks play vital roles as collectors and distributors. Although only 11 percent of total coal moved is carried directly from mine to market by truck, almost three-quarters of all coal shipped is shipped by truck for a portion of the trip. Trucks are particularly cost efficient for short-lived strip mines where it is too expensive to build a rail spur to the mine. Moving coal by truck is of special significance in the eight coal-rich Appalachian states that currently produce some 60 percent of the nation's coal. More than 75 percent of the total miles of coal-haul roads are in the eight Appalachian coal-producing states; Pennsylvania and Kentucky have 47 percent of the total of the coal-haul roads.

Currently, much of the eastern coal-haul road network is in a deteriorated condition. The transportation of coal over deteriorating roads entails high operating costs, the operation of heavy equipment at low speed, higher accident rates, illegal overloads, deterioration of environmental quality, and reduced safety and transportation efficiency for the general public in the coal communities. Most of the coal roads were not built to withstand the volume and weight of today's coal trucks. Since 1959, the average capacity of coal trucks has doubled and by 1985 it is expected to be even greater.

Even though considerable attention has been devoted to existing and potential state and federal constraints on moving coal by road, federal policy, to date, has assumed that the problem is primarily a state and local one. Unfortunately, the states whose coal hauling roads are in the poorest condition have tended to allocate state and federal road-repair funds to more densely populated areas, to the detriment of the sparsely populated coal-haul communities. In the absence of a program to construct or reconstruct and maintain safe and efficient coal-haul roads, road deterioration is likely to make for more expensive Appalachian coal, which has regional and national implications.

POLICY OPTIONS FOR REDUCING COAL-TRANSPORT EXTERNALITY PROBLEMS

Although no single policy option can be expected to alleviate coal-transportation externality problems without some economic and political disadvantages, a number of alternative financial and allocative options have been considered as possible remedies. This section surveys several of the most frequently mentioned policy mechanisms for reducing road and rail problems.

Overview of Rail-Related Policy Options

Considerations of policy that would mitigate the detrimental effects of increased coal-train traffic on communities have produced a range of low- and high-cost alternatives. Included among the proposed remedies are (a) the installation of safety devices, (b) the institution of staggered working hours within the affected communities, (c) train scheduling to reduce congestion during rush hours, (d) train separations to allow the passage of emergency vehicles, (e) the relocation of rail lines to bypass towns, and (f) land use planning. The available evidence (4) suggests that for some affected communities a low-capital solution is possible. For other communities, high-cost remedies such as the construction of rail and highway grade separations would provide the most efficient means of avoiding community traffic congestion and the impeding of coal movement. Unfortunately, as of now, there is no local, state, or federal consensus on how to finance the estimated $643 million to $2 billion that would be required to build such grade separations (information from an unpublished draft report, Costs and Benefits of Western Rail/Highway Grade Crossing Improvements, Transportation Systems Center, U.S. Department of Transportation, January 1980).

Even though the coal-producing states are empowered to levy coal severance taxes [see Table 1 (2, p. 73)], the state coal severance tax mechanism does not provide an adequate remedy for the traffic congestion problems of non-coal-producing "bridge" states through which coal trains pass. Several western coal-producing states have enacted hefty coal severance taxes that have no apparent rationale beyond increasing state revenue (5). Montana's 30 percent coal severance tax was legally challenged by a coalition of western mining and northeastern-midwestern coal-consuming interests. In June 1981, the U.S. Supreme Court upheld Montana's right to levy the severance tax. In effect, the Court ruled that the state severance tax is not a restriction of interstate commerce if a severance tax is "fairly" applied to both in-state and out-of-state taxpayers. The question of what constitutes an excessive state severance tax was not resolved by the Court. Coal-consuming interest groups that consider the severance tax rates of Montana and Wyoming (17 percent) confiscatory have appealed to Congress to limit the amount of state severance taxation of coal. Legislation has already been introduced in the U.S. Senate to put a ceiling of 12.5 percent on severance taxes imposed on coal mined on federal lands (6).

Even if the legal challenges were resolved, the state coal severance tax mechanism does not provide a uniform remedy for interstate coal-train problems. Since there are significant variations in the financial needs generated by coal transportation within each affected state, some coal-producing states are reluctant to use the state coal severance tax to finance coal transportation improvements because of the potential impact on the competitive

Table 1. Coal taxes and receipt distribution, by state.

State	Tax			Receipt Distribution (%)		
		Rate				
	Type	Cents per Ton	Percent	General Fund	County	Other
Alabama	S	13.5				100[a]
	S	20			100	
Arizona	S		2.5 (gross proceeds)			100[b]
	I		5.5 (income)	100		
Arkansas	S	2		25	75	
	Sales		3	100		
Colorado	S	60 (surface)			100[c]	
	S	30 (deep)			100[c]	
Georgia	NA					
Illinois	Sales		5	80	20	
Indiana	NA					
Iowa	NA					
Kansas	NA					
Kentucky	S		4.25 (market value)	100		
Maryland	S	15		6	47	47[d]
Missouri	S	0.2				100[e]
Montana[f]	S		35			
Nebraska	NA					
New Mexico	S	38 (steam)		100		
	S	18 (met)		100		
	Excise		0.93 (value)	82		18[g]
North Dakota	S	65		30	20	50[h]
Ohio	S	4				100[i]
Oklahoma	NA					
Pennsylvania	NA					
Tennessee	S	20			97	3[j]
Texas	NA					
Utah	NA					
Virginia	S		1		100	
Washington	Other[k]		5.5664	91	9	
West Virginia	S		3.85	91	9	
Wyoming	S		16.8	62	38	

Note: S = severance tax, and I = income tax.

[a] State Dock Facilities Trust Fund.
[b] Education.
[c] Most but not all receipts; the rest are unaccounted for.
[d] Research and reclamation.
[e] Finances the Missouri State Mine Inspection Department.
[f] Montana allocates its receipts as follows (%): coal tax permanent trust fund, 50.5; local impact and education trust, 18.75; general fund, 19.5; and various other uses, 12.25.
[g] Supports the Energy Resources Board.
[h] Grants and loans to impacted communities.
[i] 75 percent from strip-mine reclamation, 25 percent for oil and gas well plugging.
[j] Administrative costs.
[k] Tax on extractive resource production.

position of coal in each coal-producing state. Some bridge states have also considered a carrier tax as a possible source of revenue for grade-separation and grade-crossing improvements. Nebraska's carrier tax, however, is currently under court challenge.

Several sources of federal funding have also been proposed. The federal Highway Trust Fund can be and has been used to assist states to construct grade separations. But such assistance is likely to be very limited unless states are given greater discretion in how to use the fund. Currently, states do not qualify for this assistance to construct grade separations unless it is demonstrated that a crossing is unsafe. Generally, grade separations have had a poor cost/benefit ratio compared with other existing highway safety measures.

The use of the Highway Trust Fund might also be expected to lead to objections that highway users are being forced to subsidize coal users. State gasoline tax proposals would tend to meet with similar objections.

Federal general-revenue financing has also been mentioned as a possible source of financing for such construction. Although general-revenue financing would avoid many of the difficulties associated with matching revenue with specific needs, it would force coal-transportation needs to compete with other allocative demands. Thus, the continuity of funding would be in question. The general-revenue tax mechanism also fails to meet the taxation principle--the user pays.

Another possibility is the imposition of a federal coal severance tax similar to the existing national severance taxes levied to fund black lung and mine reclamation programs. The national coal severance tax, unlike the state severance tax, could be imposed on coal uniformly and would influence coal's competitive position vis-à-vis oil and gas. The extent of the national severance tax effect would depend on the size of the tax. Another alternative often mentioned is a federal coal utility tax (or coal converter tax) that would also meet the user-pays principle by passing the transportation costs (and all other costs) to the ultimate consumer.

Overview of Coal-Haul Road Policy Options

As previously indicated, the coal-haul road externality problems are concentrated in the eastern coal-producing states. The estimated cost of improving the entire coal-haul road system to the standards of the American Association of State Highway and Transportation Officials could be as high as $21 billion for the years 1977 to 1985. The total cost would be less if road improvements are restricted to high volume non-Interstate coal-haul roads. Table 2 (2, p. 72) depicts the estimated improvement costs by state.

Some eastern states have tended to subsidize

Table 2. Improvement needs of coal-haul roads, 1977-1985.

State	Improvement Costs: Full Standards[a] ($000s, 1977)	Improvement Costs: Reduced Standards[b] ($000s, 1977)
Alabama	536 289	61 054
Colorado	42 049	3 468
Illinois[c]	192 614	36 982
Indiana	810 651	70 226
Iowa[c]	287 150	55 133
Kansas	151 435	26 863
Kentucky	4 404 499	844 709
Maryland[c]	469 939	90 228
Missouri	673 885	151 063
Montana	12 828	7 000
New Mexico	164 028	56 401
New York	418 119	1 637
Ohio	1 307 774	175 561
Oklahoma[c]	217 612	41 782
Pennsylvania	7 072 163	1 748 205
South Dakota[c]	11 472	2 203
Tennessee	620 674	96 727
Utah	144 186	107 425
Virginia	317 386	33 539
West Virginia	2 699 974	331 522
Wyoming[c]	54 337	10 433
Total	20 609 064	3 952 161

[a] Cost of improving the entire coal-road system to full standards.
[b] Cost of improving the high coal-truck volume non-Interstate system roads with payment deficiencies to reduced standards.
[c] Federal Highway Administration estimates. All other values are based on state estimates.

their coal by failing to levy adequate coal taxes to the building and repairing of coal-haul roads. Just as the state severance or gasoline taxes hold limited promise as remedies for coal-train problems, such mechanisms are unlikely to offer the total financial solution of the coal-road problem.

Federal funding through the Highway Trust Fund could provide additional funding relief, subject to modifications of regulations for the allocation of federal-state matching revenues for highways, or of the federal aid apportionment ratios, which might apportion funds according to coal-production or transportation needs. However, the expected shrinkage of the Highway Trust Fund combined with the reluctance of the affected eastern coal-producing states to exercise the political will necessary to raise taxes and/or reallocate highway funds according to the coal-road needs suggest that road problems will not be wholly overcome through the Highway Trust Fund.

For coal-road improvements (as with coal-train problems), federal carrier taxes, general-revenue financing, and severance and utility taxes are potential financing mechanisms. However, the concentration of the coal-road problem in three eastern coal-producing states that have so far shown little incentive to resolve the problem tends to complicate the development of politically acceptable federal tax and allocative mechanisms.

POLICY CRITERIA

The overviews of frequently mentioned policy options for financing the solution of coal-transportation externality problems suggest the need to develop specific criteria for the selection and assessment of taxing and allocative mechanisms. Although the following discussion does not pretend to represent a comprehensive analysis of all the important financial issues related to the alleviation of coal-transportation externalities, it will, I hope, identify some of the considerations relevant to the formulation of criteria for the allocation of federal funds.

Tax Mechanism Considerations

Any federal tax scheme designed to foster the transportation of coal should include, at a minimum, the following: facilitation of tax administration, equity of tax incidence, consistency of the tax with national and regional objectives, and adequacy of revenues generated (information from an unpublished memorandum, Coal-Haul Impact Issues, Transportation Systems Center, U.S. Department of Transportation, November 16, 1979).

A tax that meets the ease-of-administration criterion would tend to avoid a probable legal challenge, tax those who have the ability to pay (e.g., the tax should be collectible), and be relatively simple to monitor; and the tax base and the amount of the tax should be easily determined. For example, if a national coal severance tax was imposed on mine operators, the tax could prove hard to collect unless the ability of the mine operators to shift the incidence of the tax was taken into consideration. A severance tax on mine operators would also tend to be harder to collect and/or audit than a tax on coal converters (e.g., a utility tax) because mine operators are more numerous and their market entry and exit are more frequent than that of utility firms. A coal tax based on coal produced can be easily administered since data on coal tonnage are easily obtainable. Conversely, total ton-mile data for truck traffic from mine to tipple are not generally available, and their use would therefore complicate tax administration.

Should the burden of coal-transportation taxation be borne by producers, coal transporters, coal consumers, and/or others who directly or indirectly benefit from a national increase in coal production and use? These and other tax-incidence questions must ultimately be settled through the normative judgments of policymakers. If the chief criterion is directly to relate the total costs of producing and transporting coal to the consumer (user-pays principle), then the levying of a federal tax on mine operators or transporters (e.g., a severance or excise tax) may force some of the burden of the tax on certain producers and transporters because they may not be able to pass all of the tax through to the consumer. Conversely, a tax levied on an electric utility can be more easily passed on to the consumer by an adjustment in the cost-of-service mechanism. Thus, a coal utility tax is more likely than a severance tax to shift the incidence of the tax to the ultimate recipient of the benefit--the consumer of electricity.

The selection of the coal-transportation tax mechanism should also consider the balance of national and regional energy, economic, and political objectives. For example, a severance tax levied on mine operators could depress coal production if it displaces marginal producers. This could lower national coal production and hurt the political and business environments of a region. The coal utility tax would not only be consistent with the user-pays principle, but it would also tend to minimize political fallout since the increased costs would be spread across large numbers of users. This is to be contrasted with the federal coal severance tax where the impact on certain regions or coal producers could be greater. Thus, the regional effects could be more economically and politically disruptive.

In order to assure an adequate source of funding to mitigate the problems related to coal traffic, the tax mechanism selected should incorporate a planned level and continuity of revenue that should match funds with financial needs. Although all tax mechanisms can generate too little or too much revenue, some mechanisms are more revenue-to-needs

balanced than others. For example, with a coal tax levied at a fixed amount per ton, there is the possibility that inflation will erode the real dollar value of a coal transportation fund. However, a tax based on the value of the coal--such as an ad valorem excise tax or a sale receipts mechanism--would incorporate inflation protection.

When evaluated against the policy criteria of efficiency, equity, and consistency with national objectives relevant to coal production, the national coal utility tax mechanism offers a comparative advantage over the alternative tax mechanisms discussed. Even though the problems generated by highway and rail traffic have different physical, geographic, economic, social, and political consequences, the coal utility tax has a balance of characteristics necessary to internalize the external costs associated with each of these modes of transportation.

Allocative Mechanism Considerations

The selection of an appropriate coal-transportation tax should be considered in tandem with the choice of allocative mechanisms that will result in a match of coal-tax funds with coal-transportation needs. The criteria for the selection of an allocative mechanism should include some means for measuring transportation-generated needs. The adequacy of the measure is somewhat determined by the mode of transportation and the characteristics of the need. For example, road and rail problems are different enough to warrant separate allocative mechanisms. The needs concentrated in the eastern coal-producing states could be estimated by some measure that relates damage to coal-haul roads with coal production within a specific region or state. Total coal tonnage produced might be considered an appropriate measure for damage to coal-haul roads. Most of the damage to roads that result from the movement of coal trucks is within the producing regions. Bridge states are few in number and have insignificant problems associated with coal-haul roads.

The needs associated with coal-haul roads are in marked contrast with the needs created by coal trains. Coal-train externalities are not damage-to-mode related; instead, the societal cost is manifested through the disruptions that ensue from the coal trains that pass through communities. Thus, total coal produced would not be a good measure of the societal cost. Indeed, the use of a measure of coal tonnage produced (or a measure of ton miles) would provide no funds to bridge states that produce no coal. The needs of coal-train-affected communities could be assessed by such measures as number of trains, number of intersections crossed, population density, volume of cross traffic, number of cities affected, and value of affected property.

Given the differences between road and rail externalities, consideration should be given to distinguishing the needs test for each respective mode. Thus, a total coal-tonnage-produced measure might determine coal-haul road needs, while the effect produced by coal trains could be evaluated by the formulation of some type of community or state needs measure.

CONCLUSIONS

On the surface, the identified transportation-related problems are seemingly neither complex nor difficult to remedy because they do not involve insurmountable physical, technological, environmental, or economic obstacles. But closer scrutiny reveals that the coal-transportation issue consists of several sets of societal problems that are without a single policy solution that does not generate further problems. Thus, anticipated private or public solutions are quickly transformed into a search for policy resolutions that will effect a balance of allocative efficiency, financial and allocative equity, and political feasibility.

The transportation of coal affects the public traffic corridors of both the coal-producing and the non-coal-producing communities (regions and states). To date, neither market nor state financial and allocative mechanisms have provided a satisfactory resolution of the politically charged question of who pays and who benefits from the transportation of coal. Thus, federal intervention seems to be the most promising way of responding to the public needs created by the road and rail transportation of coal.

Previous discussions have suggested the merits of tailoring the public allocative mechanism to the scope and character of each particular public coal-transportation need. National policy objectives of increased coal production and energy efficiency are more likely to be achieved in time if the total cost of producing, transporting, and converting coal is passed through to the ultimate consumer; the tax mechanism most likely to achieve a balance of these policy objectives is a national coal utility tax. The political acceptability of separate highway and rail allocative mechanisms would also tend to be reinforced by a separate coal tax for roads and a separate tax for railways, even if the same kind of tax (e.g., a utility tax) is used for each of these coal-transportation problems. Finally, while the foregoing discussion may have done more to reveal the complexities of coal-transportation issues than to make policy choices easier, the analysis will, I hope, widen the area of informed judgment.

REFERENCES

1. H.H. Landsberg. Energy. In Setting National Priorities: Agenda for the 1980s (Joseph A. Peckman, ed.), The Brookings Institution, Washington, DC, 1980, pp. 119-126.
2. National Energy Transportation Study: A Preliminary Report to the President. The Secretary of the U.S. Department of Transportation and the Secretary of the U.S. Department of Energy, July 1980.
3. Transportation Issues in the 1980s. U.S. General Accounting Office, 1980.
4. Minnesota Department of Transportation; North Dakota State Highway Department. Alternative Solutions to Railroad Impacts on Communities--Phase 2 Summary Report. U.S. Department of Transportation, May 1980.
5. D.E. Ramsett. A Conceptual Model for the Coal Severance Tax. Bureau of Business and Economic Research, Univ. of North Dakota, Grand Forks, North Dakota Economic Studies 24, 1979.
6. A Drive to Cap Severance Taxes. Business Week, July 27, 1981, p. 94.

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