Status, Issues and Impacts Of Coal Slurry Pipelines On Agriculture and Water

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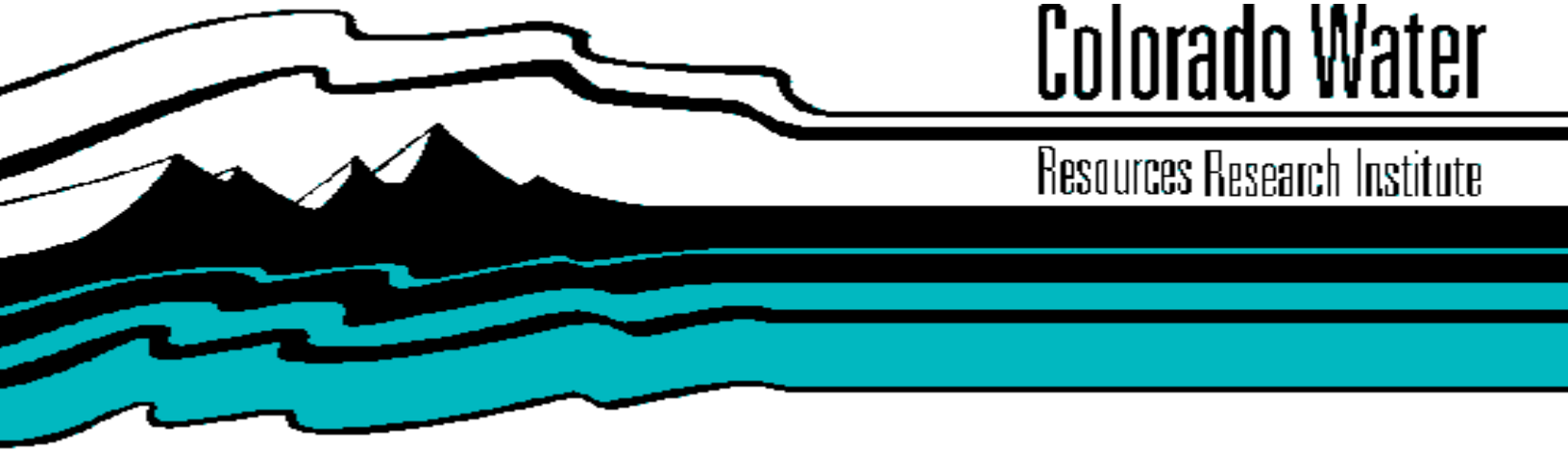
January 1988

Technical Report No. 51



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STATUS, ISSUES AND IMPACTS OF COAL SLURRY PIPELINES ON AGRICULTURE AND WATER

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Initial research was funded in part by the
U.S. Department of Agriculture
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January 1988

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Chapter I

INTRODUCTION

Uncertain petroleum costs and supplies continue to make coal an economical and reliable fuel alternative. Coal slurry pipelines may further lower the cost of coal as a fuel, as well as provide competitive alternatives to some shippers. Increased competition and reductions in transportation rates would decrease the delivered price of coal to the buyer and, ultimately, to the consumer.

Railroads are the primary movers of coal. Since the mid 1970s, railroads have transported approximately two-thirds of all bituminous and lignite coal mined in the United States.[1] During the same period, the rates railroads charge for transporting coal have increased faster than the general rate of inflation and minemouth prices for coal.[2] Some utilities pay more to deliver coal to their power plants than they pay for the coal itself. Many mines have access to only one railroad, thereby becoming captive shippers. Because of these conditions, coal shippers and consumers have been looking for competitive, long-distance transportation alternatives for coal. Coal slurry pipelines have been proposed as a viable alternative to the rail transportation of coal, but not without considerable debate and resistance. Proponents of coal slurry pipelines claim that pipelines are reliable, safe and economical.

Others doubt these claims. A variety of economic, environmental and legal questions have been raised over the construction and operation of slurry pipelines. The primary issues of concern in this report are pipeline eminent

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1 Association of American Railroads, Economics and Finance Department, Railroad Ten-Year Trends, Vol. 1 (Washington, D.C., 1984) Table III-C-8.

2 U.S. Department of Labor, Bureau of Labor Statistics, Producer Prices and Price Indexes, Coal and Railroad Coal Freight.

domain, water rights and scarcity, environmental impacts on land and water quality and economic competition with railroads. Each of these issues is discussed, particularly as they relate to agriculture. The major issue in building coal slurry pipelines is the acquisition of rights-of-way across many railroads. The power of eminent domain is critical to this issue in order to avoid lengthy negotiation and legal battles over each crossing. Railroads in the East own most of their lands in fee simple, i.e., total ownership rights, both surface and underground. This type of ownership makes eminent domain a necessity in order to obtain rights-of-way. In the West, railroad ownership is not as comprehensive and, thus, rights-of-way can be obtained through costly and time consuming negotiation and litigation. Rights-of-way across Federal lands can be obtained under the Federal Land Management and Policy Act of 1976.

Many bills have been introduced since 1960 to grant Federal eminent domain to slurry pipeline constructors. All except one have failed to pass either House of Congress; only one has passed the Senate (1974). These bills are summarized in this report. Current bills in Congress are also discussed. State water laws and rights, environmental impacts and economic competition with the railroads have all played major roles in the debate over eminent domain for coal slurry pipelines. These issues are discussed following an overview of coal slurry transportation.

An extensive bibliography has been compiled from an array of reference sources to support more detailed research. The bibliography concentrates on the resource, economic and legal aspects of coal slurry pipelines. The last chapter provides an abbreviated list of references by subject area to provide direction in further research. Some technical references are included describing the design, construction and operation of slurry pipelines.

The vast literature detailing the engineering, fluid mechanics and chemical interactions has been excluded from this bibliography but is available from other sources. Most of the references are available from the publishing agency.

CHAPTER II

COAL SLURRY TRANSPORTATION

The large demand for coal by electric utilities and the high cost of rail transportation has prompted the proposal of several coal slurry pipelines. Coal slurry pipelines can be used as an alternative to, or in conjunction with, rail transportation.

Existing and Proposed Pipelines

More than thirteen pipelines have been proposed but only one (Black Mesa) is in operation. Table II-1 shows planned and existing coal slurry pipelines in the United States, including origin, destination, capacity, distance and status. All but two of these pipelines propose to use a coal-water slurry. Western Resource Transport and Southwest Public Service propose to use liquid CO_2 as the carrier medium. Several other pipelines have also been proposed using mediums other than water or liquid CO_2. However, they are either in the preliminary stages of planning, on hold, or cancelled. Figure 1 is a map showing the routes of some of the proposed pipelines. These routes originate in the major coal producing regions and extend to other transportation modes (barges) or to specific utilities. Each of three pipeline alternatives is summarized in a recent report by the Energy Information Administration.[1] The relative economic advantages of the railroad and pipeline modes of coal transport are determined by:[1]

* volume shipped,
* anticipated rates of inflation,

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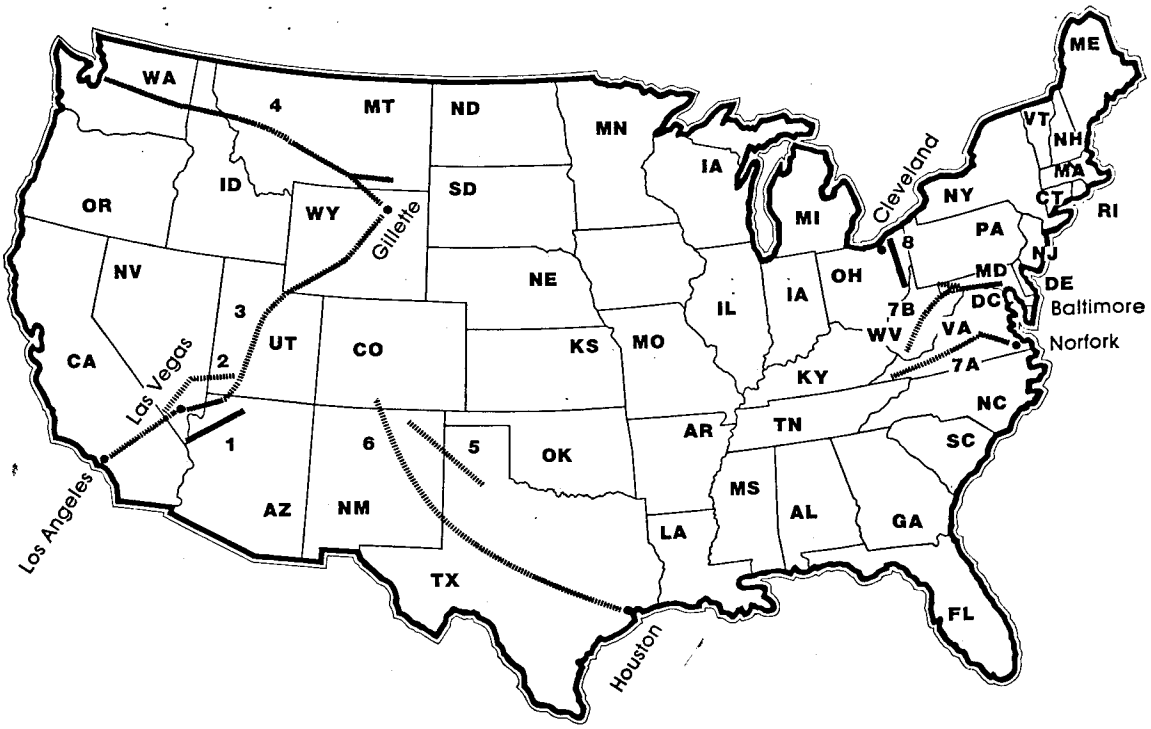
1 U.S. Department of Energy, Energy Information Administration, Coal Slurry Pipelines: Impact on Coal Markets, DOE/EIA-0468, Washington, D.C., April, 1985.

Table II-1 Planned and Existing Coal Slurry Pipelines

Name	Origin	Destination	Distance Miles	Coal Capacity Million Tons/yr	Status
Alton Pipeline (Allen-Warner Valley)	Utah	Nevada	183	11.6	Proceeding
Atlantic Coast Pipeline Associates	A) Virginia	Export (Virginia)	400	15	Proceeding
	B) W. Virginia	Export/Maryland	375	15	Proceeding
Black Mesa	Arizona	Nevada single delivery	273	4.8	Operating
CoalStream	Illinois,Ky Ohio, W. Va	Florida/Georgia multiple delivery	1500	15-45	On hold
ETSI Pipeline	Wyoming	Arkansas/Louisiana multiple delivery	1378	25	Cancelled 7-84
Houston NG.CO/ San Marco Pipeline	Colorado	Texas multiple delivery	900	10	On hold
Northwest Energy	Wyoming	Oregon/Export single delivery	1100	25	Proposed
Ohio Pipeline	Ohio	Ohio	106	1.3	Shut down
Pacific Bulk	Utah	Export	650	10	Cancelled
Powder River	Wyoming	Great Lakes/Export	1300	25-36	Cancelled
Southwestern P.S.	New Mexico	Texas	300	3	Proceeding
Texas Eastern	Wyoming	Texas single delivery	1260	22	Planning
Western Resource Transport*	Wyoming/Utah	Export	1180	10-20	Proposed

Sources: Slurry Technology Association, Stuart Serkin, 1800 Connecticut Ave. N.W., Washington, D.C. Electric Power Research Institute. Coal Slurry Pipelines: A Review and Analysis of Proposals, Projects, and Literature. August 1982. pp. 1-16. *Liquid CO_2 proposed as carrier medium.

Figure 1. Proposed Coal Slurry Pipelines



EXISTING ━━━
PROPOSED ═══

U.S. Coal Slurry Pipeline Systems	Length	Annual Capacity (Tons)
1. Black Mesa	273	4,800,000
2. Allen-Warner Valley	183	11,600,000
3. Western Resource Transport*	1,180	10,000,000
4. Pecten Pipeline	1,100	10-20,000,000
5. Southwest Public Service*	300	3,000,000
6. San Marco	900	10,000,000
7. Atlantic Coast Coal Pipeline Associates		
A. Viginia line	400	15,000,000
B. West Virginia to Maryland line	375	15,000,000
8. Ohio	108	1,300,000

* Proposes to use liquid CO_2 as the carrier medium.

Source: Adapted from information provided by the Slurry Technology Association

* rates of return on debt and equity,
* geographic concentration of supply and demand,
* geophysical characteristics of the market region,
* water availability and cost,
* costs of power and transportation fuels and the energy efficiency of alternative modes,
* physical condition and economic efficiency of existing modes,
* proximity of navigable waterways, and
* regulatory environment.

The Black Mesa pipeline has been in operation since 1970 and is transporting coal reliably and economically. Since it is the only operating coal slurry pipeline in the United States, the operating characteristics are used extensively for estimating technological requirements, costs and the feasibility of proposed pipelines.

The recent cancellation of the ETSI pipeline, after eleven years of planning and 145 million dollars of investment, is expected to be a major blow to other proposed pipelines. The ETSI pipeline was seen to be the most likely to succeed of all the proposed large coal slurry pipelines. Failure of the project is attributed to the slack demand for coal and increased costs and delays resulting from railroad opposition to rights-of-way. In addition, ETSI lost a major supply contract with Arkansas Power and Light Company to Chicago and Northwestern Railroad. ETSI has brought suit against the railroads for blocking construction of their coal pipeline.[2]

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2 Wall Street Journal, Bryan Burrough. "Plans for 1,800 Mile Coal-Slurry Pipeline are Cancelled by Texas Eastern Venture," August 2, 1984.

Table II-2. Summary of Commercial Solid-Liquid Pipelines

Location	Solid Materials	Length	Pipeline Diameter	Capacity
		Miles	Inches	Million tons per year
Black Mesa, Arizona	Coal	270	18, 12	5.8
Cadiz, Ohio (deactivated in 1963)	Coal	108	10	1.3
Nerovolynskaya, U.S.S.R.	Coal	38	12	1.9
Lorraine, France	Coal	6		1.5
Emile Muchet, France	Coal	5.6		
Carling, France	Coal	5.5	15	2.2
Poland	Coal	130	10	
Russia	Coal	40	10	1.8
France	Coal	6	16	1.5
Bonanza, Utah	Gilsonite	72	6	.38
Rugby, England	Limestone	57	10	1.7
Australia	Limestone	55		.45
Columbia	Limestone	5.9	8	.57
Calaveras, California	Limestone	17.4	7	2.0
Savage River, Tasmania	Iron Ore	53	9	2.2
Argentina	Iron Ore	20	8	2.1
North Korea	Iron Ore	61		4.5
Pena Colorado, Mexico	Iron Ore	30	8 5/8	1.8
Waipipi, New Zealand	Iron Sands	6	8, 12	1.0
El Salvador, Chile	Copper Ore	14	6	800 tons/day
West Irian, Indonesia	Copper Concentrate	69	4 1/2	0.3
Bouganville, Indonesia	Copper Concentrate	17	6	1.0
Turkey	Copper Concentrate			135 tons
Pinto Valley, Arizona	Copper Ore Concentrate	11	4	0.4
Japan	Copper Tailings	40	8	1.0
South Africa	Gold Tailings	21.5	6, 9	1.05
Sandersville, Georgia	Kaolin, Clay	70	18	200 tons/day
Akita, Japan	Mining Waste	44.1	12	0.5
Gardanne, France	Mining Waste	29.8	9, 12	135 tons
Western U/S.	Mining Waste	4.3	4	0.1
Kagoshima, Japan	Earth	4	24	25,000 C.Y./day
Canada	Sulphur/Hydro-carbon	800	12, 16	
Kudremukh, India	Iron Ore	40	18, 16	7.5

Source: Skelly and Loy, A Report on the Assessment of Coal Slurry Pipelines, Vol. 2, Main Report, June 1981, p. 4.

Coal slurry pipelines are still believed to be economically viable and the commercial operation of slurry pipelines has been proven to be feasible in many countries. Table II-2 shows the location, material transported, distance and capacity of other commercial slurry pipelines worldwide.

Most of the debate in the United States does not center on technical feasibility but is related to the issues of water consumption, eminent domain (rights-of-way), environmental impacts and competition with railroads. These issues are discussed in the next chapter. First, however, we discuss a pipeline being debated, followed by a discussion of the various components of slurry technology.

Virginia Coal Associates

The Virginia Coal Associates Pipeline project is owned equally by Dominion Resources, Inc. (owners of Virginia Electric and Power Co.), A.T. Massey Coal Company (owned by Royal Dutch Shell Petroleum and Fluor Corporation), and Transco Energy of Houston. Under various conditions proposed, the Virginia pipeline would transport between 5 and 25 million tons of coal per year in a 48/52 coal/water slurry from southwestern Virginia to Hampton Roads in extreme southeastern Virginia, near the mouth of the Chesapeake Bay. Depending on the exact route selected, the pipeline would span 340 to 412 miles.

The topography in this project creates a slightly higher cost per ton-mile than most of the other pipeline proposals. The topography ranges from mountainous, extreme maximum slope to coastal flood plain.

Water for the Virginia coal pipeline--2,000 to 24,000 acre feet per year--would come from the Clinch River below Cleveland, Virginia, in the Tennessee Basin and from reservoirs in the Big Sandy Basin. Either source would provide

an adequate supply with the least interference with competing water uses.[3]

In effect, as is common with other proposed eastern coal slurry pipelines, water availability poses little real problem. Also no identifiable problems with contamination beyond the capabilities of conventional water treatment methods are foreseen. Slurry waste water would be reused or recycled into the pipeline, depending on economics and local laws.

Setting off Virginia, however, in the coal slurry controversy are two particular aspects. First of all, Virginia is the only State with a statute that specifically prohibits the granting of eminent domain rights-of-way for coal slurry pipelines. On the basis of three feasibility studies recently completed regarding the coal slurry pipeline transport of Virginia coal, legislation was introduced in early 1984 in the Virginia Assembly to remove the coal slurry pipeline exclusions from Virginia statutes. However, in January 1985, the House of Delegates rejected the bill.

Second, the Virginia pipeline proposal appears to be the only proposal, so far, in direct response to competitive challenges from another State--specifically, West Virginia. A coal slurry pipeline that could reduce the delivered price of Virginia coal could assist Virginia in becoming more competitive with coal from West Virginia and Kentucky and in counteracting plans for a pipeline to be built from West Virginia to east coast ports.[4]

Slurry Technology

Proposed coal slurries are a mixture of pulverized coal with either water, methanol, fuel oil or liquid carbon dioxide. Most coal-water slurries are

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3 BDM Corporation, Virginia Coal Slurry Pipeline Study Final Report, p. IX-37.

4 Virginia Society of Professional Engineers, Virginia Coal Transportation Study pp. 80, 88.

proposed to be a fifty-fifty mixture. Some companies are actively marketing the technology for the direct combustion of finely ground coal-water slurries. Proposed mixtures for direct combustion are 75 percent coal, 25 percent water with patented additives. These slurries would be combusted using equipment similar to that used for residual fuel oil. No dewatering would be required removing concerns over water treatment. A slurry line using this technology is under construction in the Soviet Union and is projected to begin deliveries in 1988.

Aqueous coal slurries are of primary interest because they are the most likely to be developed, the least cost, and have the greatest potential for agricultural impacts.

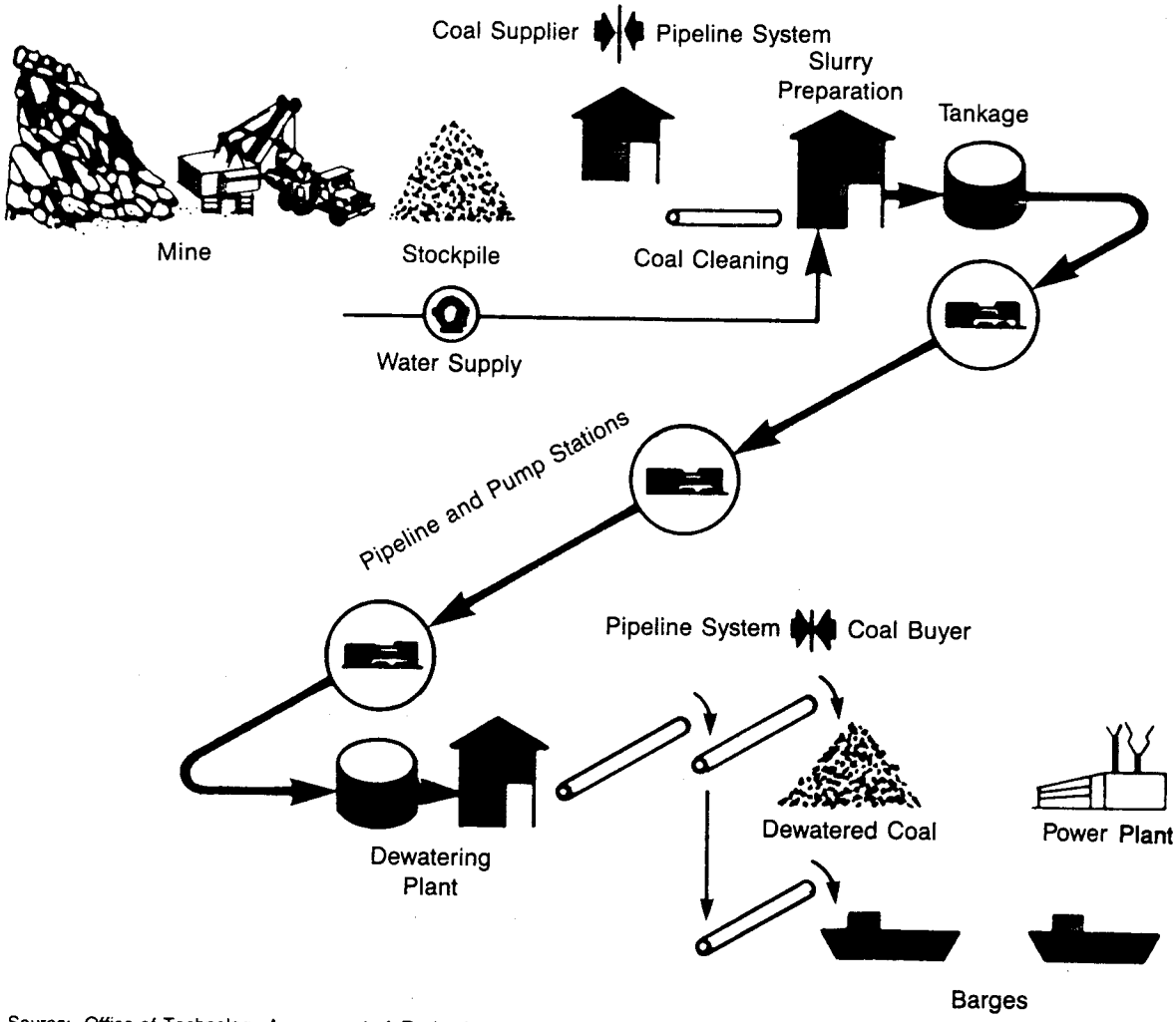
The basic components of a slurry transport system are: 1) preparation of the slurry, 2) transmission, and 3) delivery/dewatering. The subparts are broken into the following processes and components.

1) Slurry preparation
   - Coal and water storage
   - Crushing
   - Mixing
   - Slurry storage

2) Transmission
   - Pipeline
   - Monitoring slurry mixture
   - Pump stations
   - Water storage ponds
   - Dump ponds

3) Delivery/Dewatering
   - Slurry storage
   - Settling ponds
   - Centrifuge/filtration
   - Drying
   - Storage
   - Water treatment

Each of these components is discussed below and shown in Figure 2.



Source: Office of Technology Assessment, *A Technology Assessment of Coal Slurry Pipelines* (Washington, D.C., March 1978), p. 29.

Figure 2. Basic Components of a Slurry Transport System

Slurry Preparation

Coal is mined and then transported to a central point where it is crushed to a particle size of one-eighth inch (mesh 14) or less. Crushing is required to fluidize the coal slurry mixture. Coal fines (very small particles) are undesirable because of problems they create in dewatering. The crushed coal is then mixed with the transport medium to form the slurry. Water, oil, methanol and liquid CO_2 have been proposed as transport mediums. The choice of a transport medium depends on availability, cost and final utilization. A coal-water (50/50) slurry must be dewatered at the destination whereas the coal-oil or coal-methanol slurries are used directly in combustion. Oil and methanol slurries are considerably more expensive and have the potential for more serious environmental impacts. Liquid CO_2 is normally expensive but may be obtained as a by-product from local gas wells. Table II-3 shows the concentration mixtures most frequently proposed for each medium. Some pipeline projects have proposed using as little as thirty percent water while others have proposed as much as eighty percent water by weight. Water resource requirements are discussed later in this report. The lower water concentration slurries cause more pipeline and pump abrasion, thus reducing the life of the system. A fifty-fifty slurry by weight is most often proposed. The slurry is held in storage tanks until fed to the first pump station. The storage tanks are equipped with agitators to prevent settling of the coal particles.

Transmission

Slurry from the storage tanks is fed to the first pipeline pump station. The slurry is monitored for proper density and may be further diluted at this point. The pumps utilized for slurry transportation are either centrifugal or positive displacement. Generally speaking, centrifugal pumps are capable of

Table II-3. Coal Slurry Concentration, by Medium

	Medium			
	Water	Methanol	Fuel Oil	Liquid CO_2
Slurry Concentration Coal by weight (Pct.)	49	49	30	80
Pounds of Coal per ton of slurry	980	980	600	1,600
Pounds of Transport Medium per ton of slurry	1,020	1,020	1,400	400
Total Heating value of Slurry Mixture (Million Btu/Ton)[a]	12.54	22.54	34.92	20.45

a Assumptions: Coal 12,800 Btu/lb. dry
Methanol 9,800 Btu/lb.
Fuel Oil 19,460 Btu/lb.

Source: Skelly and Loy Systems Consultants, Inc. Report on the Assessment of Coal-Slurry Pipelines. Volume II. Main Report. U.S. Department of Energy, No. DOE-EI/11268-T4-V.2, June 1981, p. 77.

handling high rates of flow but at discharge pressures lower than displacement pumps. Centrifugal pumps can also handle larger particle sizes. Positive displacement pumps can generate high discharge pressures and typically operate at higher efficiencies. Higher pressure and efficiency make the positive displacement pumps desirable for long distance transport.[5] The Black Mesa pipeline utilizes positive displacement pumps with a normal discharge pressure of 1000 psi. The slurry speed is approximately 4 miles per hour through an 18

5 California Institute of Technology, Jet Propulsion Laboratory. Assessment of Saline Water Use in Coal Transport and Multipurpose Systems, Final Report. Prepared for Bureau of Reclamation, U.S. Department of Interior, December 1982, pp. 2-21.

inch pipeline.[6] Slurry speeds of 3 to 5 miles per hour have been proposed for other pipelines. Slow velocities are desirable from the standpoint of pipewear but the velocity must be high enough to prevent deposition. In addition, turbulent flow is generally necessary to prevent settling. General practice has been to design the system so that the slurry velocity exceeds the deposition velocity by at least 30 percent, thus creating a margin of safety.[7]

Pump stations are usually located every 50 to 150 miles along the pipeline, depending on slurry medium and terrain, to maintain adequate pressure and to handle emergencies. Water storage and emergency dump ponds are located at each pump station in case of shutdown or pipeline breaks.

Delivery/Dewatering

At the terminus(es) of the pipeline are slurry storage and separation facilities. The storage tanks supply slurry to the dewatering facilities. Dewatering may be accomplished using settling ponds, filtration or centrifuges. Finely ground coal still suspended in the water may be removed by chemical flocculation. The coal is dried and then stored, shipped or directly utilized. Water treatment is usually required before its disposal or use in cooling towers or for some other purpose. General water slurry pipeline parameters are provided in Table II-4 for four coal quantities.

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6 M. Rieber and S. L. Soo, Coal-Slurry Pipelines: A Review and Analysis of Proposals, Projects and Literature, Prepared for Electric Power Research Institute, Final Report No. EPRI/EA-2546, August 1982, pp. 2-8.

7 California Institute of Technology, Jet Propulsion Laboratory, Assessment of Saline Water Use in Coal Transport and Multipurpose Systems, Final Report, Prepared for Bureau of Reclamation, U.S. Department of Interior, December 1982, pp. 2-8.

Table II-4. General Water Slurry Pipeline Parameters

	Dry Coal Throughput (millions of tons per year)			
	5	10	15	20
Outside pipe diameter (inches)	18	25	31	36
Pump station spacing (miles)	50	75	100	125
Total water required for slurry 52% water, 48% coal by weight (acre ft./yr.)	3,988	7,969	11,957	15,945

Costs

Coal slurry pipelines require large front end capital investment for construction. This is because slurry pipelines are capital intensive and this capital must be in place before any revenues are generated. An estimate of slurry transportation costs, by factor, is presented in Table II-5. These costs have been estimated using the Black Mesa pipeline as a basis. Capital costs represent 60-70 percent of total costs, thus, the debt to equity ratio and interest rate are very important to the construction of a slurry pipeline.

Estimates of capital costs by system facility and distance are presented in Table II-6. These estimates are for a capacity of 10 million tons of coal per year. Power for preparation, pumping and dewatering is the primary operational cost. Table II-7 presents some estimates of operation and maintenance costs by distance. More detailed cost estimates for each proposed pipeline may be found in Electric Power Research Institute's Coal Slurry Pipelines: A Review and Analysis of Proposals, Projects, and Literature, EA-2546, August 1982.

Table II-5. Costs by Type of Proposed Coal-Water Slurry Pipeline (Millions of Dollars per year)

Cost Type	Black Mesa[a] (5 MMTY)	Houston Natural Gas (15 MMTY)	ETSI (25 MMTY)
Debt Retirement	43.4	39.3	41.6
Depreciation	25.9	25.2	26.7
Federal Tax	10.6	10.8	11.6
Labor[b]	4.3	10.4[c]	2.5
Supplies	3.6	2.3	2.5
Power	9.9	7.8	10.5
Water[d]	2.3	4.2	4.6

a Scaled as if constructed in 1980.
b Larger tonnages reduce labor cost per unit transported.
c Branch systems introduce high labor costs.
d The amount of water required is directly proportioned to throughput.
Source: Electric Power Research Institute. Coal Slurry Pipelines: A Review and Analysis of Proposals, Projects, and Literature. August 1982, pp. 2-39.

Table II-6. Capital Cost Estimates (10 MMTY in Millions of 1982 dollars)

	Transport Distance (Miles)			
System	600	800	1,000	1,200
Slurry Preparation Facility	27.6	27.6	27.6	27.6
Pipeline	236.6	315.4	394.3	473.2
Pump Station Facilities	36.1	49.6	63.1	72.2
Dewater Facility	50.2	50.2	50.2	50.2
Total Capital Cost	350.5	442.8	535.2	623.2

Source: California Institute of Technology, Jet Propulsion Laboratory, Assessment of Saline Water Use in Coal Transport and Multipurpose Systems, Final Report, Prepared for Bureau of Reclamation, U.S. Department of Interior, December 1982, pp. 1-19.

Table II-7. Annual Operation, Maintenance and Power Costs Baseline Capacity (10 MMTY of Dry Coal)

	Transport Distance (Miles)			
	600	800	1,000	1,200
Facility	Millions of 1982 Dollars			
Slurry Preparation Facility				
Operation and Maintenance	3.8	3.8	3.8	3.8
Power	2.8	2.8	2.8	2.8
Dewater Facility				
Operation and Maintenance	8.3	8.3	8.3	8.3
Power	8.9	8.9	8.9	8.9
Pumping Facilities				
Operation and Maintenance	3.0	4.2	5.3	6.1
Power	10.5	14.6	18.5	21.2
TOTAL SYSTEM COSTS				
Operation and Maintenance	15.1	16.3	17.4	18.2
Power	22.3	26.3	30.2	32.9

Source: California Institute of Technology, Jet Propulsion Laboratory, Assessment of Saline Water Use in Coal Transport and Multipurpose Systems, Final Report, Prepared for Bureau of Reclamation, U.S. Department of Interior, December 1982.

Transportation cost estimates range from $3.50 to $15.00 per ton in 1980 dollars. This is approximately 1 to 8 cents/ton-mile. Cost estimates vary considerably between pipeline proposals and outside studies. However, slurry pipeline ton-mile cost estimates are generally far below existing rail rates. The potential economic impacts of slurry pipelines on railroads, as well as other issues, are discussed in the next chapter.

Technical References

Extensive research has been conducted on the technical aspects of slurry pipelines. The following four reports provide a good summary of this aspect and are recommended as an initial source for further, more detailed research.

1. U. S. Department of Commerce, National Technical Information Service. Coal-Water Slurries. 1976-January 1984. Citations from the NTIS Data Base. No. PB84-862028, March 1984.

2. U.S. Office of Technology. A Technology Assessment of Coal Slurry Pipelines. Assessment Report, Volumes 1, 2, Summary. March 1978.

3. Skelly and Loy Systems Consultants, Inc. Report on the Assessment of Coal-Slurry Pipelines. Volumes 1, 2, and 3. June 1981.

4. Electric Power Research Institute. Coal Slurry Pipelines: A Review and Analysis of Proposals, Projects, and Literature. EA-2546. August 1982.

CHAPTER III

COAL SLURRY ISSUES

The proposed construction of coal slurry pipelines has raised many legal, economic and environmental issues. Legal issues pertain to pipeline rights-of-way, water acquisition and transportation competition. Economic issues pertain to the cost of water, construction and transportation costs, and pipeline-rail competition. Environmental issues pertain to pipeline construction and operation, particularly in regard to water consumption and quality. These issues will be discussed under the following headings:

* Eminent Domain
* Water Requirements
* Environmental Impacts
* Competition with Railroads

The range of pipeline proposals is large and impacts vary depending on the individual pipeline. In addition, numerous technical studies have reached conflicting conclusions for the same pipeline proposal. Therefore, this report briefly presents the issues involved and provides a range of potential impacts resulting from slurry pipeline transportation proposals.

Eminent Domain

Eminent domain, or government sanctioned rights-of-way, is a critical legal problem for the construction and planning of coal slurry pipelines. Although two slurry pipelines (Black Mesa and Ohio) have been built without Federal eminent domain, the scale of proposed pipelines and the financial risks mean that pipeline companies and investors now need the guarantee that interstate pipelines will have rights-of-way granted. Congress has granted eminent domain to the railroads and other pipelines (gas and oil) for their construction and

operation. However, Congress has debated eminent domain legislation for coal slurry pipelines for several years without a consensus. The debates have brought out all the issues involved in the construction and operation of a coal slurry pipeline. Congressional committee hearings and mandated studies are an important source of information covering many different issues.

Opposition to eminent domain legislation for coal slurry pipelines has been led by the railroads. Railroad testimony has centered on transportation competition and the potential loss of future revenue and jobs. These topics are discussed more thoroughly in a later section. The railroads have already been granted eminent domain but are now trying to block rights-of-way to coal slurry pipelines. Coal slurry pipelines need to cross numerous rail lines to reach consumers. The now cancelled ETSI project had won more than 65 individual rights-of-way suits against the railroads but obtaining rights-of-way via individual court actions was very expensive and time consuming. Lack of federal eminent domain has quadrupled the estimated cost of the project. This is one of the arguments in ETSI's suit against the railroads that "protracted opposition that brought about costly delays in securing the necessary permits, rights-of-way and clearances for the project."[1] Four states (South Dakota, Missouri, Iowa and Kansas) have also filed antitrust suits against railroads for interfering with the ETSI pipeline on the grounds of lost state revenues.[2] Coal transportation competition and fear of lost revenues and employment are behind the debate on eminent domain. Another issue affecting eminent domain legislation is western state resistance caused by the fear of loss of state control over water rights once the pipeline is in operation and water is being

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1 Coal Age. September 1984. p. 11.
2 Coal Age. July 1984. p. 13.

exported across state lines. These concerns are expressed more fully in the water requirements section. Agricultural groups are, in some cases, opposing coal slurry pipeline legislation because of uncertainty and concern over water availability, land impacts and effects on agricultural rail rates.

Legislative Proposals

Since 1962, nearly 20 separate bills have been introduced in Congress to secure the right of Federal eminent domain for coal slurry pipelines. The first bill was considered in a Senate committee in 1962 but lost momentum as railroads introduced unit trains dedicated to hauling coal to large consumers (electric utility plants) at substantially lower rates. The introduction of this new mode of operation "sidetracked" the need for slurry pipelines and eminent domain for a dozen years.

Coal slurry pipeline legislation reemerged in the 93rd Congress (1974) as an aftermath of the 1973 oil crisis and has been considered in every subsequent Congress. The only bill to pass either House of Congress was the Coal Pipeline Act of 1974. The many issues surrounding the granting of eminent domain are introduced here and are also summarized in DOE/EIA-0468.[3] The following summarizes the legislation which has been introduced and the major issue(s) addressed by each bill.

87th Congress - 1962

* S. 3044 - Senator Magnuson (WA-D)
* amend Interstate Commerce Act to grant the power of eminent domain to coal slurry pipelines
* Senate Commerce Committee held 6 days of hearings
* the bill was not reported out of committee

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3 U.S. Department of Energy, Energy Information Administration, Coal Slurry Pipelines: Impact on Coal Markets, DOE/EIA-0468, Washington, D.C., April 1985.

93rd Congress - 1974

* S. 2652, Coal Conversion Act of 1974, Senator Jackson (WA-D)
* referred to Interior and Insular Affairs Committee
* granted power of eminent domain to coal slurry pipelines and provided rights-of-way over Federal lands
* one day of hearings was held on Amendment No. 1175 to amend the Mineral Leasing Act of 1920
* The Committee reported out a clean bill, S. 3879, Coal Pipeline Act of 1974, Senator Jackson (WA-D)
* S. 3879 passed the Senate by voice vote but died when the House did not act on the legislation

94th Congress - 1975

* H.R. 1863, Coal Slurry Pipeline Act of 1975, Representative Jones (OK-D)
* referred to Committee on Interior and Insular Affairs
* provided rights-of-way over Federal lands and the power of Federal eminent domain
* hearings were held
* H.R. 2220 was identical to H.R. 1863 but added several cosponsors
* H.R. 2553 was also identical but with different sponsors
* none were reported out of committee

95th Congress - 1977

* H.R. 1609, Coal Pipeline Act of 1977, Rep. Eckhardt (TX-D) and many cosponsors
* referred jointly to Committees on Interior and Insular Public Works and Transportation
* granted power of eminent domain to coal pipelines and rights-of-way across Federal lands
* reported out of both committees with amendments
* failed to pass full House: 161-246
* H.R. 1324, Coal Slurry Pipeline Act of 1977, Rep. Rooney (PA-D)
* referred to Committee on Public Works and Transportation
* provided for regulation of coal pipelines as common carriers and granting of eminent domain by the ICC
* H.R. 6248, Coal Transportation Act of 1977, Rep. Rooney (PA-D)
* referred jointly to Committees on Interstate and Foreign Commerce and Public Works and Transportation.
* provided for regulation of pipelines, easements across railroad property and parity in ratemaking procedures
* H.R. 6643, Coal Transportation Act of 1977, Rep. Santini (NV-D)
* referred jointly to Committees on Interior and Insular Affairs, Interstate and Foreign Commerce and Public Works and Transportation
* granted Federal lands rights-of-way and amended Interstate Commerce Act to allow ICC to regulate pipelines and to grant rights-of-way across railroad properties

* S. 707, Coal Pipeline Act of 1977, Senator Johnston (LA-D) and others
* referred jointly to Committee on Commerce, Science and Transportation and the Committee on Energy and Natural Resources (identical to H.R. 1609.)
* hearings were held
* S. 1492, Coal Transportation Act of 1977, Senator Magnuson (WA-D) (identical to H.R. 6248).
* referred to Committee on Commerce, Science and Transportation.
* S. 3046, Coal Pipeline Act of 1978, Senator Bumpers (AR-D), (identical to H.R. 1609.)
* referred to Committee on Energy and Natural Resources
* hearings were held
* none of these bills were reported out of Committee

96th Congress - 1979

* H.R. 4370, Coal Pipeline Act of 1979, Rep. Eckhardt (TX-D) and others
* jointly referred to committees and favorably reported out of both
* the full House failed to act
* H.R. 4632, Coal Pipeline Act of 1979, Rep. Breaux (LA-D)
* jointly referred to committees but never reported out
* H.R. 6879, Coal Slurry Pipeline Act of 1980, Rep. Staggers (WV-R)
* jointly referred to committees, hearings were held but it was never reported out
* H.R. 7082 Coal Slurry Pipeline Act of 1980, Rep. Udall (AZ-D) and others
* Combined and modified provisions of previous bills but was never reported out
* S. 2665, The National Coal Production, Distribution and Utilization Act of 1980, Senator Bumpers (AR-D)
* referred to Committee on Energy and Natural Resources, hearings were held but it was not reported out.

97th Congress - 1981

* H.R. 1374, Rep. Daschle (SD-R)
* prevented rights-of-way to coal slurry pipelines utilizing groundwater without State consent
* H.R. 4230, Coal Pipeline Act of 1981, Rep. Udall (AZ-D) and others
* referred jointly to committees, both reported it out with amendments but the House Rules Committee failed to act
* H.R. 5278, Rep. Bedell (IA-D) and others
* referred to Committee on Interior and Insular Affairs
* prohibited any State from selling or transferring interstate waters without other State's consent
* S. 305, State Water Protection Act of 1981, Senator Pressler (SD-R)
* referred to Committee on Environment and Public Works
* directed Corps of Engineers to conduct a study of the Madison aquifer and prohibited water use from that aquifer until the study was completed

* S. 1844, Coal Distribution and Utilization Act of 1981, Senator Johnston (LA-D) and others
* referred to Committee on Energy and Natural Resources, was reported out but then died

98th Congress - 1983

* H.R. 1010, Coal Slurry Pipeline Act of 1983, Rep. Udall (AZ-D) and others
* was referred to two Committees and reported out of both but failed to pass the House 182-235.
* H.R. 3857, Coal Slurry Pipeline Act of 1983, Rep. Udall (AZ-D) and others - see H.R. 1010 above
* H.R. 1749, Rep. Bedell (IA-D) and others
* prohibited any State from permitting sale of water resources shared with other States unless there is a compact in place
* required the Secretary of Agriculture to study the effects of interbasin water transfers
* S. 267, Coal Distribution and Utilization Act of 1983, Senator Johnston (D-LA)
* assigned to and reported out of Committee on Energy and Natural Resources but no further action was taken
* defined State authority to regulate water use by coal pipelines
* opposition from farm groups led to the defeat of H.R. 1010 in the House vote

99th Congress - 1985

* H.R. 2708, Coal Pipeline Act of 1985, Rep. Udall (AZ-D) introduced with 36 cosponsors
* was referred to the Interior Committee
* Public Works Committee also had jurisdiction.
* S. 994, Coal Distribution and Utilization Act of 1985, Senator Johnston (LA-D), S. Bradley (NJ) and S. Stevens (AK) cosponsors.
* referred to Energy and Natural Resources Committee
* essentially the same as S. 267 introduced by Johnston in the 98th Congress
* provided for Federal eminent domain for coal slurry pipelines but not for acquisition of water
* added a section allowing pipeline operators to enter into long term contracts
* Section 5 of S. 994 established the primacy of state water laws and dictated their enforcement
* The committee did not take the Bills up for consideration.

100th Congress - 1987

* H.R. 1531, Coal Pipeline Act of 1987, Rep. Udall (AZ-D) introduced with 45 cosponsors.
* referred to the Interior and Insular Affairs and Public Works and Transportation Committee

* hearings were held September 22, 1987
* almost identical to H.R. 2708 introduced in the 99th congress
* declaration of eminent domain by the Secretary of the Interior
* S. 801, Coal Distribution and Utilization Act of 1987, Senator Johnston (LA-D) and others
* referred to the Senate Committee on Energy and Natural Resources
* hearings were held September 10, 1987
* almost identical to S. 994 introduced in the 99th congress
* additional clarification of State's water rights
* building and construction trades lobbying in support
* eminent domain declared by the Secretary of Energy
* both bills require the construction of underground lines, require the set aside of up to ten percent of capacity for small producers and retain state utility commission authority

Water Rights and Requirements

Another major issue under debate, perhaps the most critical, has been the large quantities of water needed by coal slurry pipelines and the intrusion on State water rights and laws that Federal legislation for coal pipelines might pose. The water-related issues have been particularly sensitive in arid Western and Midwestern States, where several coal slurry pipelines have been proposed and where a delicate balance of water allocations among states and among competing uses has been maintained. State legal concerns are that Federal involvement could invalidate State water rights either through eminent domain legislation or from interstate commerce involvement prohibiting restrictions on interstate commodities. Another concern is that water permits granted by one State (upstream) for pipeline use could mean a loss of that water which would otherwise be available to neighboring on downstream States and for other possible future uses. Arid Western and Midwestern States want protection of their water rights and laws from Federal eminent domain legislation for coal pipelines; they oppose such legislation until their water rights and laws are protected in the eminent domain legislation. In the past two Congresses, the issue of State water rights and laws has become the prime issue

in the debate and defeat of coal pipeline legislation.[4]

Although the adequacy of water supplies has been a major controversy and is discussed in the next section, legal factors governing water rights are the real problem. The prior appropriation doctrine, interstate compacts and individual state restrictions limit water availability more than physical supplies. Most western states use prior appropriation rights for water distribution. This system allocates available water according to first-in-time first in right with specified quantities. Water rights may be sold but they can be costly and limitations often apply to their transfer. Water rights, rather than cost, are the primary problem because coal slurry pipelines are relatively insensitive to water cost. Thus, in a strictly price allocative system, pipelines could conceivably outbid other water users. State water laws may prevent this from happening by specifying user priority. Water priority is frequently specified in the order of domestic, industrial and then agricultural use. In addition, some state statutes specifically prohibit the use of water for slurry pipelines (Montana) or prohibit exporting water from a state. However, recent Federal court rulings prohibit discriminatory restrictions on interstate water transfers. Specifically, groundwater has been ruled as an article of commerce and therefore subject to congressional regulation.[5] These regulations also apply to interstate surface water transfers. Furthermore, the Federal Government has the power to control water resource allocation and hence, could supersede State water allocation authority (under some circumstances) by certifying coal pipeline projects to be in the

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4 U.S. Department of Energy Information Administration. Coal Slurry Pipelines: Impact on Coal Markets, DOE/EIA-0468, Washington, D.C., April 1985, p. 19.

5 Sporhase vs Nebraska, U.S. Supreme Court, July 1982.

national interest.[6]

Legislative Recognition of States Water Rights[7]

Recognizing the sensitivity of water use by coal slurry pipelines and State water rights, all of the comprehensive coal pipeline legislation introduced in the past 10 years has carefully and expressly worded the separation of Federal eminent domain from the use and development of water required for operations of coal slurry pipelines. For example, S. 3879, introduced in the 93rd Congress, provided that the power of Federal eminent domain shall not be exercised to acquire any right to use or develop water and that water rights would have to be acquired under existing State law. Subsequent coal pipeline legislation provided clearer and more expressive language on the separation of eminent domain from water rights for coal slurry pipelines. For instance H.R. 1609 as amended by the House Interior and Insular Affairs Committee declared, "Nothing in this Act shall be construed to permit the United States, the Secretary, or a coal pipeline operator to acquire any right to use or develop water through the exercise of the power of eminent domain" (Sec. 4(c)).

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6 Office of Technology Assessment, A Technology Assessment of Coal Slurry Pipelines: Summary (Washington, D.C., September 1980), p. 9. "Sufficient unused quantities of suitable water are physically present although not necessarily legally available for the operation of several slurry pipelines from Western coal-producing areas. Under the prior appropriation system for water allocation in many Western states, slurry pipelines like any new applications of water are accorded a lower priority relative to existing rights." "The Federal Government has substantial power to control water resource allocation for pipelines, notwithstanding State provision, if it should choose to exercise it. Even without an explicit choice to exercise that power, Federal certification of a pipeline project based on a finding that it served the public interest could supersede State water allocation authority under some circumstances."

7 Most of the discussion in this section has been extracted, with few changes, from DOE/EIA-0468, pp. 20-22.

In order to minimize water use by coal pipelines in the West, many critics have proposed that a water recycling condition be imposed on coal pipelines.[8] This proposal has been rejected by coal pipeline proponents, as it would substantially increase the cost of coal pipeline operations. For example, it would cost a minimum of $3,000 to recycle an acre-foot of water in a closed loop from Arkansas to Wyoming--about eight times what ETSI would pay for underground water from Wyoming.[9] One pipeline supporter succinctly stated that if a water recycling condition is imposed on coal slurry pipelines "you have defeated all coal slurry lines" because it is much cheaper to carry coal by railroad.[10] Water is not necessarily the only slurry medium. Oil, methanol derived from coal and liquid carbon dioxide have also been proposed as slurry media but would increase costs over water.

With water as the primary medium, the debate surrounding coal pipeline water use and related legal matters continues. Strengthening the language on the separation of water rights for coal pipelines from eminent domain was only one aspect of the water-related issues. The issues turned to the protection and preservation of the existing State water rights and laws from eminent domain legislation.

ETSI initially planned to carry 20 million tons of coal from Wyoming to the

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8 See, for example, statement of Hon. Teno Roncalio (WY-D) before the Subcommittee on Surface Transportation, Committee on Public Works and Transportation, U.S. House of Representatives, on H.R. 1601, 95th Congress, 2nd Session, Report No. 5-59, p. 29.

9 W. Pat Jennings, President, Slurry Transport Association, Statement before the Subcommittee on Public Lands and Resources, Committee on Energy and Natural Resources, U.S. Senate, on S. 707 and S. 3046, Coal Pipeline Act, Publication No. 95-136, p. 162.

10 Hon. Morris K. Udall (AZ-D), Statement before the Subcommittee on Public Lands and Resources, Committee on Energy and Natural Resources, U.S. Senate, on S. 707 and S. 3046, Coal Pipeline Act, Publication No. 95-136, p. 99.

Arkansas and Louisiana area. For this coal shipment, ETSI originally obtained an underground water permit from the State of Wyoming to draw up to 20,000 acre-feet of water a year from the Madison Aquifer.[11] This caused concern not only in Wyoming, but also in neighboring States, Nebraska and South Dakota, under which the Madison Formation lies.

These concerns led to the adoption of the Roncalio (WY-D) amendment in H.R. 1609 of the 95th Congress, which would prohibit the use of underground water "unless the U.S. Geological Survey has conducted a comprehensive study which demonstrates that the impact of the use of such groundwater on the quality and quantity of the water table in surrounding areas or adjoining States is insignificant" (Sec. 5(h)(1)) and a provision that would require water permits, surface or underground, obtained from "the State or States having jurisdiction over the waters prior to application for a certificate of public convenience and necessity" (See 5(h)(2)).

The Roncalio amendment, however, was controversial. Coal pipeline backers opposed it because it could prohibit the use of underground water for coal pipelines. Many, including both proponents and opponents of coal pipeline legislation, opposed it because it would bring the Federal Government into the matter of water allocation among States, prohibiting them from making their own decisions. This provision was dropped from H.R. 4370, the Coal Pipeline Act of 1981, which received the most attention in the 96th Congress.

The requirement that water permits be obtained from each State having an interest in the water to be used by coal pipelines (prior to application for

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11 Frank B. Odasz, Statement before the Subcommittee on Public Lands and Resources, Committee on Energy and Natural Resources, U.S. Senate, on S. 707 and S. 3046, Coal Pipeline Act, Publication No. 95-136, pp. 264-269.

pipeline certification) was also dropped in the House Committee on Interior and Insular Affairs version of H.R. 4370, while it was retained by the Committee on Public Works and Transportation. One committee took the view that the problem of granting water permits to a coal pipeline by a State is not a question of the eminent domain legislation, but a question of the State granting the permits vis-a-vis neighboring States. The other committee took the view that State water rights cannot be protected without allowing water sharing States the right to deny the granting of water permits by a State.

Nevertheless, recognizing the States' power to protect their traditional authority and responsibility over the appropriation and use of their water resources, both the Committee on Interior and Insular Affairs and the Committee on Public Works and Transportation provided, in their respective versions of H.R. 4370, that the Federal Government neither can appropriate water within any State for use in a coal pipeline without complying with State law nor may claim water for a coal pipeline under the reserved rights doctrine unless such reservation is expressed. Also, H.R. 4370 specified that any State may place terms or conditions on a water permit for a coal pipeline as it deems appropriate and that such State water action shall not be deemed to violate the commerce clause of the Constitution.[12] The latter provision was to protect State water action for coal pipelines from possible challenges under the commerce clause, which makes any action against flow of interstate commerce unconstitutional. As an alternative to the controversial Wyoming Madison Aquifer water, ETSI obtained from the State of South Dakota in 1981 the right

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12 See H.R. 4370, Sec. 301, as reported by the House Committee on Public Works and Transportation, and H.R. 4370, Sec. 302, as reported by the Interior and Insular Affairs Committee.

to take 10,000 acre-feet of water a year from the Oahe Reservoir.[13] This also caused concerns in the downstream States for the protection of their interests.

In the 97th Congress, four bills (H.R. 1374, H.R. 5278, S. 1527, and S. 305) were introduced for that purpose. The first three bills were to provide downstream States that share the same water source with a veto power to protect their rights when a State in the same water basin grants water permits to interstate coal pipelines. S. 305, the State Water Protection Act of 1981, was to protect State water laws from Federal reserved water rights by prohibiting the United States from using water from any State for any energy project, including coal slurry pipelines, unless water is obtained in accordance with State law.

H.R. 4230, the Coal Pipeline Act of 1981, which received the most legislative consideration in the House in the 97th Congress, explicitly delegated the authority to the States to regulate their water resources involving coal pipeline use. H.R. 4230 provided that no one, including the Federal Government, can reserve, appropriate, use, or claim water within any State for a coal pipeline unless such an action takes place "pursuant to State substantive and procedural law," and that "the establishment and exercise of terms or conditions, including terms or conditions terminating use, on permits or authorization for the reservation, appropriation, use of diversion of water for a coal pipeline ... shall be determined pursuant to State law notwithstanding any transportation, use, or disposal of such water in interstate commerce."[14]

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13 William J. Janklow, Governor, State of South Dakota, Statement before the Committee on Energy and Natural Resources U.S. Senate, on S. 1844, Coal Distribution and Utilization Act of 1981, 97th Congress, 2nd Session, Publication No. 97-70, p. 813.

14 Sections 10(a) and 10(b) respectively, of H.R. 4230, Coal Pipeline Act of 1981.

H.R. 4230, however, did not provide water-sharing States with a veto power. Slurry interests strongly opposed this proposal because it would be almost impossible to secure unanimous agreement on water permits from all of the States which share the same water source.

The Senate Committee on Energy and Natural Resources also made several substantive changes to S. 1844, the Coal Distribution and Utilization Act of 1981, to make a clear statement regarding the primacy of State water law and the protection of States' interests in water related to coal pipeline use. S. 1844 gave an express Congressional consent to States to regulate interstate commerce of water through the application of State water law. The need for such an express Congressional delegation of authority to States to regulate interstate flow of water for coal pipelines was heightened by the Supreme Court ruling on the Sporhase v. Nebraska case (458 U.S. 273(1982)). It held that groundwater (and by implication, surface water) is an article of commerce and, hence, a Nebraska statute banning the export of groundwater to another State unless the State has a law granting reciprocal rights to export water to Nebraska is unconstitutional under the Constitution's commerce clause. H.R. 1010, as amended, also adopted language that expressly delegates authority to the States to regulate the use of water by coal pipelines and that expressly protects interstate water compacts. Furthermore, the Committees reinstated a provision that requires an applicant for pipeline certification to secure approval from the appropriate State or States for the use of water prior to submission of the application. H.R. 1010, however, did not adopt the measure (e.g., H.R. 1749) which requires the consent of all other States that share water from the same source to the sale of water by a State for interstate coal pipelines.

The Committees believed that the need for the protection of State water rights related to coal pipelines became greater in light of not only the Supreme Court decision on the Sporhase v. Nebraska case but also the ruling by the U.S. District Court of the District of New Mexico on the El Paso v. Reynolds case (D.N.M. January 17, 1983) that a New Mexico statute containing an outright prohibition against the transportation of water from New Mexico to another State is unconstitutional.

S. 267, the Coal Distribution and Utilization Act of 1983, as reported by the Senate Committee on Energy and Natural Resources, also provided express language regarding State authority to regulate coal pipeline water use in accordance with State water laws.

Two bills were introduced during the first session of the 99th Congress. In the House, H.R. 2708, the Coal Pipeline Act of 1985, was introduced with 36 cosponsors. H.R. 2708 was essentially the same Bill as H.R. 3857 (Rep. Udall AZ-D), introduced in the 98th Congress and has been referred to the Interior Committee. S. 994, the Coal Distribution and Utilization Act of 1985, Senator Johnston (LA-D), Senator Bradley (NJ) and Senator Stevens (AK) cosponsors, and was referred to the Energy and Natural Resources Committee. The bill was essentially the same as S. 267 introduced by Johnston in the 98th Congress. S. 994 provided Federal eminent domain for coal slurry pipelines but not for acquisition of water, added a section to allow pipeline operators to enter into long term contracts and, in Section 5, established the primacy of state water laws and dictates their enforcement. Although little action was expected on coal slurry legislation in the 99th Congress, a compromise was discussed which had the potential to enable passage of eminent domain legislation in the second session. The compromise would have coupled S. 994 with S. 2427, the Coal

Leasing Bill (McClure, ID) and in return amended Section 2C of the Mineral Lands Leasing Act to permit railroads to lease Federal coal. No action was taken in the 99th Congress. Resolution with the railroads over eminent domain would have been a major accomplishment for slurry pipeline proponents, even so, the water issues would still be a major stumbling block.

Two bills have been introduced in the 100th Congress. In the House, H.R. 1531, the Coal Pipeline Act of 1987, was introduced by Rep. Udall (AZ-D) and has 45 sponsors. H.R. 1531 is almost identical to H.R. 2708 introduced in the 99th Congress and has been referred to the Interior and Insular Affairs and Public Works and Transportation Committee's. Hearings were held September 22, 1987. In H.R. 1531, declaration of eminent domain is by the Secretary of the Interior. S. 801, the Coal Distribution and Utilization Act of 1987 introduced by Senator Johnston (LA-D), has been referred to the Energy and Natural Resources Committee. S. 801 is almost identical to S. 994 introduced in the 99th Congress with some additional clarification on state's water rights. In S. 801, eminent domain is declared by the Secretary of Energy. Both bills require the construction of underground lines, require the set aside of up to ten percent of capacity for small producers and agree that state utility commissions retain authority. The Senate Energy and Natural Resources Committee held hearings September 10, 1987. Railroads opposed the legislation on the grounds that coal slurry pipelines are private concerns which should not receive federal eminent domain and that construction of coal slurry pipelines would be detrimental to railroad revenues and employment. This was countered by testimony from the Slurry Transport Association and others. The building and construction trades are lobbying in support of coal slurry pipeline eminent

domain legislation. Water rights experts again testified that state water rights will be adequately protected.

Despite the clear and express language on the separation of water rights from eminent domain and the Congressional consent to allow States to regulate interstate commerce of water for coal pipelines through the application of State water laws, the water issues remain unresolved. The opponents of coal pipeline legislation have argued that these provisions would not adequately protect State water rights and laws, e.g., the rights of other water-sharing States from a sale of water for a coal pipeline by a water-origin State. The farmers, ranchers, and environmentalists in the arid West, along with the railroads, have defeated coal pipeline legislation many times in the past. The agricultural interests are also concerned that they might have to pay higher rail rates if the railroads lose a significant share of their coal traffic to coal pipelines and railroad revenue declines. This is discussed in a later section.

Water Requirements and Availability

The water requirements of coal slurry pipelines have also been of concern to other users such as agriculture and to states worried about future growth. In general, one ton of coal requires one ton of water (by weight) for slurry pipeline transport. To the opponents of coal slurry pipelines, the quantities of water needed in the West by several pipeline projects are simply too large. To the proponents, suitable water for coal pipelines is available. They also argue that moving coal out of the coal-producing region requires far less than is required for development of alternative coal-based energy projects such as electricity generation and synthetic fuels production, i.e., coal slurry

pipelines are far less water-intensive than other energy projects.[15] By comparison, a coal pipeline would use 20 percent of the water required for a mine-mouth electricity generation plant.

Estimates of water requirements for several hypothetical coal slurry pipelines are illustrated in Table III-1. Water requirements vary widely depending on coal throughput, moisture content and flushing reserves maintained in case of a spill. These estimates of water requirements are compared to the average annual flow of several Northern Great Plains rivers in Table III-2. Both surface and ground water have been proposed as potential sources of pipeline water.

Adequate water supplies are generally available for coal slurry pipelines, however, water appropriated to coal slurry pipelines may be at the expense of other future uses. Withdrawals of surface water for coal slurry pipeline use would constitute a very small fraction of the physically available flows in most large streams or rivers. For example, the OTA estimated that a group of pipelines moving 125 million tons of coal per year from Wyoming would use a maximum of 3 percent of the Bighorn River's average depleted flow. Agricultural uses downstream from the nearby Boysen Reservoir are more likely than pipelines to deplete flows to a point where water quality seriously declines.[16]

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15 Frank B. Odasz, Vice President, Energy Transportation Systems, Inc., Statement before the Subcommittee on Public Lands and Resources, Committee on Energy and Natural Resources, U.S. Senate, 95th Congress, 2nd Session, on S. 707 and S. 3046, Coal Pipeline Act, Publication No. 95-136, p. 259 and p. 263.

16 Office of Technology Assessment. A Technology Assessment of Coal Slurry Pipelines, Washington, D.C., March 1978. p. 87.

Table III-1
Estimates of Water Requirements for
Several Hypothetical Coal Slurry Pipelines

Pipeline	Route	Millions of Tons of Coal Per Year	Annual Water Requirements Acre-Feet/Yr
Alton	Utah-Nevada	11.6	5.4 - 7.8
San Marco	Colorado-Texas	10	15.0
Texas Eastern	Wyoming-Texas	22	20.0
ETSI	Wyoming-Arkansas	25	20.0
Coal Stream	IL, KY, OH, WV-Florida, Georgia	15	20.0

Source: Office of Technology Assessment, Coal Slurry Pipelines March, 1978, p. 88.

Groundwater has also been considered as a primary source for slurry water. The concern about groundwater is that increased pumping from aquifers could result in declining water levels or groundwater mining. Detailed studies of surface and groundwater supplies and impacts have been conducted to evaluate coal slurry proposals, in particular the ETSI pipeline proposal. The U.S. Department of Interior, Bureau of Land Management completed a voluminous Environmental Impact Statement on the ETSI project which contains detailed maps and estimates of the water resources and impacts. Groundwater impacts vary widely depending on the water source and location.

The criteria for evaluating water transfers is important. Because of the high value of water in coal slurry pipelines, evaluations based on benefit cost analysis, income distribution or changes in employment may show the water

Table III-2
Average Annual Flow of Selected Rivers in the Northern Great Plains

River	Drainage Area Square Miles	Average Annual Flow Acre-Feet
Bighorn	22,885	2,550,000
Powder	13,415	416,000
Tongue	5,400	304,000
Yellowstone	70,115	8,800,000

Source: T. C. Campbell, Coal Slurry Pipelines, Water Laws, Customs and Availability, U.S. Department of Energy, Process Evaluation Office, Fossil Energy, June 1978, p. 7

transfers to be beneficial to the region.[17] The high value of water in slurry pipelines also means that pipelines will be able to bid the water away from other lower value uses.

Sufficient water appears to be available for coal slurry pipelines, even in the West, but this water use may be at the expense of other future uses. Thus, obtaining water rights has been a major problem. States have been reluctant to grant pipeline water rights, in part, because they do not want to lose control of the rights. This fear may be justified in light of recent court decisions interpreting water as a commodity, opening the door for federal regulation.

17 Marie Leigh Livingston, "Competition for Water: Criteria for Decisionmaking" State Government, Winter, 1982.

Environmental Impacts

Environmental impacts of coal slurry pipelines may be divided into the land and water resource impacts resulting from construction, pipeline operation and water disposal. Construction impacts are primarily limited to land disturbance, whereas water quality is of concern during the operation (spills) of the pipeline and disposal of slurry water. The EPA has examined the environmental aspects of coal-water slurry pipelines and concluded that the environmental and related pollution problems are minimal and can be easily resolved.[18]

Land would be disturbed in the construction of coal slurry pipelines by the laying of the pipeline and vehicular traffic on open ground. Depending on the technology employed and the pipeline design, underground or overland, most of the disturbed land could be reclaimed. The OTA has estimated land disturbance impacts for the construction of a Wyoming to Texas pipeline. Results of OTA's estimates are presented in Table III-3. Land disturbance is in terms of traversed acreage by county. The acreage of farmland by county is also reported, along with estimates of disturbed land and miles traversed. Percent of disturbed land of the total traversed acreage and totals have been added using the OTA estimates. As may be observed, disturbed land is less than four hundredths of a percent of the total land traversed or an estimated total of 14,040 acres for a 1,170 mile pipeline. Again, depending on the technology and pipeline used, much of the disturbed land could be reclaimed. Thus, pipeline construction is not expected to have a major impact on land and specifically agricultural resources.

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18 R. R. Faddick. The Environmental and Pollution Aspects of Coal Slurry Pipelines. U.S. EPA, EPA 600/2-79-067, March 1979.

Table III-3
Estimated Land Disturbance
Along Wyoming-Texas Pipeline Route

State	Acreage			Miles Traversed	Percent Disturbed of Total
	County Total	Farmland	Disturbed		
Wyoming	10,423,104	9,753,655	1,872	165	0.018
Nebraska	3,913,280	3,406,782	1,440	120	0.037
Colorado	3,124,288	3,050,551	1,308	109	0.042
Kansas	5,344,000	4,860,650	2,640	220	0.049
Oklahoma	6,240,128	5,535,023	2,760	230	0.044
Texas	7,541,888	5,341,483	4,020	335	0.053
Total	36,586,688	31,948,144	14,040	1,170	0.038

Source: Adapted from the Office of Technological Assessment, A Technology Assessment of Coal Slurry Pipelines, March 1978, p. 113.

Water quality problems have been the primary environmental concern of coal-water slurry pipelines. Water, in the coal-water slurry, can leach a variety of chemicals from the coal, including sulfur, hydrocarbons and, in some cases, heavy metals. Variation in the chemical composition of slurry water is due to differences among coal types and the quality of the input water.

Pilot tests were conducted for the ETSI pipeline to examine the chemical composition of the coal slurry disposal water. These tests indicated lowlevels of sulfur and heavy metals, generally well below present water quality standards. Some proposed sources of input water as a slurry medium include the use of saline or brine water and sewage. Obviously, the quality of input water

will have a direct effect on the quality of the disposal water. Earlier reports conflict on the amount of degradation, but disposal water can be expected to be mildly acidic and to contain high levels of sulfates, chlorides and dissolved solids.[19] Nonetheless, most coal slurry pipeline proposals have included water treatment as part of their dewatering facilities. Coal slurry water, in most cases, is not expected to exceed the normal removal capacity of conventional water treatment methods. Slurry water disposal options considered include discharge into streams or oceans, industrial use, cooling use, agricultural application and potable water. The chemical concentration, water quality regulations and cost of treatment limit the options available for disposal.

Pipeline ruptures and spills are not expected to present major environmental problems. Spills should be infrequent and relatively easy to clean up when on land. The Black Mesa pipeline has experienced only two spills over a twelve-year period of transporting over 40 million tons of coal. More serious problems could arise if the spill occurs in or near a waterway. Even then, long term impacts from slurry spills are not likely to be severe.

Economic Competition with Railroads

The economic issues of coal slurry pipelines are concerned less with feasibility than with competition with the railroads. Existing (See Table II-2) slurry pipelines have been found to be economically viable. The demand for coal, pipeline design (technical and geographic) and financial markets

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19 Clara B. Cox. Comparing the Studies of a Coal Slurry Pipeline. Virginia Water Resources Research Center, Virginia Polytechnic Institute, Blacksburg, VA. December 1983. p. 8.

determine the economic feasibility of each proposed pipeline. Coal slurry pipelines are limited in application to longer distances with few destinations because of the expense of slurry dewatering systems. This means that where transportation competition exists, it will be with the longer haul carriers, i.e., railroads. Coal slurry pipeline impacts on railroad revenues and employment have been the major emphasis of pipeline economic studies. Competition with the railroads for the coal market could result in changes in railroad revenues and employment, especially if the coal market does not expand. The coal market is, however, expected to continue expanding after the current slump. Secondary impacts, such as change in the rail rates for other commodities are debatable because they are, in part, legal questions and are difficult to analyze in detail.

Economic impacts of coal slurry pipelines on railroad revenues and employment depends on the degree of competition (relative rates), the demand for coal and employment opportunities. Numerous studies have estimated slurry pipeline rates and forecasted rail rates for comparison.[20] Estimated coal slurry rates have generally been lower than rail rates for movements of 5 million tons per year or greater and over long distances. Rail rates are generally forecasted to be lower than pipeline rates for smaller movements and short distances.

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20 T.C. Aude. "How Slurry Pipe Lines Compare with Unit Rail Transportation," Pipeline Industry. June 1980. p. 55. Office of Technology Assessment. Technology Assessment of Coal Slurry Pipelines, Summary. Staff Report OTA-E-127, September 1980. Rieber, M., and S. L. Soo. Coal Slurry Pipelines: A Review and Analysis of Proposals, Projects and Literature. Prepared for Electric Power Research Institute, Final Report No. EPRI/EA-2546, August 1982. Skelly and Loy and Systems Consultants, Inc. Report on the Assessment of Coal Slurry Pipelines, Vol. I-II, Executive Summary and Main Report. U.S. Department of Energy, No. DOE/ET/11268-T4-V.1, V-2, June 1981. U.S. Department of Energy, Energy Information Administration, Coal Slurry Pipelines: Impact on Coal Markets, DOE/EIA-0468, Washington, D.C., April 1985.

One study estimated 1983 tariffs at $18.48 per ton for slurry pipelines and $20.63 per ton for unit trains. Using a five percent inflation rate, the same study projected tariffs in 2010 of $38.74 per ton for slurry pipelines and $86.36 per ton for unit trains.[21] A recent report by the DOE/EIA estimated rail and coal slurry pipeline standard, low and high rates in 1995 for several origins and destinations. Table III-4 shows the DOE/EIA rate projections.

DOE standard estimates of coal slurry pipeline rates are less than half of estimated rail rates. Low estimates of pipeline rates are almost one quarter of estimated rail rates and high coal slurry pipeline rate estimates are at least ten percent below estimated rail rates. Other studies have estimated rates above and below these rates, however, most estimates of coal slurry pipeline rates are significantly below forecasted rail rates.

The OTA estimated baseline railroad revenues and operating expenses out to the year 2000 in order to estimate the direct economic impacts of pipelines on railroads. OTA's study adjusted the baseline railroad revenue and employment estimates with tonnages "lost" to pipelines under several scenarios. Potential rail revenues were reduced by the largest amount in the West where a number of pipelines have been proposed. Net rail revenues compared with coal slurry pipelines were estimated to be lower than the baseline case with no competition. This is not to say that railroads would necessarily lose coal traffic (a reduction) but that the increase in coal traffic may not be as much as it would be without any competition. Using this methodology, railroads would appear to suffer when faced with any competition.

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21 T.C. Aude. "How Slurry Pipe Lines Compare with Unit Rail Transportation," Pipeline Industry. June 1980. p. 55.

Table III-4 DOE/EIA Estimates of Coal Slurry Pipeline Rates, 1984 and 1995 (1984 Dollars per Ton)

State of Origin	State of Destination	1984 Railroad Rates	1995 Railroad Rates	1995 Pipeline Standard Rate	1995 Pipeline Low Rate	1995 Pipeline High Rate
Wyoming	Texas	29.47	36.23	16.15	12.11	32.30
Utah	Nevada	16.11	18.86	6.18	4.58	13.04
West Virginia	Florida, North	27.98	33.68	13.18	9.77	26.88
Virginia	Virginia	16.67	20.03	7.71	5.76	15.66

Sources: Coal Slurry Pipelines: Impacts on Coal Markets, US DOE/EIA-0468, April 1985, p. 31. Railroad Rates: Energy Information Administration, Annual Energy Outlook 1984, DOE/EIA-0383(84) (Washington, D.C., January 1985), unpublished detailed base case computer printouts. Pipeline Rates: Estimates by the Energy Information Administration, Office of Coal, Nuclear, Electric and Alternate Fuels, Coal Division.

One of OTA's assumptions was that rail tariffs, adjusted for inflation, would remain stable or decline slightly over the next twenty years.[22] Shortly after the OTA study, rail coal tariffs increased dramatically with deregulation under the Staggers Act. A pipeline-rail cost comparison would now be substantially different with the newer rail rates.

Cross subsidization of rail commodity costs has been raised as an economic concern by other shippers. The concern is that reduced rail coal traffic will reduce the subsidy to other commodities thereby raising the rail rates for other commodities, for example, increased grain transportation costs. This hypothesis is difficult to validate for several reasons. Cross subsidization

22 OTA Summary. September 1980. p. 8.

of costs has not been documented, in part, because of the difficulty in obtaining specific commodity revenue and corresponding cost data. American Association of Railroads President William Dempsey testified that 85 percent of the non-coal related rail traffic is competitively priced with the given interpretation that most commodity rates could not be raised without losing traffic to competing modes.[23] Although one may question this statement, it is difficult to verify the existence of competitive versus captive rates.

The Staggers Act, which deregulated much of the rail industry, prohibits the cross subsidization of transportation costs. It is interesting to note that in the 1987 Senate Energy and Natural Resource Committee hearings, Mr. Dempsey testified (pg. 7, 1987) that if coal slurry pipelines were constructed, rail rates for smaller mines would need to increase to "recover revenues lost by the diversion of traffic to pipelines." This seems to indicate rail rate cross subsidization. This also would raise questions about the arguments used to justify stand alone costing in evaluating captive shipper rail rates. There has, however, been much discussion about what costs may be appropriately counted. Further speculation about rail rates for coal and other commodities has included the suggestion that higher rail costs instead of lower, could be incurred because of the excessively large volume of coal traffic. One aspect of pipeline-rail competition is the market for coal. Increasing coal demand could allow pipelines to operate, while permitting a steady or increasing market for rail traffic. The optimistic coal industry growth projections of the mid and late seventies have been delayed by recent economic conditions and lower prices for oil. Coal production and demand is still expected to continue

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23 House Public Works Subcommittee hearings on Surface Transportation, December 8 and 9, 1981.

growing, with the rate of growth contingent on electricity demand, oil prices and regulatory changes (forced fuel conversion and air quality requirements). The development of coal slurry pipelines is not expected to reduce existing rail revenues, but may diminish growth in future revenues of competing railroads.

Another economic issue is the employment effects of coal slurry pipelines. The OTA study findings indicate that pipelines employ less labor than does rail over their respective useful lives. However if a substantial pipeline industry were to develop, enough people probably would be employed in the construction and supply industries to offset cumulative employment impacts in the rail industry for the rest of the century.[24] Building and construction trade labor unions support the development of coal slurry pipelines. Other studies have suggested the possibility of increased employment opportunities due to the introduction of pipelines. The increase in employment is attributed to stimulation of the coal industry because of the lower transportation costs. Given current rail rates, where the cost of transportation is greater than the mine mouth price of coal, this argument may ring true.

Overall, the development of a coal slurry pipeline industry would create competition with the railroads and could reduce future increases in revenue and employment. If rail revenues were to fall significantly, other shippers (agriculture) may face increased costs. Alternatively, projected increases in coal demand would translate into increasing rail revenues, even with the development of slurry pipelines. Consumers would benefit from the reduction in coal cost, due to lower transportation costs with pipelines, through a reduction in electricity rates.

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24 OTA Summary Report, September 1980, page 9.

Economic impacts of coal slurry pipelines on rail revenues, rates and employment are indeterminate. Benefits to the public may be derived through employment in the construction and operation of coal slurry pipelines, expansion of the coal industry resulting from reduced transportation costs and from lower electricity costs.

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CHAPTER IV

SUMMARY: THE PRESENT AND THE FUTURE

The coal slurry pipeline issue is not dead. Slurry pipelines are technologically and economically feasible as evidenced by current operations in the United States and around the world. Coal slurry pipelines will, however, require eminent domain for success because of the legal impediments to construction and because the time and expense required to obtain individual rights-of-way is prohibitively high.

Coal industry and slurry pipeline supporters are gearing up their lobbying battle against the railroad industry in Congress, an arena in which they've not had much success in the past. The Slurry Technology Association (STA) and the Alliance for Coal and Competitive Competition (ACCT) have joined forces to push legislation granting Federal eminent domain rights to interstate coal slurry pipelines. Building and construction trade labor unions are also supporting the development of coal slurry pipelines.

The issues of water use, water rights, State control, interstate transfer, interstate compacts and conflicts with agricultural interests continue to be a part of the coal slurry pipeline eminent domain legislative debate. Water rights rather than water availability is the main issue. Coal slurry pipelines require a relatively small amount of water compared with other types of energy development. Water is available for pipeline use in the present,but commitment of this water may be at the expense of alternative future uses. States and individuals are wary of granting water rights, in part, because of the fear that once granted, the water right may be interpreted as interstate commerce and come under federal jurisdiction. The fear remains even though current eminent domain legislation explicitly maintains States water rights.

Environmental impacts are expected to be minimal. Agricultural land disturbed by construction of a pipeline could be reclaimed with minimal loss. Water quality is also not expected to be a problem. Slurry water is treatable using current technology to meet existing water standards and direct combustion slurries do not require water treatment.

Economic impacts will depend largely on growth in the coal industry and competition with railroads. Increased coal demand is projected to far exceed the capacity of all proposed coal slurry pipelines thereby allowing continued growth for the railroads. Coal slurry pipeline rates are estimated to be substantially below estimated rail rates. The competition with railroads should provide utilities with lower cost coal and consumers with lower cost electricity, a benefit on the regional or national level. Reduced employment opportunities in the railroad industry may be more than offset by the employment opportunities generated by the pipeline industry. Finally, because of the projected growth in coal demand and, in part, the legal limitations on cost cross subsidization, a reduction of increases in rail coal traffic should not adversely affect agricultural rail rates.

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