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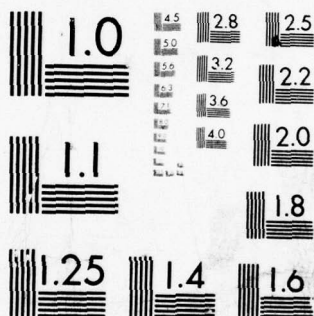
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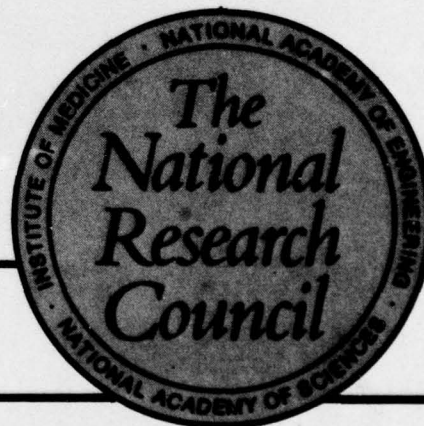
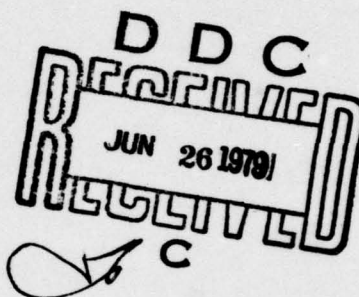
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# Critical Issues in Coal Transportation Systems

Committee Report



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Maritime Transportation Research Board

Commission on Sociotechnical Systems

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# Critical Issues in Coal Transportation Systems; Committee Report .

MARITIME TRANSPORTATION RESEARCH BOARD  
COMMISSION ON SOCIOTECHNICAL SYSTEMS  
NATIONAL RESEARCH COUNCIL



11 Apr 79

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NATIONAL ACADEMY OF SCIENCES  
WASHINGTON, D. C. 1979

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# NOTICE

The project that is the subject of this report was approved by the Governing Board of the National Research Council, whose members are drawn from the Councils of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine. The members of the committee responsible for the report were chosen for their special competences and with regard for appropriate balance.

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Maritime Transportation Research Board  
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## FOREWORD

The U.S. energy crisis and the steady depletion of known world oil reserves have turned national attention to coal as the most promising short- and medium-range alternative fuel. The increased emphasis on coal has accelerated research in all aspects of coal production, transportation, and use.

Despite much past and current research on coal transportation, no effective effort has been made to examine critical issues and, ultimately, to identify gaps where further research is required. Accordingly, an interdisciplinary committee was formed to address this problem. The areas of competence represented on the committee include distribution and transportation planning, naval architecture, economics, port development, and systems analysis. Edward Margolin, former Director of the Bureau of Economics at the Interstate Commerce Commission served as committee chairman.

I extend my thanks to the committee chairman and members, the liaison representatives, the project manager, and the review committee. I also thank the Symposium speakers and participants for their efforts.

*R. R. O'Neill*

R. R. O'Neill  
Chairman  
Maritime Transportation Research  
Board

Washington, D.C.  
December 1978

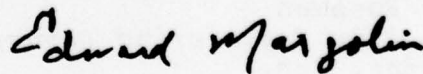
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## PREFACE

During the past year, it has been my pleasure to chair the Maritime Transportation Research Board's Committee on Critical Issues in Coal Transportation Systems. As a committee, we planned and held a Symposium addressing a number of very important issues in the U.S. system for transportation of coal.

Following the Symposium, we met several times to develop the conclusions and recommendations contained in this report. Basically, we concluded that the nation's transportation system can move whatever coal may be required for the nation's benefit in the future. We recognize that there will be difficulties but that these difficulties will be such that they can be overcome. Most of the requirements are matters of "smoothing" and improving the transportation system. A major overhaul will not be required.

Every member of this Committee has contributed from his own personal and professional experience in developing the conclusions and recommendations. It has been a most pleasurable experience to work with these men, and I extend my personal thanks to each for his contribution. At all stages of our activity, we had the benefit of the extremely valuable support of the MTRB Executive Director, RADM Randolph King; the Project Manager, Marlene Phillips; and other members of the MTRB staff.



Edward Margolin  
Chairman  
Committee on Critical Issues in  
Coal Transportation Systems

Washington, D.C.  
December 1978



COMMITTEE  
ON  
CRITICAL ISSUES IN COAL TRANSPORTATION SYSTEMS

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*Transportation Economics*  
Chevy Chase, MD

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*Project Manager*  
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Richland, WA

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Washington, DC

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*College of Mines*  
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Washington, DC

Daniel P. Maxfield  
*Chief, Technology Assessment*  
*Nonhighway Transport Systems*  
*and Special Projects*  
*U.S. Department of Energy*  
Washington, DC

\* \* \* \* \*

Marlene R.B. Phillips  
*Project Manager*  
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*Executive Director*  
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Richard W. Rumke  
*Executive Secretary*  
*Ship Research Committee*

S. Lynn Walton  
*Project Manager*  
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# CRITICAL ISSUES IN COAL TRANSPORTATION SYSTEMS

Committee Report  
An Interpretive Report



## BACKGROUND AND APPROACH

As the twentieth century moves to a close, the nation's increasing energy dependence has become an issue of major importance. A number of studies have been undertaken to develop an energy plan that would address not only the forms and quantities of energy used, but also the alternative sources, transportation modes, and types of ultimate uses.

To assist in the national assessment of this problem, the Maritime Transportation Research Board of the National Research Council formed a committee charged with identifying critical issues in coal transportation systems and with making recommendations that would contribute to the resolution of these issues. As a Committee, it was our opinion that a symposium would be the most effective medium for addressing these critical issues in coal transportation.

The Symposium was held on June 14-15, 1978. Sixteen papers addressing economic, security, labor, circuitry, regulatory, and technological issues affecting the transportation of coal were presented. Extensive question-and-answer sessions followed the delivery of each paper, and a complete record of the Proceedings of the Symposium covering rail, pipeline, inland waterway, Great Lakes, and ocean transport has been published separately.

Following the Symposium, we held several additional meetings. In keeping with the basic role of MTRB to identify issues and problems that may require research, analysis, or additional studies, our primary purpose was not to conduct any original study in the area of coal transportation, but rather to evaluate comments and discussions presented at the Symposium and to make an assessment of the issues raised. This report is, therefore, a supplement to the Proceedings of the Symposium.

## BASIC FINDINGS

Issues of supply of coal by type and origin as affected by national energy policy critically interrelate with transportation. Assuming no dramatic increases in coal supply projections, total transportation capacity is likely to be adequate. Problems that do arise will probably arise with particular modes on particular routes or at particular points, but, if the supply increase is assessed over time, even these local problems need not be insurmountable.

The supply question -- which coals will be extracted, consumed, or converted -- is influenced by a number of factors. Among these factors are incentives and constraints such as comparative transportation costs, government regulations, government energy policies (including alternative fuels and fuel prices), the interaction between private firms and labor, and the environmental versus the political and economic concerns.

On the demand side, the potential consequences of congressional and state legislative actions such as the Clean Air Act Amendments, as well as the actions and policies of other state and local government agencies, may affect the overall growth in coal use. These actions may cause a change in existing coal flow patterns and in the current trend toward the use of low-sulfur coal. An equilibrium may evolve in which the overall effect may be slower rates of growth in demand than those currently projected. While this could have an impact on the national goal of increasing coal use, concerns related to the adequacy of coal transportation will be reduced correspondingly.

Establishment of consistent policies is the function of government. The private sector is likely to wait until the relevant federal, state, and local agencies resolve the questions of whether or not coal consumption can be increased, how it can be increased, and at what economic cost. While political factors make it difficult to reach a national consensus on national policy, it is widely recognized that failure to formulate consistent policy exacerbates the national energy problem.

Although no easy solution to the overall coal supply-and-demand question exists, some basic issues require expression. To avoid the problem of constantly changing policies and regulations, a long-range energy policy should be established. The U.S. Congress should move to establish consistent energy-related goals and regulations to be administered by agencies such as the U.S. Departments of Energy and Transportation and the Environmental Protection Agency, as well as appropriate state and local governments. Incentives such as short- and medium-term subsidies may have to be provided to coal-user industries to cause desired consumption shifts and to accelerate industry decisions to shift to coal use at some future date.

To anticipate, mitigate, or prevent adverse effects on coal supply patterns caused by transportation problems, continuing studies should be conducted on a case-by-case basis. We feel that analyses of government policies, transportation factors, and technological developments should be continued



to determine the effects of trade-offs on coal distribution system planning including local versus distant supply of coal, domestic versus imported coal, the use of low-sulfur coal versus coal conversion or cleanup, and the relative Btu content of the coals. These studies should be a cooperative effort among the concerned industry groups, federal government agencies including the Departments of Energy, Transportation, and Labor, the Environmental Protection Agency, and state departments of transportation.

Basically, we consider that constant surveillance of coal supply and demand is essential so that the transporters can stay ahead of demands. This surveillance should include both domestic and international movements. Among the problems to be evaluated in connection with supply and demand are economic regulations, environmental concerns, capital formation, and public acceptance.

We emphasize that new technology should be assessed to obtain solutions for frozen coal and sludge removal problems. Constant review of security of movements against sabotage is necessary. Also needed is a systems approach to the design of the movement of coal on an intermodal basis to ensure safe, efficient, and economic movement of coal in the national interest. Cost-benefit ratios should be carefully assessed and should serve as a guide during examination of the entire coal movement system.

The following are the details of our conclusions and recommendations, along with suggestions for agencies and groups that should be concerned about the issues. Basic to these conclusions and recommendations is our assumption that the various industries within the transportation community will continue their involvement in all aspects of coal transportation research. Therefore, many of the stated recommendations focus on complementary efforts, such as those by government agencies and trade groups, that will aid these industries in making sound business decisions.

#### CONCLUSIONS AND RECOMMENDATIONS

Many of our recommendations suggest further industry-government cooperative studies. Because we are addressing coal movement as a system, information that will affect the total system must be available to all components within the system. Certain government regulations, including anti-trust, discourage industrial organizations from sharing the results of internal studies. We, therefore, reasoned that the widest possible distribution of results would be obtained

if there was a federal, state, or local government link. We feel strongly that industry and government must cooperate to ensure resolution of these coal transportation system issues and the long-term movement of the volumes of coal that the nation will require. The following is a summary of some of the basic issues to be addressed along with our recommendations for improvements.

#### Economic Regulation

A basic issue addressed at the Symposium -- and one that affects many industries, not just the coal transportation industries -- has to do with economic regulations. The United States is in a period of changing regulatory policies at all levels of government -- federal, state, and local. The major effects will be felt most strongly in the areas of service requirements, freedom of entry and exit, and rate determination in unregulated transportation versus economically regulated transportation. There is a need for a continuing assessment of specific regulations and regulatory issues affecting domestic and foreign transportation and modal coal transport substitution. In addition, the effect of domestic regulatory actions on coal export opportunities and imports substitution should be evaluated, and regulations should be developed that are consistent with desired coal transport patterns.

*We recommend that coal producers, users, and transporters in cooperation with various government agencies such as the Departments of Transportation and Commerce, the Interstate Commerce Commission, the Federal Maritime Commission, and appropriate state agencies take responsibility for conducting regular, periodic assessments of the changing regulatory climate, and that they make every effort to ensure that future regulations are based on consistent, long-range goals and on nationally accepted coal use and coal transportation patterns. Within this same context, it is important that concerned transportation industry and trade groups maintain cognizance of and participate in these decisions.*

#### Environmental Concerns

A number of key environmental concerns were also addressed at the Symposium. Some of these concerns will result in shifts in coal movement patterns or in regulations that may affect coal transportation mode choices. Among these concerns are the many technical uncertainties regarding various environmental impacts and their relationship to public health. The failure to fully define the potential health effects of coal use contributes substantially to conflicting regulations.

Uncertainty also exists in the area of coal transport forms. The development of new transport systems for such commodity form changes as coal slurry, synthetic liquids, syngas, and extra-high-voltage transmission will result in different environmental impacts from those recognized in conventional dry coal transport.

Consideration must also be given to the ecological impact of alternative energy sources such as nuclear, hydroelectric, and geothermal. The amounts, forms, and types of coal required will depend on which alternatives are adopted and to what extent. The ecological impact derived from these decisions will also be directly dependent on the selected alternative mix.

In general, a balance between increased coal-based energy consumption and environmental concerns has not been satisfactorily determined. Possible increased and/or altered coal distribution patterns will contribute to an increased level of ecological disruption and will result in additional pollution of air and water, which means reduced social acceptability of coal.

The issuance of environmental and health regulations falls within the purview of several government agencies. So long as government agency charters preclude their co-operative decision-making, an adversary procedure should be established to settle differences that affect the transportation of coal.

*We recommend that a series of studies be conducted to clarify the relationship of various environmental effects and public health. By mode and by specific ecological problem within each mode, the economic implications and trade-offs occasioned by coal-based energy and environmental and health concerns, including regional relations, should be assessed. The economics of the environmental regulations should be studied and the alternatives identified for decision-making purposes. The U.S. Congress, the U.S. Department of Energy, the Environmental Protection Agency, and the appropriate state agencies should be involved in this work.*

#### Capital Formation

Although it is surely not unique to the coal transportation industry, the problem of capital formation is very real in all sectors of the industry, especially the railroads. Given the likelihood of a sustained growth of coal production and movement, capital availability for continued maintenance



of an adequate coal distribution system is uncertain in the present and foreseeable future. The opportunity for profit should be a continuing incentive for management to develop needed transportation capacity and for investors to provide the necessary capital to finance equipment acquisition and facility expansion. However, this is not always the case. Where insolvency may be a deterrent to free-market investment, the government has established the precedent of providing financial assistance. As a last resort, further industry reliance on this assistance may be required.

*To avoid further financial involvement and the necessity of eventual ownership by the government, we recommend that study of public policies and the mechanisms for capital formation be undertaken to ascertain factors inhibiting the attraction of capital to coal distribution systems. Included in the study should be an assessment of tax equity and government transportation assistance policies and prospective incentives. The study could be a joint industry and government effort that includes agencies such as the U.S. Departments of Energy, Transportation, and Commerce, the Interstate Commerce Commission, the Federal Maritime Commission, the U.S. Army Corps of Engineers, the Federal Reserve Board, and the U.S. Treasury.*

#### Systems Approach

The development and refinement of computer analysis has added new meaning to the concept of system analysis. Current work in the area of coal transportation system analysis was the basis for several Symposium papers. Because it is probable that for most coal movements more than one mode will be utilized, the systems for movement of coal must be designed on an intermodal basis. The design should include rail, truck, water, and pipeline (slurry), except in the case of short hauls from mine to user.

Basic incompatibilities currently exist among the large number of studies of coal transport modes. Differences exist in terms of both approach and modal and/or route specificity. Also, as the system components change, new technologies such as liquid fuel-coal slurries must be introduced. This interrelation among system alternatives is an important consideration, and there is a general need for more whole-system-level data to support system route alignment comparisons.

*To support system-wide comparisons, we recommend that studies be made based on a systems approach rather than parochial mode-specific considerations. This work should*

primarily synthesize existing studies, rather than attempt to start afresh.

Analyses should also be made of intermodal coal transportation capacity and coal transfer limitations. The investigation should include an assessment of how establishment of multiple-distribution coal terminals will affect coal consumption by industrial and other non-utility users. These terminals might provide the transport advantages of large-scale operations to relatively small consumers.

Along with the basic studies, there is a need to determine in advance whether these methodologies and systems can be designed to provide adequate safety, meet security requirements, and be environmentally acceptable.

Studies in the application and effects of a systems approach should be a cooperative effort between the appropriate U.S. government agencies, private industry, and university research centers.

#### Public Acceptance

Speakers addressing the rail transport of coal expressed concern over the public acceptance problem in coal transport. The transportation of coal, especially by rail, generates many effects, such as noise and dust, that could conceivably cause a deterioration in public acceptance of some transportation methods. The passage of unit trains through small mid-western towns is also a cause of public concern. Reduced public acceptance could lead to new and tighter regulations that might escalate costs and hinder development of adequate coal transportation systems. Unless the problem is mitigated, increasing levels of public reaction can be anticipated as the volume of transported coal increases.

We recommend that a comprehensive program be undertaken to identify the potential consequences of adverse public reaction to increased coal transportation. Guidelines should be established that will outline actions to resolve possible conflicts. Such a program should involve government and parties-of-interest at all levels on a regional and local basis. The National Transportation Policy Study Commission is one appropriate group to study and determine public acceptance problems. Other federal agencies responsible for involvement of the public include the U.S. Departments of Commerce, Transportation, and Energy and the Interstate Commerce Commission.



## International Trade

The United States has traditionally held a position as a coal exporter. However, the possibility of the U.S. importation of coal was raised as a new issue that has not really been addressed to date.

Forecasting future regional and/or international markets in terms of type of coal to be used, how it will be used, constraints on its use, and requirements for use is difficult at best. Projections of future coal exports, including both metallurgical and steam coal, vary widely. Export demand is affected by alternative foreign steel-producing methodologies as well as by alternative sources of steam coal. Projections of imports of steam coal will depend on the level of enforcement of the Best Available Control Technology segment of the Clean Air Act Amendments and relative cost of imported versus domestic coal.

An underestimation of exports would lead to transport congestion and missed sales opportunities. An overestimation would lead to costly excess capacity at a number of shipment points. The effects of either will influence all sectors of the transport system, tracing back from the point of shipment through all feeder modes to the mines. The quantity, type, and origin of coal imports are issues that will further affect the total U.S.-international coal transportation system.

*To ensure that the maximum trade benefits of coal exports are realized, we recommend that the review and updating of assessments relative to uncertainties affecting transportation system requirements forecasts be continued. Based on such reviews and on recently completed and ongoing commodity forecasts for exports and imports of both steam and metallurgical coals, total system studies of coal transport should be conducted to include the following considerations:*

- *Port, terminal, and waterway constraints and desirable improvements;*
- *Technological developments including commodity form changes such as coal slurry versus dry bulk coal, and the development of restricted-draft ship designs and corresponding relation to port, terminal, and waterway constraints;*
- *Intermodal issues with respect to distribution systems to and from the points of export and import; and*
- *Effects on the existing U.S.-flag bulk carrier fleets, with particular respect to the merits of providing a significant U.S.-flag transport capability for international and coastwise trade.*

*These assessments should include cooperation between industry, industry groups, and the U.S. Departments of Energy, Transportation, and Commerce, the U.S. Congress, and the Federal Maritime Commission.*

### **Frozen Coal**

The problem of frozen coal has been recognized for a number of years. Coal freezing in rail cars, barges, and stockpiles has kept normal delivery schedules from being met at the same time that prolonged and severe cold weather conditions have created periods of high demand. Although chemicals and the use of thawing sheds can mitigate the effects, coal freezing in the future could cause significant regional shortages of coal. Conservatively, coal transportation plans should be developed with the assumption that recent severe winters may be typical for the near- and medium-term future.

*We recommend that a program of innovative research and development be conducted to establish more effective methods for ensuring that frozen coal is not a future problem. The recommended effort should address both system-level options and specific cost-effective, environmentally compatible techniques to prevent freezing or to thaw frozen coal. Studies in this area should be drawn from existing work and should involve cooperation of the U.S. Departments of Energy and Transportation and the affected segments of the coal transportation industry.*

### **Sludge Removal**

The Clean Air Act as amended was a basic issue addressed at the Symposium. These laws contain New Source Performance Standards (NSPS) and the concept of Best Available Control Technology (BACT). A current interpretation of the BACT provision, which has yet to be enforced, requires that SO<sub>2</sub> removal systems not only meet the NSPS but also be the best system existing at the time of installation. Limestone scrubbers, presently the most widely accepted SO<sub>2</sub> removal system, generate large amounts of sludge. Combined with ash collection (and depending on the sulfur content), the quantity of waste requiring disposal may approach one-half ton for every ton of coal consumed. Large increases in coal consumption may accelerate the depletion of present disposal sites and force the expansion of waste disposal systems. This expansion may necessitate increased shipping distances and, therefore, an increased dependence on transportation. To date, inadequate attention has been applied to these problems.

*We recommend that there be a complete review of all current disposal site capacities and that a determination of possible locations of acceptable new disposal sites be made and compared with areas where sludge disposal may involve a future transportation problem. If sludge transportation development in particular regions is shown to be needed, a systems approach to planning should be undertaken to ensure environmentally acceptable and cost-effective transportation of the sludge. This analysis should recognize opportunities for a sludge backhaul on what is currently a costly, one-way transport of coal.*

*In addition, investigations of the feasibility of alternative flue gas desulfurization processes as well as alternative modes of coal consumption including liquefaction, gasification, and in situ combustion should be continued. The Department of Transportation, the Environmental Protection Agency, and appropriate state and local governments should be involved in this work.*

#### Year-Round Great Lakes Navigation

As discussed by Symposium participants, the increased demand for iron ore for the steel mills on the Great Lakes and the movement of western coal by water from the upper Great Lakes to the utility companies in Michigan and Ohio have led to attempts to provide year-round navigation on the Great Lakes. The U.S. Army Corps of Engineers, the U.S. Coast Guard, and the Saint Lawrence Seaway Development Corporation (as the Winter Navigation Board) have concluded that winter navigation is possible with Coast Guard ice-breakers, bubbling systems, and other such equipment.

*We recommend that the U.S. Departments of Energy and Transportation, together with the Winter Navigation Board, assess the results and recommendations of the U.S. Army Corps of Engineers. Based on this assessment, cost-benefit determinations should be made and trade-offs determined of the possible ecological, environmental, and local community effects of maintaining an open channel.*

#### Security

The threat of deliberate disruptions of coal movements, especially in pipelines and on the railroads, is very real. The escalation of public reaction to the increased volume of coal and other energy materials movements may increase the acts of physical interference, including sabotage. Although different transportation modes have different levels of



vulnerability, potential acts of sabotage are unlikely to affect the overall future adequacy of coal transportation. The potential of railroad vulnerability appears to be mitigated by redundant routes and traditional rapid repair capabilities. However, slurry pipelines might be put out of action for long periods, especially during freezing weather.

Security breaches including physical interference with system operations could cause significant safety problems and temporary loss of supply in particular localities. This could cause a severe impact on plants that have no alternative supplies. The common practice of stockpiling coal and the overall supply system flexibility will, however, mitigate the potential effects of sabotage.

*To properly address the issue of sabotage, we recommend that further study be made of the opportunities on all modes of coal transportation for security improvements that may further reduce the possibilities of sabotage. An example of such an opportunity is the need for federal jurisdiction for railroad police and for separate communication links for security personnel. Joint efforts between industry, affected trade groups, and several government and state agencies including the U.S. Departments of Transportation, Energy, and Justice and the Interstate Commerce Commission could identify effective means for improving system-wide security.*

### Congested Waterways

Among the Symposium participants representing the various transportation sectors there was some disagreement as to the full extent of the congestion problem on the U.S. inland waterways system. However, there was little overall disagreement that, unless the issue of upgrading capacity at various major inland waterways locks and dams is resolved, increasing waterway congestion may adversely affect the future value of barge transportation as a competitive alternative for moving coal. In the long term, reduced riverside siting of coal-burning utilities may reduce the demand for barges and, therefore, reduce some of the congestion. Also, railroad, truck, and slurry modes could be expected to expand capacity to absorb the coal traffic that may be diverted from the waterways.

Although these coal transport alternatives mitigate the importance of this problem on the national level, local congestion on particular waterways could develop that, in the short term, is not readily covered by alternative supply systems. To some extent, stockpiling can cushion this short-term variability in supplies, but it will not solve the long-term issue.

Although we felt that no specific action could be recommended at this time, we believe that the problem will require continuous surveillance in order to determine and to guarantee the responsiveness of alternative modes in relieving congestion in inland waterways coal movements.



LIST OF PAPERS

SYMPOSIUM ON  
CRITICAL ISSUES IN COAL TRANSPORTATION SYSTEMS

Lecture Room - National Academy of Sciences  
Washington, DC

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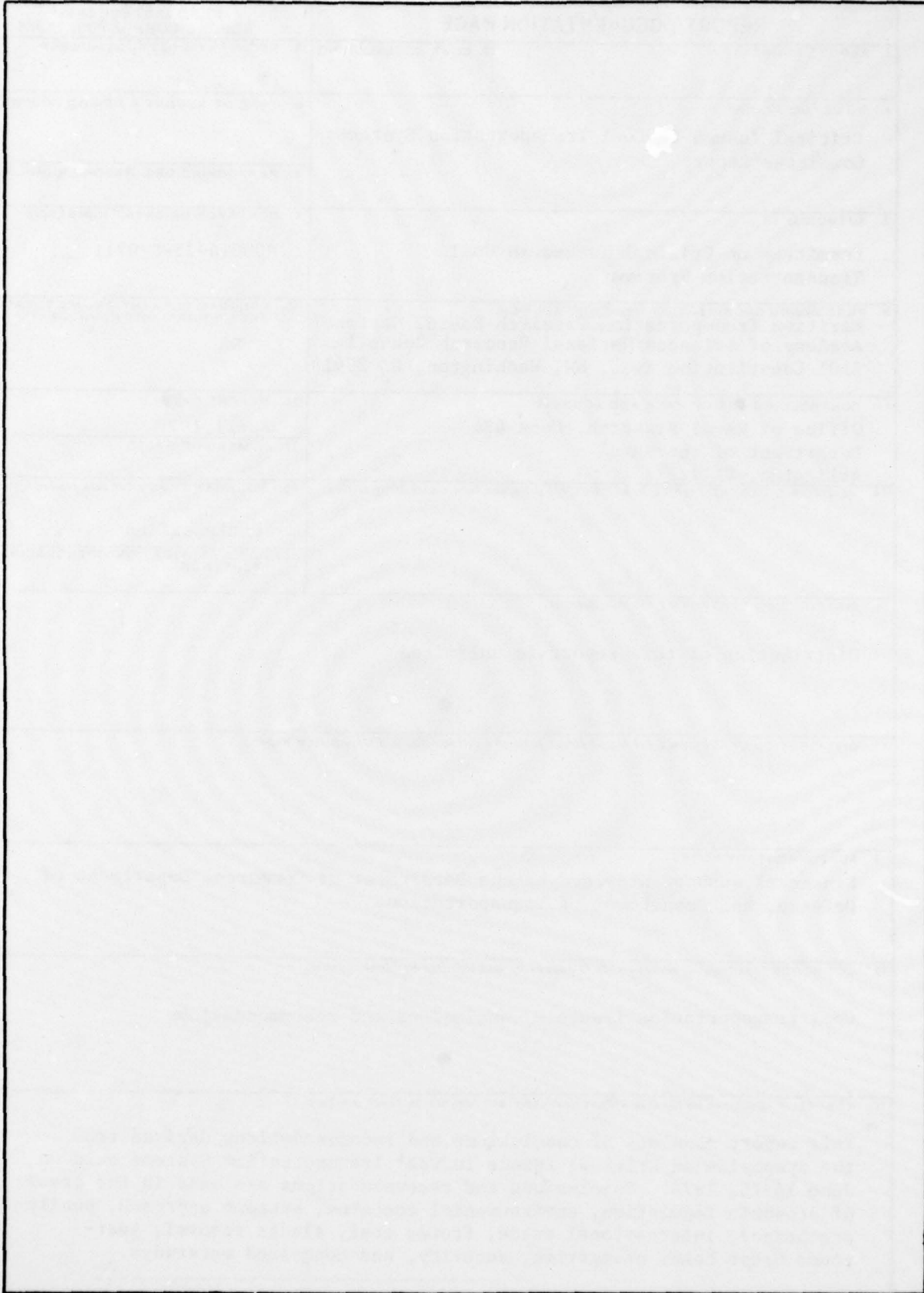
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