DOE/CS/51175--T15

Contract No. EY-76-C-03-1175
AC 03-76CS51175

June 30, 1977

DRAFT REPORT
ENERGY USE IN THE MARINE TRANSPORTATION INDUSTRY
TASK II - REGULATIONS AND TARIFFS

for

Division of Transportation Energy Conservation
Non-Highway Transport Systems
Energy Research and Development Administration
20 Massachusetts Avenue
Washington, D.C. 20545

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Mr. Richard Alpaugh
Division of Transportation
Energy Conservation
Non-Highway Transport Systems
Energy Research and
Development Administration
20 Massachusetts Avenue, N.W.
Washington, D.C. 20545

Subject: Draft Report Task II - Energy Use in the Marine Transportation Industry - Regulations and Tariffs

Dear Dick:

We are pleased to submit our draft Task II report entitled, "Energy Use in the Marine Transportation Industry - Regulations and Tariffs." We are enclosing seven copies for your use. Three copies have been forwarded to Ms. E. Romo in ERDA Oakland as required by the contract.

If you have any questions concerning this report or the conclusions reached as a result of the analysis please do not hesitate to call Mr. Leo Donovan or myself at (301) 656-2200.

Very truly yours,

BOOZ · ALLEN & HAMILTON Inc.

John G. Blackburn
Project Manager

Approved:

Leo J. Donovan
Research Director

cc: E. Romo, ERDA, Oakland, California

Enclosures

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I. INTRODUCTION AND EXECUTIVE SUMMARY

I. INTRODUCTION AND EXECUTIVE SUMMARY

This report covers the work accomplished under the second task of a four-task assignment, entitled "Energy Study of Ship Transportation Systems." This second task defines the regulatory framework of the commercial marine transportation industry and evaluates these regulations in terms of their energy impact. The objectives of the four tasks are:

- Task I — Industry Summary — to define energy use patterns in the commercial maritime transportation industry
- Task II — Regulations and Tariffs — to define the regulatory structure surrounding the commercial marine transportation sector and evaluate the energy impact of various regulations
- Task III — Efficienty Improvements — to identify conservation-related research and development programs and evaluate their impacts in terms of costs, energy savings potential, and technological risk
- Task IV — Industry Future — to define future scenarios which offer energy savings potential and evaluate the cost and energy use implications of each and recommend specific courses of action to be pursued by ERDA.

The approach used in Task II is discussed in the following section.

1. METHODOLOGY USED IN THE EVALUATION OF REGULATIONS AND TARIFFS

The approach used in the evaluation of the energy impacts of regulations and tariffs was structured around three sequential steps:

- Identification of agencies and organizations that impact the commercial marine transportation industry

- Identification of existing or proposed regulations that were perceived to have a significant energy impact

- Quantification of the energy impacts.

Each of these three steps is described in greater detail in the following sections.

(1) Agencies and Organizations That Have Jurisdiction Over the Commercial Marine Transportation Industry Were Identified

Based on the marine transportation experience of Booz, Allen's Transportation Consulting Division, and a series of interviews with federal agencies, 33 federal, state and private institutions were identified that impact the commercial marine transportation industry.

(2) Existing and Proposed Regulations With Potential for Energy Impacts Were Identified

Following the identfication of the 33 agencies, their jurisdictions were established under two major areas of influence:

- Construction aspects which was further subdivided into six areas

- Operational aspects which was further subdivided into ten areas.

Concurrent with the establishment of the agency/jurisdiction matrix, those regulations with a potential for a major energy impact were identified for further analysis in the following step.

(3) Energy Impacts Were Quantified

Discussions were held with Federal agencies and private individuals who were concerned with each of the regulations identified as having a potential for an energy impact. These discussions resulted in the identification of seven case studies in which the energy use impacts were quantifiable.

2. SUMMARY OF RESULTS AND CONCLUSIONS

The analysis of the regulatory and tariff structure of the commercial maritime transportation industry resulted in four major conclusions. Each of these is discussed below.

(1) Thirty-Three Federal, State, International and Private Organizations Were Identified That Either Impact or Have Regulatory Jurisdiction Over the Commercial Marine Transportation Industry

Thirty-three organizations, falling into four institutional categories.

- Federal
- State
- International
- Private, non-profit

were identified that impact the operations of the commercial marine transportation industry. These organizations and their areas of impacts are shown in Table I-1.

The area of impacts can affect either the design and construction or operational aspects of commercial marine transportation. These two major areas of impact were subdivided into 16 areas as follows:

- Construction - 6 subcategories
  - Propulsion machinery
  - Hull
  - Habitability
  - Environment and safety
  - Manning and licensing
  - Financial assistance
- Operational - 10 subcategories
  - Itinerary
  - Entry restrictions
  - Tariff review and filing
  - Monopoly control
  - Financial assistance
  - Cargo allocation
  - Fuel price and availability
  - Traffic control

TABLE I-1
Agencies and Their Areas of Jurisdiction in the
Commercial Marine Transportation Industry

	CONSTRUCTION ASPECTS							OPERATIONAL ASPECTS									
	PROPULSION MACHINERY	HULL	HABITABILITY	ENVIRONMENTAL AND SAFETY	MANNING & LICENSING	FINANCIAL ASSISTANCE	ITINERY	ENTRY RESTRICTIONS	TARIFF REVIEW AND FILING	MONOPOLY CONTROL	FINANCIAL ASSISTANCE	CARGO ALLOCATION	FUEL PRICE AND AVAILABILITY	TRAFFIC CONTROL	MAINTENANCE & REPAIR STANDARDS	ENVIRONMENTAL AND SAFETY
1. UNITED STATES COAST GUARD	◐	●	●	●	●									●	●	●
2. FEDERAL ENERGY ADMINISTRATION													●			
3. MARITIME ADMINISTRATION	◐	●	●	●		●	●				●	●			●	
4. FEDERAL MARITIME COMMISSION							●	●	●	●					●	
5. CLASSIFICATION SOCIETIES	◐	●	●	●	●										●	
6. ENVIRONMENTAL PROTECTION AGENCY				●												●
7. INTERGOVERNMENTAL MARITIME CONSULTATIVE ORGANIZATION	◐	●	●	●	●											●
8. INTERSTATE COMMERCE COMMISSION				●			●	●	●	●						
9. ST. LAWRENCE SEAWAY DEVELOPMENT CORP.				●										●		
10. PANAMA CANAL COMPANY		●		●										●		
11. STATE GOVERNMENTS	◐	●												●		●
12. ARMY CORPS OF ENGINEERS														●		
13. ACTION												●				
14. AGENCY FOR INTERNATIONAL DEVELOPMENT												●				
15. BONNEVILLE POWER ADMINISTRATION												●				
16. DEPARTMENT OF AGRICULTURE												●				
17. DEPARTMENT OF COMMERCE												●				
18. DEPARTMENT OF DEFENSE												●				
19. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE												●				
20. DEPARTMENT OF STATE												●				
21. DRUG ENFORCEMENT ADMINISTRATION												●				
22. ECOLOGICAL SURVEY												●				
23. ENVIHONMENTAL PROTECTION AGENCY												●				
24. FEDERAL AVIATION AGENCY												●				
25. FEDERAL HIGHWAY ADMINISTRATION												●				
26. INTER-AMERICAN DEVELOPMENT BANK												●				
27. INTERNATIONAL EXCHANGE SERVICE												●				
28. NATIONAL AERONAUTICS & SPACE ADMINISTRATION												●				
29. SMITHSONIAN INSTITUTION												●				
30. TENNESSEE VALLEY ADMINISTRATION												●				
31. UNITED STATES INFORMATION AGENCY												●				
32. UNITED STATES TRAVEL SERVICE												●				
33. EXPORT-IMPORT BANK												●				

- Maintenance and repair standards
- Environment and safety.

The 33 institutions also impact the commercial marine transportation industry in the form of direct regulatory jurisdiction and approval authority or indirectly by generating a requirement for U.S. flag shipping services through U.S. Government impelled cargoes. Twelve of the 33 organizations were judged to have direct and 21 were judged to have indirect impacts on the commercial marine transportation industry.

(2) Nine Organizations Were Identified That Had a Potential Energy Impact

The organization/jurisdiction matrix shown in Table I-1 was evaluated in terms of the potential for energy consumption impacts. Nine organizations were evaluated with respect to marine transportation energy use impacts:

. The United States Coast Guard was examined for its potential for energy impacts in two areas:

  - Mandatory vessel traffic control systems
  - Segregated ballast requirements

. The Federal Energy Administration was examined for its potential for energy impacts in the approval authority for the foreign sale of Alaskan crude oil. Transportation alternatives available for the movement of the expected crude oil surplus that will occur on the U.S. west coast to the east of gulf coast each carries a transportation energy requirement.

. The Maritime Administration was examined for its potential for energy impacts in two areas:

  - Administration of operational differential subsidy contracts

  - Administration of cargo preference laws

. The Federal Maritime Commission was examined for its potential for energy impacts in two areas:

- Regulation of conference agreements and the maintenance of competition in the liner trades

- Administration of tariff approval authority

. The Interstate Commerce Commission was examined for its potential for energy impacts in two areas:

  - Tariff approval authority for common carriers on the inland rivers which could control itinerary

  - Granting of operating authority for common carriers

. The St. Lawrence Seaway Development Corporation was examined for its potential for energy impacts in their control of traffic movements on the St. Lawrence Seaway

. The Panama Canal Company was examined for its potential for energy impacts in its control of traffic movements through the Panama Canal

. The State Governments were evaluated for their potential for energy impacts in their attempts to control both the construction and operational practices of tankers operating in their waters

. The Army Corps of Engineers was evaluated for its potential for energy impacts in two areas:

  - Traffic control through sizing and building of locks, dams and navigation aids on the inland rivers

  - Traffic diversion impacts due to the imposition of waterway user charges.

(3) Seven Existing or Proposed Regulations Were Found to Have a Quantifiable Impact on Marine Transportation Energy Consumption

The analysis of the nine organizations identified above resulted in the identification of seven specific regulations that impact or could impact commercial marine transportation energy consumption.

The energy implications of each of these regulations is examined in a separate case study in Chapters III through IX. A summary of the results of each of those analysis is given in Table I-2 and discussed briefly below.

TABLE I-2
Energy Impacts Due to Regulatory Actions

Case Study	Energy Impact Increase (Decrease) in Quads
1. Puget Sound Tanker Regulations	0.003 to 0.001
2. Foreign Sale or Alaskan Crude	0.066 to 0.103
3. Segregated Ballast	0.0 to 0.066
4. Inland Waterway User Charges	0.003 to 0.005
5. Cargo Pooling or Service Rationalization	(0.0) to (0.73)
6. Minibridge	(5×10^6 BTU's)
7. Lock and Dam 26	0.0 to 0.0007

1. The State of Washington's Tanker Construction and Operational Regulations Could Increase Transportation Energy Requirements for Alaskan Crude Oil by 0.003 to 0.001 Quads

The estimated impact in energy consumption due to the tanker construction and operational restrictions imposed by the State of Washington were evaluated under two different operating scenarios:

- The volume of crude oil moving through Puget Sound would be limited to that necessary to supply local refinery capacity

- The volume of crude oil moving through Puget Sound would be that required to feed local refinery capacity, plus the entire expected surplus of west coast crude oil was assumed to be shipped to the midwest through a proposed northern tier pipeline.

The details of this case study are presented in Chapter III. The results of that analysis are given in Table I-3.

TABLE I-3
Projected Increased Fuel Consumption
in 1980 due to H.B. 527

	16,580,000 L.T/Year Without Northern Tier Pipeline	45,928,000 L.T./Year With Northern Tier Pipeline
Baseline Transportation Energy Requirement	2.72×10^{12} BTU's	7.17×10^{12} BTU's
Increase Due to Tug Escort	$.037 \times 10^{12}$ BTU's	$.108 \times 10^{12}$ BTU's
Increase Due to Size Limitations	$.250 \times 10^{12}$ BTU's	1.040×10^{12} BTU's
Total Increase Due to H.B.527	$.287 \times 10^{12}$ BTU's	1.148×10^{12} BTU's
Increase/Baseline	10.5%	16%

2. Allowing Surplus West Coast Crude Oil Production to Be Sold to Japan Could Increase Transportation Energy Requirements by .066 to .103 Quads

The recent proposals to allow surplus west coast crude oil production to be sold to Japan in exchange for Middle Eastern crude was evaluated in terms of the energy required for transportation against three proposed domestic transportation options:

- Ship surplus to Long Beach, California, and then by pipeline to the U.S. gulf coast
- Ship surplus to Puget Sound and then by pipeline to the northern tier states
- Ship surplus to U.S. gulf coast by way of the Panama Canal.

Of the four transportation alternatives evaluated, the two options that involved a combination marine and a pipeline system required the least amount

of energy for transportation. The details of this case study are given in Chapter IV. The results of that analysis are presented in Table I-4.

TABLE I-4
Transportation Energy Requirements for Four Alternative Distribution Schemes for the Projected West Coast Crude Surplus

Option		Transportation Energy Requirements
Option 1:	Ship surplus crude to Japan in exchange for Arabian Gulf crude delivered to U.S. gulf coast	0.136 quads
Option 2:	Ship surplus to Long Beach, then by pipeline to U.S. gulf coast	0.057 quads
Option 3:*	Ship surplus to Puget Sound, then by pipeline to northern tier states	0.033 quads
Option 4:	Ship surplus to gulf coast by way of Panama Canal	0.070 quads

* Destination different than other options.

3. Imposition of Segregated Ballast Requirements Could Result in an Increase in Petroleum Transportation Energy Requirements by As Much As 0.066 Quads

Due to a series of 15 major incidents involving oil tankers off the U.S. coast or in U.S. harbors, between December 15, 1976 and March 27, 1977, the United States Congress and the U.S. Coast Guard have under consideration a regulation that would require all tankers entering U.S. waters to be fitted with segregated ballast. A requirement to dedicate a certain percentage of the available cargo tank space of a tanker to ballast service only, impacts the energy efficienty (BTU's/ton-mile) in three ways:

- Dedication of cargo tanks to ballast service reduces the amount of space available to carry cargo

- Reduction of the amount of cargo carried while operating the main propulsion plant at design conditions will result in higher speeds

- Reduction of the level at which the main propulsion plant is operated will reduce speed and total energy consumption, but increase specific fuel consumption.

In addition to these considerations, the speed/power relationship under which marine vehicles operate is nonliner such that power requirements increase faster than speed. Conversely, as speed is reduced, power requirements drop such that a two percent decrease in speed could result in as much as an eight percent reduction in power requirements.

The results of this case study indicate that the impact of segregated ballast requirements could increase the petroleum transportation energy requirements by as much as 0.066 Quads. This increase could be avoided through a reduction in speed, as shown in Table I-5. The details of this case study are presented in Chapter V.

4. Imposition of Inland Waterway User Charges Could Result in an Increase in the Transportation Energy Requirements of .003 to .005 Quads

Inland waterway user charge legislation has been introduced in Congress by every administration since the 1930's. User charges are defined by proponents as necessary for equity in modal competition and by opponents as unfairly taxing the efficient performance of the inland towing industry.

There are four options available that could be used to recover Federal operations maintenance and rehabilitation expenditures:

- Fuel tax
- Segment tolls

TABLE I-5
Energy Impact of
Segregated Ballast Requirements

Case	Operating DWT as % of Normal	Horsepower as % of Normal	Speed as % of Normal	Specific Fuel Consumption as % of Normal	Combined Impact on Productivity (BTU's/ton-mile)	Potential for Increased Energy Use (QUADS)
1	80	100%	104%	100%	+20.2%	0.066
2	80	88%	100%	101%	+11.1%	0.037
3	80	95%	102%	100.3%	+16.8%	0.055
4	80	85%	98%	101.5%	+10.0%	0.033
5	80	80%	97%	102.5%	+ 5.7%	0.019
6	80	75%	95%	103.6%	+ 2.2%	0.007
7	80	70%	92%	105.1%	0.0%	0.000

*Based on 1974 tanker energy consumption of 0.33 QUADS, Booz, Allen & Hamilton "Energy Use in the Marine Transportation Industry - Task I Industry Summary". Jan. 11, 1977.

- License fees
- Lockage fees.

Depending upon whether these four fee options are uniformly applied or river segment specific the impacts on the inland river traffic would be different. In general a uniform charge per ton-mile of use imposed through a fuel tax would impact long haul movements such as grain from the upper Mississippi to New Orleans much more than short hauls. Impacts from segment specific charges would be localized on the tributory, high cost rivers such as the Arkansas, Kentucky and the Appalachicola/Chattahoochee/Flint Rivers. It is quite conceivable that segment specific charges would elininate all commercial traffic on the high cost rivers.

The details of this case study are given in Chapter VI. It has been estimated by the Department of Transportation that depending upon the type of user charge imposed, the traffic diversions from the inland rivers to the railroads could reach as high as ten to fifteen percent. Based on a relative difference in energy intensiveness of:

- Water - 481 BTU's/ton-mile
- Rail - 655 BTU's/ton-mile

the transportation energy requirements could increase on the order of .003 to .005 quads.

5. Energy Savings Due to Pooling or Service Rationalization in the Foreign Trade Container Service Could Reach .073 Quads

Cargo pooling or service rationalization refer to actions on the part of shipping lines to maximize space utilization through the elimination of duplications and redundancies in the services offered to shippers, while maintaining the level of service offered at the level of demand. Over capacity or service redundancies result in those situations where a number of shipping lines offer all services to all shippers.

Table I-6 gives the number of containers and container-miles carried in the U.S. foreign trade in 1974.

TABLE I-6
Container-Miles in the U.S. Foreign Trade

Trade Routes	Number of Containers on the Trade Route in 1974	One Way Distance (nautical miles)	Container-Miles (millions)
5, 7, 8, 9	463,000	4,000	1,852
29	457,000	6,750	3,085
12	164,000	11,750	1,927
10	144,000	5,000	720
16	65,000	12,000	780
21	61,000	5,000	305
26	67,000	8,000	536
11	47,000	4,500	212
4	43,000	2,500	108
6	24,000	4,000	96
All others	115,000	5,000	575
	1,650,000		10,196

The potential for significant energy savings exists on those highly developed trade routes where competition has forced operators to offer all services to all shippers. A report* recently completed for the U.S. Maritime Administration indicated that a potential for energy savings on the order of 40 percent exists in the container trade on the North Atlantic (TR 5-7-8-9).

If it is assumed that a similar potential for energy consumption also exists on two other highly developed containerized trades, trade routes 29 and 12, and a potential for a ten percent reduction exists on all other trade routes, then the energy savings existing under a service rationalization scenario could approach .073 Quads. The details of this case study are given in Chapter VII.

* "The Possible Effect of Rationalization on Maritime Fuel Consumption" John Binkley, National Maritime Research Center Report No. NMRC-KP-147, Dated Oct. 1975.

6. Intermodal Container Transportation Services Offers an Energy Savings Potential That Could Reach $5x10^6$ BTU's as Compared to Traditional All-Water Routes

Minibridge service is an intermodal shipping service that combines rail and water movement of container cargo in competition with all water routes.

Certain shipping interests have challenged the minibridge service on the grounds that it violated:

- Sections 15, 16, 17 & 18 of the Shipping Act of 1916
- Section 8 of the Merchant Marine Act of 1920

The question at issue was the diversion of cargo from traditional ports of embarkation.

As shown in Figure I-1 there are five intermodal movements that compete with traditional all-water routes:

- U.S. Gulf Coast to Far East Minibridge
- U.S. Atlantic Coast to Far East Minibridge
- Far East to Europe Landbridge
- U.S. Gulf Coast to Europe Minibridge
- U.S. Pacific Coast to Europe Minibridge.

Each of these multimodal transportation systems offer an energy savings as shown in Table I-7. The details of this case study are given in Chapter VIII.

7. Constraining Traffic Growth Through Lock and Dam 26 by Not Increasing Capacity Could Result in Increased Transportation Energy Consumption Due to Diversion of Cargo to Railroads on the Order of 0.0007 Quads

Lock and Dam 26 (L&D 26) located on the Mississippi River at Alton, Illinois, is a facility that, according to the Army Corps of Engineers, is limiting the amount of traffic that can move between the Upper Mississippi-Illinois River systems and the Ohio-Lower Mississippi River systems.

TABLE I-7
Energy Savings Potential of Intermodal
Container Transportation Systems

Option	Mode	BTU's/Ton	Savings (BTU's/Ton)	1974 All Water Container Movement (Long Tons)		Potential for Energy Savings (BTU's x 10^6)	
				Trade Route	L. Tons	High	Low
1. Minibridge N.Y. to Yokohama	Rail	2.02		12	2,141,200	4.48	4.35
	Water	4.01		½ of 18	20,800		
Total		6.03					
All water direct	Water	8.04	2.01 to 2.07	Total	2,162,000		
All water indirect	Water	8.10	(25% to 26%)				
2. Minibridge Gulf Coast to Yokohama	Rail	1.25		22	36,400	0.11	0.07
	Water	4.01		½ of 18	20,800		
Total		5.26					
All water direct	Water	6.57	1.31 to 1.89	Total	57,200		
All water indirect	Water	7.15	(20% to 26%)				
3. Far East to Europe Landbridge	Rail	2.02			Unknown	Unknown	Unknown
	Water	6.81					
Total		8.83	0.22 (2%)				
All water	Water	9.05					
4. Los Angeles-Europe Minibridge	Rail	2.02					
	Water	2.80		26	819,000		
Total		4.82	0.78 (14%)	65	68,600	0.69	0.69
All water	Water	5.60		Total	887,900		
5. Gulf Coast to Europe Minibridge	Rail	0.66		21	891,500		
	Water	2.80		13	122,500	0.04	0.04
Total		3.46	0.04 (1%)	Total	1,014,000		
All water	Water	3.50					

There presently exists a controversy surrounding L&D 26. Major repair work on the facility is necessary and the positions of the various interest groups are:

- Railroad and allied conservation interests that want to restrict any work to a minimum repair of the existing facility with no increase in capacity

- The Army Corps of Engineers and allied river towing interests that want to replace the existing structure with a new and larger facility two miles downstream of the present site.

The present facility is reaching capacity. This capacity limitation has an energy consequence:

- Delays result in increased non-productive idling time which increases fuel consumption

- Delays result in diversion of cargo to the railroads whose energy intensiveness is greater than the inland river towing industry.

The increased energy consumption due to these two factors is shown in Table I-8. The details of this case study are given in Chapter IX.

TABLE I-8
Additional Energy Consumed (1980) Resulting From No Additional Capacity at Lock and Dam 26

Item	Energy (BTU's)
Additional energy due to idling of towboats	$.120 \times 10^{12}$
Additional energy due to cargo diversion to rails	$.546 \times 10^{12}$
TOTAL	$.666 \times 10^{12}$

(4) Two Proposed Legislative Actions Will Cause A Change in Transportation Energy Consumption Patterns But Have Little Effect on the Amount of Fuel Consumed

Two recent legislative actions have been initiated that would change the existing fuel consumption patterns. Cargo preference legislation would reserve a portion (approximately 30 percent) of all petroleum imports for United States flag registered vessels. In addition, a bill has been introduced to bring the Virgin Islands under the cabatoge laws of the United States. This would reserve all waterborne movements from the Virgin Islands to the U.S. mainland for U.S. flag vessels.

Currently, U.S. flag tankers carry approximately seven percent of all U.S. petroleum imports. The effect of cargo preference legislation would shift approximately 23 percent of the tanker fuel consumption from foreign flag to U.S. flag. Very minor changes in total fuel consumption are expected due to these actions.

3. ORGANIZATION OF THE REPORT

This report is organized around nine chapters. Chapter I contains and introduction and summary of the results and conclusions. Chapter II describes the regulatory structure of the commercial marine transportation industry and includes:

- A description of the role of each organization and the legislative basis for their jurisdiction
- An identification of major areas of regulation and those areas that have an energy impact.

Chapters III and IX each address one of the seven existing or proposed regulatory or legislative actions that have an energy impact. The results of each of these seven case studies are summarized above.

II. THE REGULATORY STRUCTURE OF THE COMMERCIAL MARINE TRANSPORTATION INDUSTRY

II. THE REGULATORY STRUCTURE OF THE COMMERCIAL MARINE TRANSPORTATION INDUSTRY

The commercial marine transportation industry is subject to regulatory actions from four institutional categories:

- Federal
- State
- International
- Private nonprofit.

This report identifies 33 agencies in these categories and has classified their jurisdiction into two areas: construction, and operational, as shown in Table II-1. Each of the 33 organizations are described in the following sections.

1. SIX REGULATORY BODIES WERE JUDGED TO HAVE AN IMPACT ON COMMERCIAL MARINE TRANSPORTATION ENERGY USE

Six of the 33 organizations were judged to have a quantifiable impact on commercial marine transportation energy usage. These six organizations and their area of impacts are shown in Table II-2. These organizations impacted energy use in seven specific instances. In the following sections each of the six organizations:

- U.S. Coast Guard
- Federal Energy Administration
- Intergovernmental Maritime Consultative Organization
- U.S. Federal Maritime Commission
- State Governments
- U.S. Army Corps of Engineers

is described in terms of their regulatory functions, enabling legislation and areas of impact or energy consumption. Each of the specific agency/impact pairs identified is the subject of an individual case study contained in Chapters III through IX.

(1) U.S. Coast Guard (USCG)

The United States Coast Guard (USCG) was established by the act of January 28, 1915 (14 U.S.C.1).

Table II-1
Agencies and Their Areas of Jurisdiction in the Commercial Marine Transportation Industry

	CONSTRUCTION ASPECTS							OPERATIONAL ASPECTS									
	PROPULSION MACHINERY	HULL	HABITABILITY	ENVIRONMENTAL AND SAFETY	MANNING & LICENSING	FINANCIAL ASSISTANCE	ITINERY	ENTRY RESTRICTIONS	TARIFF REVIEW AND FILING	MONOPOLY CONTROL	FINANCIAL ASSISTANCE	CARGO ALLOCATION	FUEL PRICE AND AVAILABILITY	TRAFFIC CONTROL	MAINTENANCE & REPAIR STANDARDS	ENVIRONMENTAL AND SAFETY
1. UNITED STATES COAST GUARD	●	●	●	●	●									●	●	●
2. FEDERAL ENERGY ADMINISTRATION													●			
3. MARITIME ADMINISTRATION	●	●	●	●		●	●				●	●			●	
4. FEDERAL MARITIME COMMISSION							●	●	●	●						
5. CLASSIFICATION SOCIETIES	●	●	●	●	●										●	
6. ENVIRONMENTAL PROTECTION AGENCY				●												●
7. INTERGOVERNMENTAL MARITIME CONSULTATIVE ORGANIZATION	●	●	●	●	●											●
8. INTERSTATE COMMERCE COMMISSION				●			●	●	●	●						
9. ST. LAWRENCE SEAWAY DEVELOPMENT CORP.				●										●		
10. PANAMA CANAL COMPANY		●		●										●		
11. STATE GOVERNMENTS	●	●												●		●
12. ARMY CORPS OF ENGINEERS														●		
13. ACTION												●				
14. AGENCY FOR INTERNATIONAL DEVELOPMENT												●				
15. BONNEVILLE POWER ADMINISTRATION												●				
16. DEPARTMENT OF AGRICULTURE												●				
17. DEPARTMENT OF COMMERCE												●				
18. DEPARTMENT OF DEFENSE												●				
19. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE												●				
20. DEPARTMENT OF STATE												●				
21. DRUG ENFORCEMENT ADMINISTRATION												●				
22. ECOLOGICAL SURVEY												●				
23. ENVIRONMENTAL PROTECTION AGENCY												●				
24. FEDERAL AVIATION AGENCY												●				
25. FEDERAL HIGHWAY ADMINISTRATION												●				
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30. TENNESSEE VALLEY ADMINISTRATION												●				
31. UNITED STATES INFORMATION AGENCY												●				
32. UNITED STATES TRAVEL SERVICE												●				
33. EXPORT-IMPORT BANK												●				

Table II-2
Agencies and Jurisdictions That Have an Energy Use Impact

	CONSTRUCTION ASPECTS							OPERATIONAL ASPECTS									
	PROPULSION MACHINERY	HULL	HABITABILITY	ENVIRONMENTAL AND SAFETY	MANNING & LICENSING	FINANCIAL ASSISTANCE	ITINERY	ENTRY RESTRICTIONS	TARIFF REVIEW AND FILING	MONOPOLY CONTROL	FINANCIAL ASSISTANCE	CARGO ALLOCATION	FUEL PRICE AND AVAILABILITY	TRAFFIC CONTROL	MAINTENANCE & REPAIR STANDARDS	ENVIRONMENTAL AND SAFETY
1. UNITED STATES COAST GUARD				●												
2. FEDERAL ENERGY ADMINISTRATION													●			
3. MARITIME ADMINISTRATION																
4. FEDERAL MARITIME COMMISSION							●			●						
5. CLASSIFICATION SOCIETIES																
6. ENVIRONMENTAL PROTECTION AGENCY																
7. INTERGOVERNMENTAL MARITIME CONSULTATIVE ORGANIZATION																
8. INTERSTATE COMMERCE COMMISSION																
9. ST. LAWRENCE SEAWAY DEVELOPMENT CORP.																
10. PANAMA CANAL COMPANY																
11. STATE GOVERNMENTS	●	●												●		●
12. ARMY CORPS OF ENGINEERS														●		
13. ACTION																
14. AGENCY FOR INTERNATIONAL DEVELOPMENT																
15. BONNEVILLE POWER ADMINISTRATION																
16. DEPARTMENT OF AGRICULTURE																
17. DEPARTMENT OF COMMERCE																
18. DEPARTMENT OF DEFENSE																
19. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE																
20. DEPARTMENT OF STATE																
21. DRUG ENFORCEMENT ADMINISTRATION																
22. ECOLOGICAL SURVEY																
23. ENVIRONMENTAL PROTECTION AGENCY																
24. FEDERAL AVIATION AGENCY																
25. FEDERAL HIGHWAY ADMINISTRATION																
26. INTER-AMERICAN DEVELOPMENT BANK																
27. INTERNATIONAL EXCHANGE SERVICE																
28. NATIONAL AERONAUTICS & SPACE ADMINISTRATION																
29. SMITHSONIAN INSTITUTION																
30. TENNESSEE VALLEY ADMINISTRATION																
31. UNITED STATES INFORMATION AGENCY																
32. UNITED STATES TRAVEL SERVICE																
33. EXPORT-IMPORT BANK																

Originally, the USCG served as a Federal maritime law enforcement agency, operating under the Department of the Treasury. The USCG became a part of the Department of Transportation on April 1, 1967, in accordance with the Department of Transportation Act of October 1966 (80 Stat. 931).

The four missions of the USCG are:

- The minimization of loss of life, personal injury and property damage on and under the high seas and all waters subject to U.S. jurisdiction
- To facilitate waterborne activity in support of national economic, scientific, defense and social needs
- To assure the safety and security of vessels, ports and waterways
- To maintain or improve the quality of the marine environment.

These four missions impact the construction, manning and operation of all vessels in U.S. territorial waters of both United States and foreign registry.

The regulations promulgated by the USCG generally take the form of minimum engineering or performance standards or criteria, that have to be met prior to a vessel being licensed or offshore artificial islands and fixed structures allowed to operate. Additionally, the USCG establishes qualifications and testing requirements for merchant marine personnel, provides a clean up capability for discharges into the marine environment and maintains a search and rescue capability.

Two areas within the USCG sphere of operations are expected to have an adverse energy impact:

- Clean ballast requirements
- State versus Federal control of the marine environment.

Each of these impact areas is discussed in more detail below.

1. Clean Ballast Requirements

On May 13, 1975, the USCG published an Advanced Notice of Proposed Rule Making that would require all tankers larger than 70,000 DWT, calling at U.S. ports, to be equipped with a segregated ballast system.

Segregated ballast capability effectively reduces the cargo carrying capability of a tanker. As a result, the transportation energy intensiveness measure (BTU's/ton-mile) of petroleum movements will increase due to a reduction in the amount of cargo that a vessel can carry per trip. This case study is examined in more depth and the energy consequences quantified in Chapter V.

2. State Versus Federal Control of the Marine Environment

On May 29, 1975, the State of Washington enacted a tanker control law setting forth guidelines applicable to the construction and operation of crude oil tankers calling in Puget Sound. This action carries with it a much broader issue relative to the rights of the states to promulgate regulations more stringent than those required by the Federal Government.

This area is examined in greater detail later in this chapter, and the energy consequences quantified in Chapter III.

(2) The Federal Energy Administration (FEA)

The Federal Energy Administration was established from the Federal Energy Office (established under an executive order on December 17, 1973), as an independent agency operating under the Federal Energy Administration Act of 1974 (15 USC 762), effective July 1, 1974. The FEA was created in response to the 1973-1974 oil embargo. Its missions are to:

- Conserve energy supplies
- Insure fair and efficient distribution of energy supplies

- Maintain fair and reasonable consumer prices for energy supplies

- Promote the expansion of readily usable energy sources.

The original legislation that created the FEA provided for its expiration on June 30, 1976. The FEA's charter was subsequently extended by Congress for one month to August 31, 1976. On August 14, 1976, the Energy Conservation and Production Act (PL 94-385), was passed by Congress. It provided for an extension to December 31, 1977.

Upon completion of the Trans-Alaskan pipeline in mid-1977, it is ecpected that the west coast supply of curde oil will exceed demand by a substantial margin. Estimates by the FEA indicate that by the second quarter of 1978, the west coast surplus is expected to grow to 0.5 million barrels per day. Table II-3 gives the current west coast surplus projections through 1985.

Table II-3
Projected West Coast Crude Oil Surplus

Year	Surplus
1978	0.500 million barrels
1980	0.650 million barrels
1983	0.825 million barrels

A number of potential distribution alternatives have been proposed and are shown in Figure II-1. They are:

- A possibility of a crude oil swap with Japan which requires FEA approval

- Shipment of surplus to the gulf coast via the Panama Canal

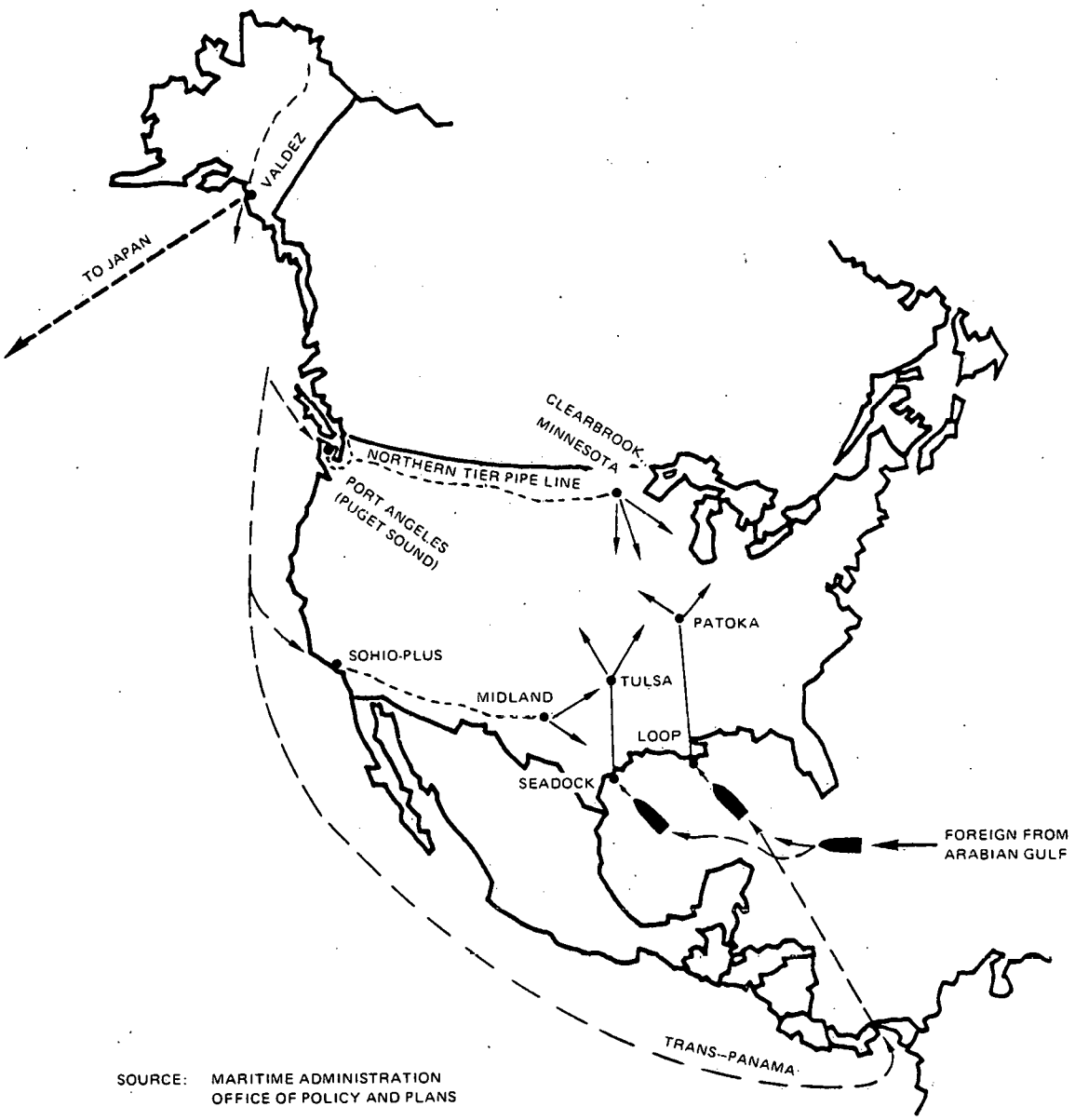


FIGURE II-1
Distribution Alternative for
West Coast Crude Surplus

- Northern tier pipeline
- Sohio-Plus pipeline.

Each of the options has a specific transportation energy requirement associated with it. These requirements are examined further in Chapter IV.

(3) Intergovernmental Maritime Consultative Organization (IMCO)

The Intergovernmental Maritime Consultative Organization is an arm of the United Nations, headquartered in London. IMCO has a membership that includes all maritime nations. Areas of interest to the international maritime community are discussed and standardized in the form of codes and conventions. These codes are then adopted on a country-by-country basis.

In the United States, adoption of an IMCO code or convention is identical to ratification of a treaty, and requires the approval of the U.S. Senate. The Federal enforcement arm is the U.S. Coast Guard. Table II-4 lists the codes and conventions adopted by IMCO. Those conventions, with a specific date listed in parentheses, indicates the date that the convention was adopted by the United States.

In addition, codes exist for:

- Existing ships carrying liquified gases in bulk
- Construction and equipment for ships carrying dangerous chemicals in bulk
- International maritime dangerous goods
- Safety practice for bulk cargoes.

The energy impact of IMCO regulations was previously discussed under the U.S. Coast Guard.

Table II-4
IMCO Codes and Conventions

1. Convention for the Safety of Life at Sea, 1948, (SOLAS '48-Nov. 19, '52)
2. Convention for the Safety of Life at Sea, 1960 (SOLAS '60-May 26, '65)
3. Convention for the Safety of Life at Sea, 1974 (SOLAS '74)
4. Regulations for Preventing Collisions at Sea, 1960 (COLREG '60-Sept. 1, '65)
5. Regulations for Preventing Collisions at Sea, 1972 (COLREG '72-July 15, '77)
6. Convention for Prevention of Sea Pollution by Oil, 1954 (OILPOL '54-May 26, '58)
7. Convention for Prevention of Pollution from Ships, 1973 (MARPOL '73)
8. Convention on Facilitation of International Maritime Traffic, 1965 (FAL '65-March 5, '67)
9. Convention on Load Lines, 1966 (LL '66-July 21, '68)
10. Convention on Tonnage Measurement of Ships, 1969 (TONNAGE '69)
11. Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties, 1969 (INTERVENTION '69-May 6, '75)
12. Protocol Relating to Intervention on the High Seas in Cases of Marine Pollution Other Than Oil, 1973 (INTERVENTION PROT '73)
13. Convention on Civil Liability for Oil Pollution Damage, 1969, (CLC PROT '76)
14. Protocol to the Convention on Civil Liability for Oil Pollution Damage, 1969 (CLC '69-June 19, '75)
15. Special Trade Passenger Ships Agreement, 1971 (STP '71-Jan. 2, '74)
16. Protocol on Space Requirements for Special Trade Passenger Ships, 1973 (SPACE STP '73-June 2, '77)
17. Convention Relating to Civil Liability in the Field of Maritime Carriage of Nuclear Material, 1971 (NUCLEAR '71-July 15, '75)
18. Convention to Establish International Fund for Compensation for Oil Pollution Damage, 1971 (FUND '71)
19. Protocol to the Convention on Establishment of an International Fund for Compensation for Oil Pollution Damage, 1971 (FUND PROT '76)
20. Convention on Prevention of Pollution by Dumping of Waste and Other Matters, 1972 (Aug. 30, '75)
21. Convention for Safe Containers, 1972 (CSC '72-Sept. 6, '77)
22. Athens Convention Relating to Carriage of Passengers and Their Luggage by Sea, 1974 (PAL, '74)
23. Protocol to the Atehns Convention Relating to Carriage of Passengers and Their Luggage by Sea, 1974 (PAL PROT '76)
24. Convention on International Maritime Satellite Organization (INMARSAT C)
25. Operating Agreement on International Maritime Satellite Organization (INMARSAT OA)
26. Convention on Limitation for Maritime Claims, 1976 (LLMC '76)

(4) The Federal Maritime Commission

The Federal Maritime Commission (FMC) was established as an independent agency on August 12, 1961, by Reorganization Plan No. 7. The FMC administers regulatory functions contained in:

- Shipping Act of 1916
- Merchant Marine Act of 1920
- Intercoastal Shipping Act of 1933
- Merchant Marine Act of 1936 as amended
- Act of November 6, 1966 (80 Stat. 1356, 46 USC 362)
- Water Quality Improvement Act of 1970.

The primary purpose of the FMC is to protect the interest of the public by regulation of foreign and domestic offshore waterborne commerce. It does this through regulation of freight rates, service characteristics and practices and agreements between common carriers. Two regulatory functions of the FMC were investigated with respect to their impacts on energy consumption of the commercial maritime transportation industry.

1. Cargo Pooling and Service Rationalization

The FMC is charged with safeguarding the public's interest by approving tariffs and regulating operating practices of common carriers. Cargo pooling and service rationalization, as used in this report, is defined as an effort on the part of competing shipping companies to eliminate duplicate services offered to shippers.

The elimination of duplicate service would increase the utilization of vessels and hence their productivity. This question is examined in greater detail in Chapter VII.

2. The Availability of Intermodal Container Transportation Service

Minibridge service is a term applied to specific intermodal shipments that move on routes that combine rail and water legs, rather than all-water movements. The Far East minibridge service, inaugurated in 1972, is one such minibridge service offered to exporters or importers on the gulf and Atlantic coasts.

Traditional shipping patterns would move goods between the U.S. gulf and Atlantic coasts and the Far East by an all-water route via the Panama Canal. Minibridge service inserts a rail leg between the U.S. gulf and Atlantic coasts and the Pacific coast, then a water leg to the Far East. The energy consumption consequences of five minibridge services are examined in greater detail in Chapter VIII.

(5) State Governments

As previously mentioned in the discussion of the U.S. Coast Guard, various coastal state governments are enacting legislation that impact the development of ports, and the operations and movements of vessels in their contiguous waters. These individual reactions of the various states are a direct result of a desire to limit polluting incidents in their waters. The various states and their actions are:

- The Great Lakes/St. Lawrence Seaway, States of New York and Michigan require all vessels to be equipped with holding tanks for sewage, bilge slops, etc., creating a zero discharge area in the Great Lakes.

- The State of Washington has enacted a law that would require double bottoms on all tankers operating in their waters. This case has been chosen for a more detailed analysis.

- The State of Alaska has legislation pending similar to the Washington State law.

- The State of Maine has promulgated regulations similar to those enacted by the State of Washington.

- The State of California has legislation similar to the State of Washington law pending.

As discussed later, there is a jurisdiction question that arises between those states who are acting unilaterally and the U.S. Coast Guard who is assigned Federal responsibility in the area of vessel safety regulations and coastal water pollution control.

The energy use impacts of the unilateral actions on the part of the State of Washington is examined in Chapter III.

(6) The Army Corps of Engineers (COE)

The U.S. Army Corps of Engineers has many responsibilities, their primary function being combat engineering support. In the area of domestic waterborne commerce, the COE is also responsible for the construction, operation and maintenance of the U.S. Inland Waterway System.

The domestic waterway system is comprised of approximately 1,600 individual projects covering 25,500 miles of navigable waterways and 230 individual locks and dams at numerous locations. Legislation that assigned this responsibility to the COE are:

- Major Control Act of 1936
- River and Harbor Act of 1938
- Flood Control Act of 1944
- River and Harbor Act of 1945.

In addition to these four pieces of legislation, each of the 1,600 individual projects that together make up the domestic waterway system have generally been authorized and funded by individual legislative actions. Two aspects of the COE's jurisdiction were chosen for further analysis.

1. Lock and Dam 26

The COE, in discharging its inland waterway management responsibilities determines the size and design of those projects that it undertakes. The size and depth of the locks and channels

determines their capacity. Currently, Lock and Dam 26 (L&D 26) on the Mississippi River is viewed as a bottleneck that is limiting traffic between the upper Mississippi-Illinois and the lower Mississippi-Ohio River systems.

L&D 26 is currently in need of repairs and a controversy exists between:

- Railroad and allied conservation interests that wish to hold the capacity of L&D 26 at its present levels
- The COE and allied river towing and agriculture interests that want to increase the capacity of L&D 26 to bring it into line with the upstream and downstream facilities.

The energy consequences of this decision are examined in Chapter IX.

2. Inland Waterway User Charges

In 1974, the Federal Government spent approximately $660 million providing support to the inland waterway transportation industry in the form of:

- River bank stabilization
- Dredging
- Construction, operation and maintenance of locks and dams
- Providing aids to navigation.

Of this amount, $385 million was spent on the inland river system. In the Presidential FY77 budget, the Office of Management and Budget proposed levying an $80 million tax via river segment tolls and lockage fees on the shallow draft navigation system of the U.S. This tax was designed to recover one-half of the Federal operating, maintenance and repair (OM&R) expenditures in 1977. By 1979 it was proposed that the recovery level would be increased to 100 percent of OM&R.

Waterway user charge legislation has been introduced in Congress by every administration since the 1930's. User charges are proposed by some as necessary for equity in modal competition and opposed by others as unfairly taxing the efficient performance of the barge industry. A major concern of all parties involved is the impact on the inland river transportation industry.

Various cost recovery schemes have been proposed including:

- Segment tolls
- Lockage fees
- Tonnage tax
- Fuel tax.

However, the impacts of each are quite different. The energy consequences of this decision are examined in Chapter VI.

2. TWENTY-SEVEN ORGANIZATIONS THAT INFLUENCE THE COMMERCIAL MARINE TRANSPORTATION INDUSTRY HAVE LITTLE OR NO IMPACT ON ENERGY USE

There are 27 additional organizations, either Federal or private nonprofit that influence the commercial marine transportation industry:

- The U.S. Maritime Administration
- Classification societies
- Environmental Protection Agency
- Interstate Commerce Commission
- St. Lawrence Seaway Development Corporation
- Panama Canal Company
- Twenty-one other Federal organizations that generate a demand for ocean shipping services.

Each organization is discussed below.

(1) The Maritime Administration (MarAd)

The Maritime Administration is located within the Department of Commerce and is under the direction of the Assistant Secretary of Commerce for Maritime Affairs. MarAd was created by the Reorganization Plan No. 21 of 1950 (84 Stat. 1036). The Reorganization Plan No. 7 of 1961 (75 Stat. 840), abolished the Federal Maritime Board and its functions were split between the Secretary of Commerce (MarAd) and the Federal Maritime Commission.

The missions of MarAd are varied and have their origins in the following Acts:

- Shipping Act of 1916
- Merchant Marine Act of 1936 as amended
- Merchant Marine Act of 1970
- Food for Peace Act P.L. 480
- Cargo Preference Act P.L. 664
- Public Resolution 17 (P.R. 17).

The major regulatory or administrative functions of MarAd that impact the commercial maritime transportation industry are:

- Title XI Mortgage Guarantee Insurance
- CDS — Construction Differential Subsidy
- CDS — Operational Differential Subsidy
- Cargo Preference Administration.

(2) Classification Societies

There are several private nonprofit classification societies that operate throughout the world. They publish rules and regulations that set structural engineering requirements and machinery performance standards for vessels that are registered with that society. These organizations date from the era of wooden ships, and were originally formed by and for the interest of marine underwriters to provide:

- A list of merchant vessels
- Essential physical particulars
- Class ratings indicating physical condition as a guide to insurance risk.

These societies have grown in importance to the influential technical groups of today that set minimum construction standards for all of today's merchant vessels. These societies, their dates of founding and headquarters' locations are given in Table II-5.

The goals of the classification societies are to insure that vessels registered are seaworthy and safe. The energy use impact of these rules was judged to be minimal.

Table II-5
Classification Societies

Society	Date of Founding	Headquarters Location
Lloyds Register of Shipping	1760	London
Bureau Veritas International Register of Shipping	1828	Paris
Registro Italiano Navale	1861	Genoa
American Bureau of Shipping	1862	New York
Det Norske Veritas	1864	Oslo
Germanischer Lloyds	1867	Hamburg
Teikoku Kaiji Kyokai	1899	Tokyo
Registry of Shipping of USSR	1935	Moscow

Source: "Design and Construction of Steel Merchant Ships," David Arnott, Society of Naval Architects and Marine Engineers.

(3) Environmental Protection Agency (EPA)

The Environmental Protection Agency was established as an independent agency to permit coordinated and effective Federal action to protect the environment. It was established as a result of the Reorganization Plan No. 3 of 1970. The energy use impact of the rules and emission criteria established by the EPA was judged to be minimal.

(4) Interstate Commerce Commission (ICC)

The Interstate Commerce Commission was created as an independent regulatory agency by the Act to Regulate Commerce on February 4, 1887 (24 Stat. 379, 383; 49 USC 1-22), now known as the Interstate Commerce Act. This Act has been amended by subsequent legislation:

- Hepburn Act
- Panama Canal Act
- Motor Carrier Act of 1935
- Transportation Acts of 1920, 1940 and 1958
- Railroad Revitalization and Regulatory Reform Act of 1976.

The ICC's function is to regulate, in the public's interest, all common carriers which are engaged in transportation in interstate commerce, as well as any foreign commerce that takes place in the United States.

Carriage of agricultural products and bulk commodities on the inland rivers is not subject to ICC regulations. Approximately 93 percent of all ton-miles carried on the inland rivers of the U.S. in 1974 were not subject to ICC regulations. For this reason, the impact of the ICC on the energy use of the domestic commercial maritime transportation industry was judged to be minimal.

(5) St. Lawrence Seaway Development Corporation (SLSDC)

The St. Lawrence Seaway Development Corporation was established by an Act of Congress on May 13, 1954 (68 Stat. 92), as amended (71 Stat. 307, 80 Stat. 943, 84 Stat. 1018), and transferred to the Department of Transportation by the Department of Transportation Act of 1966 (80 Stat. 931). The SLSDC was established for the purpose of building, operating and maintaining deep-water navigation through the St. Lawrence River and the Great Lakes in conjunction with the St. Lawrence Seaway Authority of Canada.

The SLSDC regulates all marine traffic through the St. Lawrence Seaway and requires the use and/or

presence of tugs for certain sized vessels and at times can inhibit the movement of vessels for operational or safety reasons. The energy use impact of these activities is judged to be minimal.

(6) The Panama Canal Company (PCC)

The Panama Canal Company was incorporated as an agent of the U.S. by the Act of June 29, 1948 (62 Stat. 1076), as amended by the Act of September 26, 1950 (64 Stat. 1041). The management of the corporation is vested in a board of directors with the Secretary of the Army delegated by the President of the United States to represent the U.S. as the "stockholder."

The Panama Canal Company operates, maintains and conducts all business operations of the Panama Canal. In this capacity, the PCC regulates all marine traffic through the canal and establishes regulations concerning the use or presence of tugs and pilots during a vessel's transit. At times, vessels may be forced to divert or wait due to operational or safety reasons. The energy use impact of these activities is judged to be minimal.

(7) Organizations Generating a Requirement for Ocean Shipping Services

There are over 20 different government agencies that generate a demand for shipping services. These agencies and the amount of government-impelled cargo generated during 1974 are shown in Table II-6.

The requirement to ship a certain percentage of government-impelled cargo via U.S. flag carriers originates in:

- Cargo Preference Act - PL-664
- Food for Peace Act - PL-480
- Public Resulution 17.

PL-664, the Cargo Preference Act, requires that at least 50 percent of all government generated cargo be shipped on U.S. flag vessels, to the extent that such vessels are available at fair and reasonable rates. PL-480, the Food for Peace Act, also requires U.S. flag participation in the carriage of food exports. Public Resolution 17 extends cargo preference to cargo generated by the Export-Import Bank.

Table II-6
Agencies Generating Government Impelled Cargo
(1974)

Shipper	Total Cargo Long Tons ($ Shipping Revenue)	% U.S. Flag
Action	26	87
Agency for International Development	3,607,796	35
Bonneville Power Administration	7,647	42
Department of Agriculture	1,378,583	50
Department of Commerce	42	83
Department of Defense	163,348	43
Department of Health,Education & Welfare	64	95
Department of State	8,152	74
Drug Enforcement Administration	12	95
Ecological Survey	31	79
Environmental Protection Agency	12	95
Federal Aviation Agency	35	94
Federal Highway Administration	965	78
Inter-American Development Bank	20,844	28
International Exchange Service	195	97
National Aeronautics & Space Administration	497	81
Smithsonian Institute	50	78
Tennessee Valley Administration	1,810	64
U.S. Information Agency	5,010	83
U.S. Travel Service	189	92
Export-Import Bank	($192,000,259)	81
Others	43	90

The U.S. Maritime Administration monitors the activities of all civilian government agencies subject to these cargo preference laws. The energy use impact of shipping by U.S. flag carrier was judged to be minimal.

III. THE ENERGY IMPACT OF THE STATE OF WASHINGTON'S TANKER REGULATIONS

III. THE ENERGY IMPACT OF THE STATE OF WASHINGTON'S TANKER REGULATIONS

On May 29, 1975, the Honorable Daniel J. Evans, Governor of the State of Washington, signed into law a Tanker Control Act (H.B. 527) setting forth guidelines applicable to the construction and operation of crude oil tankers calling in Puget Sount. The Act provided for:

- Pilots on board all tankers of 50,000 DWT or greater
- Limitations on the size of tankers entering Puget Sound to less than or equal to 125,000 DWT
- Entry of tankers of 40,000 DWT to 125,000 DWT if all of the following safety features are satisfied:
  - Shaft horsepower in the ratio of 1 horsepower to each 2.5 deadweight tons
  - Twin screws
  - Double bottoms beneath all cargo tanks
  - Two working radars, one of which must be of a collision avoidance type
  - Other navigational position location systems, as may be prescribed by the board of pilotage commissioners
- Entry of any tanker in the 40,000 to 125,000 DWT range, not meeting the above criteria, if they are in ballast or under the escort of a tug or tugs with an aggregate shaft horsepower of 5 percent of the DWT of the tanker.

This Act was subsequently challenged in the U.S. District Court, Seattle, by:

- Atlantic Richfield Co.
- Seatrain Lines, Incorporated.

Under various Federal laws, the U.S. Coast Guard has been given the authority to promulgate rules and regulations governing the design, construction, operation and level of maintenance of all U.S. and foreign flag vessels operating in United States waters. Table III-1 is a partial listing of those laws and statutes that grant this authority to the U.S. Coast Guard. The primary question is the jurisdiction of the State of Washington and its authority to require construction features, operational practices, and equipment on tankers, in addition to those regulations already promulgated by the U.S. Coast Guard.

In addition to the State of Washington, other states and political subdivisions have under consideration or have passed laws and/or promulgated regulations which control the design, navigation and operations of oil tankers:

- Alaska
- Maine
- California

The effect of the law passed by the State of Washington and the others mentioned above would impact energy use in the transportation of crude petroleum and petroleum products in two ways. First, the requirement for tug escorts exceeds existing operational procedures on the use of tugs by a large margin. Secondly, the limitation on the size of tankers precludes taking advantage of the lower unit energy consumption characteristics that result in the economies of scale offered by Very Large Crude Carriers (VLCC's).

The U.S. District Court subsequently ruled for the plaintiffs, Atlantic Richfield and Seatrain, and held that H.B. 527 was invalid. The State of Washington and allied environmentalist groups have since appealed this ruling. A final decision has, to this date, not been reached.

1. APPROACH USED TO DETERMINE ENERGY CONSUMPTION IMPACTS

The effect of the State of Washington law (H.B. 527) is to increase fuel consumption from:

- Additional fuel burned by tugs providing an increased escort service
- Additional fuel burned due to restriction on tanker size.

TABLE III-1
Laws and Regulations Affecting Tanker
Design, Construction and Operation

	Act or Statutes	Areas of Coverage
1.	Ports and Waterways Safety Act (PL 92-340)	U.S. C.G. sets traffic control systems, equipment standards and operating practices.
2.	46 U.S.C. 361-445	U.S.C.G. responsible for inspection of all U.S. steam vessels - regulations contained in Title 46 C.F.R.
3.	Tank Vessel Act 14 Stat, 1889, 46 U.S.C. 391a as amended	U.S.C.G. is responsible for inspection of all tankers to assure that they comply with all Federal regulations for vessel safety and protection of the marine environment - certifying vessels for cargo types.
4.	46 C.F.R. 66.03-7-9	U.S.C.G. enrolls and licenses vessels.
5.	Oil Pollution Act of 1961 33 U.S.C. 1001	Implements the International Convention for the Prevention of the Pollution of the Seas by Oil 1954 - Restricts the discharge of oil.
6.	Oil Pollution Act Amendments of 1973 (P.L. 93-119) 87 Stat 424	Requires all tankers built after a given date to comply with construction standards set in 1971 Amendments to the International Convention for the Prevention of the Pollution of the Seas by Oil 1954.
7.	The International Load Line Act of 1973 (PL 93-115) and the Coastwise Load Line Act 46 U.S.C. 88	Gives the U.S.C.G. the authority to set load lines for U.S. flag vessels and enforce limits on foreign flag vessels in U.S. waters.

The approach used to quantify the energy use impact consisted of three steps:

- Determine future level of tanker shipments affected by H.B. 527
- Identify changes in the operating profiles due to H.B. 527 and calculate additional fuel needed to support the expanded escort service
- Quantify the energy consumption economies of scale associated with use of very large crude carriers.

2. STEP 1—LEVELS OF FUTURE CRUDE OIL TANKER ACTIVITY WERE DETERMINED

The Army Corps of Engineers has reported a total of 11 million short tons of petroleum and petroleum products moving in and out of Puget Sound in 1974. Table III-2 divides this trade into crude, product and barge traffic.

TABLE III-2
Puget Sound Petroleum Trade - 1974

Tankers	Crude Oil	-	5,595,810	L. Tons
	Product	-	5,097,942	"
Barge	Movements	-	460,820	"
	Total	-	11,154,572	L. Tons

In December 1975, 93 percent of the tankers employed in the distribution of refined petroleum product from the Puget Sound area were under 40,000 DWT and as a result not subject to the provisions of H.B. 527. All crude oil shipments into Puget Sound during this period were in tankers greater than 40,000 DWT and subject to the provisions of H.B. 527. Table III-3 shows the amount of tanker traffic subject to H.B. 527 based on 1974 cargo movements.

TABLE III-3
Annual Tanker Traffic Subject to H.B.-527 (Long Tons)

	Total Volume	% Shipped in Tankers Larger Than 40,000 DWT	Amount Subject to H.B. 527
Crude Oil	5,595,810	100	5,595,810
Product	5,097,942	7	356,856
Total	10,693,752		5,952,666

Two major changes are expected in the future Puget Sound crude oil petroleum movements:

- Model shift from pipelines to tankers due to change in the source of supply
- Increased movements due to transshipment of surplus west coast crude oil through Puget Sound.

Table III-4 lists the capacity of the existing petroleum refineries on Puget Sound.

TABLE III-4*
U.S. Refinery Capacity on Puget Sound

Operator/Location	Capacity (BBL/Day)	Largest Tanker Docked		Dock Expansion Plans for Vessels to
		Fully Loaded	Light Loaded	
ARCO, Cherry Point	96,000	125,000 DWT	125,000 DWT	
MOBIL, Ferndale	71,500	101,000 "	63,000 "	150,000 DWT
Shell, Anacortes	91,000	78,000 "	64,500 "	200,000 "
Texaco, Anacortes	78,000	98,000 "	78,000 "	
U.S. Oil Refinery, Tacoma	18,500	103,000 "	45,000 "	125,000 "
Sound Refining, Tacoma	4,500	37,500 "	26,000 "	
Total	359,500	(16,580,000 L.T./year)		

The origins of crude oil feeding these refineries and their general method of shipment are:

* Source: Case C 75-648, U.S. District Court Western District of Washington, Pretrial Order.

- Domestic supplies - Tanker
- Canadian supplies - Pipeline
- Other foreign sources - Tanker

The Canadian Minister of Energy, Mines and Resources has announced that his government intends to end all oil exports to the United States by the early 1980's. Table III-5 shows the origin and transportation mode for all crude oil processed at ARCO's Cherry Point Refinery.

TABLE III-5*
Origin and Transportation Mode of Crude for ARCO's Cherry Point Refinery 1972 - 1975

Year	Total Crude Receipts (barrels per day)	Canadian Crude Receipts (barrels per day)	Tanker Crude Receipts (barrels per day)	Percentage Received by Tanker
1972	84,800	74,400	10,400	12%
1973	97,000	60,700	36,300	27%
1974	90,800	40,800	50,000	56%
1975	94,200	31,500	62,700	67%

As can be seen, receipts of Canadian crude are decreasing while tanker shipments are increasing. With the decline of Canadian crude shipments, the flow of Alaskan crude into Puget Sound is expected to reach 336,150 BBL's per day or 93 percent of the total existing refinery capacity.

In addition to the Alaskan crude trade for refining in Puget Sound, the West Coast is projected to have a crude surplus of 595,000 BBL/day by 1979. Puget Sound is the only area on the West Coast with sufficient existing water depth to accommodate VLCC's without lightering.

The Northern Tier Pipeline Company made up of the Burlington Northern Railroad, Michael J. Curran Pipeline Co. and Butler and Associates has announced plans to construct an oil transfer terminal at Port Angeles, Washington for the purpose of building a pipeline across the northern tier of states that would transport the crude surplus into those

* Source: Case C 75-648, U.S. District Court Western District of Washington, Pretrial Order.

upper western states that would be most affected by the cessation of Canadian crude exports. Approval to build the terminal at Port Angeles has been sought, but not yet received, from the Washington Department of Ecology. Other necessary governmental approval, both for the terminal and the pipeline, has not yet been sought or received. Plans call for completion of the pipeline no earlier than June 1979.

Based on the above, projections of tanker traffic carrying only crude petroleum can be made. These projections are based on two scenarios:

- 1980 tanker traffic with all crude shipped into Puget Sound being refined in the Puget Sound area of 336,150 BBL's per day or 16,580,000 L.T. per year

- 1980 traffic with the northern tier pipeline of 931,150 BBL's per day or 45,928,000 L.T. per year.

The first scenario assumes that all refineries in Puget Sound will be operating at 93 percent of capacity and all crude oil comes from Alaska. The second scenario has been chosen as a worse case, it assumes that the northern tier pipeline will be constructed and all surplus west coast crude will be shipped through it.

3. STEP 2—CHANGES IN THE OPERATING PROFILES WERE IDENTIFIED

Discussions with the Foss Tug Company in Seattle indicated that:

- Prior to H.B. 527 normal tug hire averaged approximately one-half hour per docking for tankers

- After the enactment of H.B. 527 tug hire increased to 8 hours with escort and docking

- Prior to H.B. 527 that normal procedure to use one tug of 3000 HP.

Additional fuel burned by tugs providing escort services can then be estimated based on the following assumptions:

Status Quo

- Average size of tanker carrying crude oil into Puget Sound is 70,000 DWT

- Normal procedure is to use one 3000 HP tug for 1/2 hour/docking with 1-1/2 hour travel time

- Tug operates at full power during the docking.

$$\text{fuel} = \left(\frac{\text{annual tonnage}}{70{,}000}\right)(3000\ \text{HP})\left(\frac{.37\ \text{lb}}{\text{SHP-Hr}}\right)(2\ \text{hr})\left(\frac{\text{L. Ton}}{2240\ \text{lb}}\right)$$

With H.B. 527

- Horsepower of tugs must equal 5 percent of deadweight

- Tugs used for 8 hours

- Tugs operate at full power during the hire time.

$$\text{fuel} = 5\%\ (\text{annual tonnage})\left(\frac{.37\ \text{lb}}{\text{SHP-Hr}}\right)(8\ \text{hr})\left(\frac{\text{L. Ton}}{2240\ \text{lb}}\right)$$

Based on the above, the additional energy consumed due to increased tug escorts was calculated for the two scenarios.

4. STEP 3—ADDITIONAL ENERGY CONSUMED DUE TO USE OF SMALLER, LESS EFFICIENT TANKERS WAS DETERMINED

The Maritime Administration has estimated that approximately one-third of the tankers that will participate in the Alaskan crude trade will be larger than 125,000 DWT. The terminal being constructed at Valdez will accommodate 225,000 DWT tankers. It is expected that these vessels (greater than 125,000 DWT) will carry approximately 70 percent of the available oil. Based on:

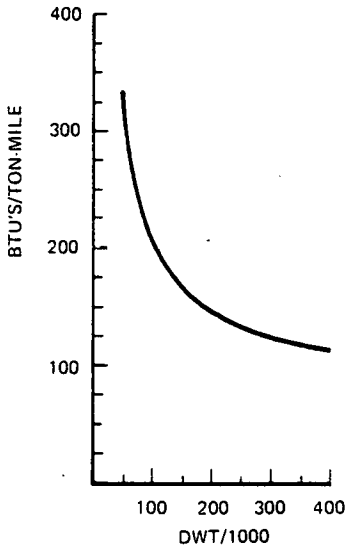
- The projected levels of tanker traffic in Puget Sound

- Discussions with the Maritime Administration

- Statements made by the Puget Sound Refiners.

In simulating the size distribution of the fleet that would be used in the Valdez-Puget Sound crude oil trade, it was estimated that 70 percent of the cargo would be carried in 150,000 DWT tankers, and 30 percent of the cargo would be carried in 70,000 DWT tankers.

The energy intensiveness of bulk maritime liquid transportation varies with the size of the tanker as shown in Figure III-1.



Source: Booz, Allen & Hamilton

FIGURE III-1
Transportation Energy Intensiveness Versus Tanker Size

5. H.B. 527 COULD INCREASE TRANSPORTATION ENERGY REQUIREMENTS BY .0003 TO .001 QUADS

The estimated increases in fuel consumption due to the provisions of H.B. 527 are on the order of 10 to 16 percent. Table III-6 gives the calculated increases in fuel consumption due to:

- Additional tug escort requirements
- Limitations on the sizes of tankers.

TABLE III-6

Projected Increased Fuel Consumption
in 1980 due to H.B. 527

	16,580,000 L.T/Year Without Northern Tier Pipeline	45,928,000 L.T./Year With Northern Tier Pipeline
Baseline Transportation Energy Requirement	2.72×10^{12} BTU's	7.17×10^{12} BTU's
Increase Due to Tug Escort	$.037 \times 10^{12}$ BTU's	$.108 \times 10^{12}$ BTU's
Increase Due to Size Limitations	$.250 \times 10^{12}$ BTU's	1.040×10^{12} BTU's
Total Increase Due to H.B.527	$.287 \times 10^{12}$ BTU's	1.148×10^{12} BTU's
Increase/Baseline	10.5%	16%

IV. ENERGY IMPLICATIONS OF THE TRANSPORTATION ALTERNATIVES AVAILABLE FOR THE WEST COAST CRUDE OIL SURPLUS

IV. ENERGY IMPLICATIONS OF THE TRANSPORTATION ALTERNATIVES AVAILABLE FOR THE WEST COAST CRUDE OIL SURPLUS

It has been estimated by the Federal Energy Administration that the west coast of the United States is expected to have a surplus of crude oil by 1980 due to production increases in California and Alaska. The surplus is expected to reach 595,000 bbl's per day by 1980.

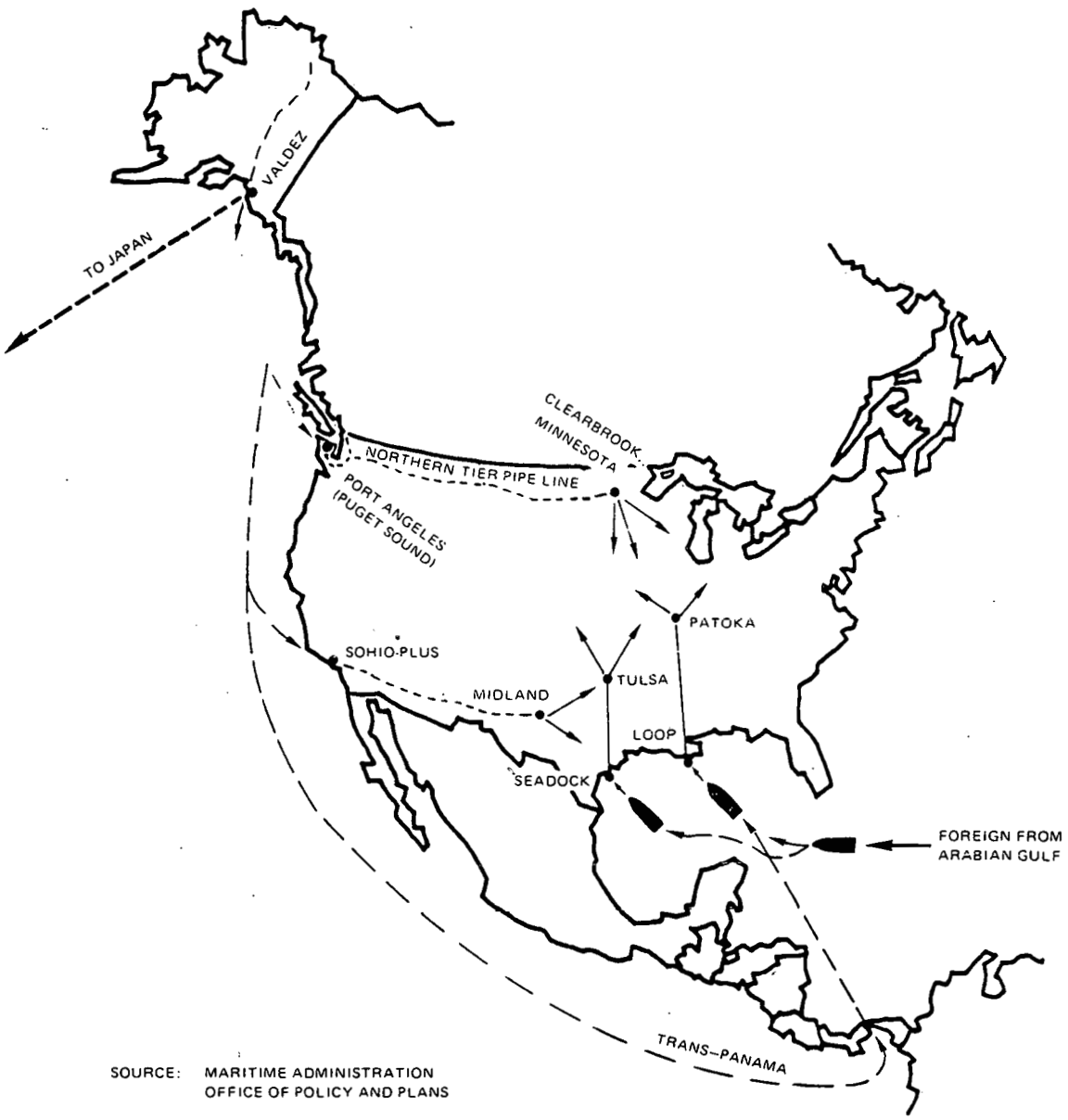
There have been a number of transportation alternatives proposed to move this surplus crude oil to other U.S. markets. Four of these transportation alternatives are evaluated here and compared from a transportation energy requirements standpoint. The four alternatives shown in Figure IV-1 are:

- Ship surplus crude to Japan in exchange for Arabian Gulf crude shipped to U.S. gulf coast
- Ship surplus crude to Long Beach, then by pipeline to gulf coast
- Ship surplus to Seattle, then by pipeline to the northern tier states
- Ship surplus to gulf coast by way of Panama Canal.

1. OPTION 1: SHIP SURPLUS CRUDE TO JAPAN AND RECEIVE ARABIAN GULF CRUDE ON THE U.S. GULF COAST

Due to the size of the terminal being completed at Valdez, Alaska and the existing port infrastructure in Japan that is capable of handling VLCC's, the scenario chosen to represent this trade is:

- All surplus crude on the west coast is shipped to Japan in 225,000 DWT, 30,000 SHP, 15.7-knot tankers, 6,744 N. miles round trip and a fuel rate of .47 lb/SHP-hr.
- All Arabian Gulf crude is shipped to the gulf coast in 80,000 DWT, 20,000 SHP, 15-knot tankers, 19,650 N. miles round trip and a fuel rate of .47 lb/SHP-hr. The 80,000 DWT tanker routed via



SOURCE: MARITIME ADMINISTRATION
OFFICE OF POLICY AND PLANS

FIGURE IV-1
Distribution Alternative for West Coast
Crude Surplus

Suez scenario was chosen due to the expected delays in completion of two deep water ports on the gulf coast, Seadock and Loop.

This alternative has been proposed by some of the participants in TAPS as a means of alleviating the crude surplus situation. Currently, it is against the law as the TAPS enabling legislation also contained the provision that all crude produced in Alaska was to be consumed domestically. Table IV-1 gives the estimated fuel requirements for this transportation option.

Table IV-1
Transportation Energy Requirements for Option 1

Voyage Leg	Long Tons of Residual Fuel	BTU's
Valdez to Japan	359,000	.015 quads
Arabian Gulf to gulf coast	2,291,000	.121 quads
Total	2,550,000	.136 quads

This option represents the most energy intensive option of the four. It requires 4.1 times more energy than the least energy intensive, option 3.

2. OPTION 2: SHIP SURPLUS TO LONG BEACH, THEN PIPELINE TO GULF COAST

This option is currently running into difficulty due to the State of California's disapproval of the request by SOHIO (BP) to use an existing gas pipeline running from Long Beach to the gulf coast. The disapproval of this option was based on increased levels of airborne petroleum vapors in the Long Beach area arising from tanker unloading operations. However, an alternate site that would be approved was identified. For this option, it was assumed that:

- All surplus would be transported from Valdez to Long Beach by 120,000 DWT, 27,000 SHP, 15-knot tanker, 4,062 N. miles round trip and a fuel consumption rate of .47 lb/SHP-hr.

- The existing natural gas pipeline is assumed to be able to handle the entire surplus flow over

a 1,750 mile route at an energy level of 650 BTU's/ton-mile.

Table IV-2 provides the results of this analysis.

Table IV-2
Transportation Energy Requirements for Option 2

Voyage Leg	Long Tons of Residual Fuel	BTU's
Valdez to Long Beach	571,000	.024 quads
Long Beach to gulf coast	807,000	.033 quads
Total	1,378,000	.057 quads

This option has the next to the lowest transportation energy requirement. It requires approximately 1.7 times more energy than the least energy intensive, option 3.

3. OPTION 3: SHIP SURPLUS TO SEATTLE, THEN BY PIPELINE TO NORTHERN TIER STATES

The northern tier pipeline option calls for a new 40 to 42-inch, 1,500-mile pipeline from the Seattle area on Puget Sound (Port Angeles) to Clearbrook, Minnesota, where it would connect with the Lakewood and Minnesota pipelines to supply the eastern portion of the northern tier refining region.

For the purposes of this analysis, the following assumptions were made:

- All surplus would be shipped from Valdez to Seattle by 200,000 DWT, 25,000 SHP, 15-knot tanker, 1,700 N. miles round trip and a fuel rate of .47 lb/SHP-hr.
- The proposed pipeline is assumed to be able to handle the entire surplus at an energy level of 650 BTU's/ton-mile.

The results of this analysis are shown in Table IV-3.

Table IV-3
Transportation Energy Requirements for Option 3

Voyage Leg	Long Tons of Residual Fuel	BTU's
Valdez to Port Angeles	130,000	.005 quads
Port Angeles to northern tier states (pipeline)	675,000	.028 quads
Total	805,000	.033 quads

Option 3 had the lowest transportation energy requirement of the four alternatives.

4. OPTION 4: SHIP SURPLUS CRUDE TO GULF COAST BY WAY OF THE PANAMA CANAL

The all-water route from Valdez to the fulf coast is the most likely option to be implemented (given that option 1, a crude surplus exchange with Japan is not approved) over the short-term.

For the purposes of this analysis, the following assumptions were made:

- All surplus would be shipped from Valdez to Houston by 65,000 DWT, 18,500 SHP, 15-knot tanker with a full consumption rate of .47 lb/SHP-hr.
- No transshipment.

The results of this analysis are given in Table IV-4.

Table IV-4
Transportation Energy Requirements for Option 4

Voyage Leg	Long Tons of Residual Fuel	BTU's
Valdez to Houston	1,681,000	.070 quads

Option 4 had the second highest transportation energy requirement of the four alternatives. It requires 2.1 times more energy than option 3.

5. OF THE FOUR TRANSPORTATION ALTERNATIVES FOR THE PROJECTED WEST COAST CRUDE SURPLUS, THE TWO ALTERNATIVES OFFERING A COMBINATION OF WATER AND PIPELINE TRANSPORTATION REQUIRE THE LEAST ENERGY FOR TRANSPORTATION

Of the four transportation alternatives evaluated, the two options that involved a combination marine/pipeline transportation system required the least amount of energy.

The results of the analysis are shown in Table IV-5.

Table IV-5
Transportation Energy Requirements for Four Alternative Distribution Schemes for the Projected West Coast Crude Surplus

Option	Transportation Energy Requirements
Option 1: Ship surplus crude to Japan in exchange for Arabian Gulf crude delivered to U.S. gulf coast	0.136 quads
Option 2: Ship surplus to Long Beach, then by pipeline to U.S. gulf coast	0.057 quads
Option 3:* Ship surplus to Puget Sound, then by pipeline to northern tier states	0.033 quads
Option 4: Ship surplus to gulf coast by way of Panama Canal	0.070 quads

* Destination different than other options.

The conclusion that can be drawn from an examination of Table IV-5 is that the current ban that exists on exports of North Slope Alaskan crude oil should not be lifted. The crude swap alternative that has recently been promoted as one means of dealing with the west coast crude surplus is clearly the most expensive in terms of transportation energy requirements.

V. THE ENERGY IMPACT OF TANKER SEGREGATED BALLAST REQUIREMENTS

V. THE ENERGY IMPACT OF TANKER SEGREGATED BALLAST REQUIREMENTS

Between December 15, 1976 and March 27, 1977, fifteen major incidents resulted in significant oil spills from petroleum tankers in or near U.S. waters. These incidents have led to a public outcry and the appointment of a special task force by the recent Secretary of Transportation William T. Coleman, whose purpose was to develop recommendations designed to curtail tanker incidents and major oil spills in U.S. waters.

Among other recommendations, the task force recommended:

- The Coast Guard speed the completion of its evaluation of the economic implications of requiring all tankers over 70,000 DWT entering U.S. waters to be retrofitted with segregated ballast.

- The Coast Guard undertake a study with the EPA to determine whether segregated ballast requirements should be extended to tank vessels under 70,000 DWT.

The focus on the requirement for segregated ballast addresses a common operational practice of tank washing, that accounts for approximately 85 percent of all oil discharged into the sea. It is implied by the advocates of segregated ballast facilities that the imposition of mandatory segregated ballast requirements would also decrease the amount of oil discharged into the environment due to accidental spills.

Currently, standard operating procedures followed by tanker operators is to take on seawater ballast into the cargo tanks in order to increase the draft of the ship after the cargo is discharged. This is necessary in order to maintain headway and submerge the propeller. The ship would then proceed to clean some of its cargo tanks with seawater, and fill the clean cargo tanks with clean seawater and pump the dirty ballast and washwater over the side. All tank washing procedures take place during the ballast leg of a voyage. The objective of the tank washing is to have the vessel arrive at the loading port with only clean ballast aboard. As the tanker proceeds to load her next cargo, the clean ballast is discharged overboard. The requirement for segregated ballast capacity would result in all tanks being dedicated to either cargo or ballast service rather

than using tanks for both, and would eliminate the discharge of dirty ballast water and washwater into the environment.

The Maritime Safety Committee of the Intergovernmental Maritime Consultative Organization (IMCO), an organization of the United Nations stated at its 23rd session that the primary objective of their 1973 conference on marine pollution was the complete elimination by 1975 of the willful and intentional pollution of the seas by oil. The United States subsequently submitted an outline of possible solutions for the disposition and/or minimization of oil from routine tanker ballast operations. As a result of that submission the United States was listed as the lead country for an IMCO analysis of this problem. The report, entitled Study I, Segregated Ballast Tankers, was published with Norway, Sweden and the United Kingdom, contributing to the analysis.

Following the completion of this study, a proposal was submitted to IMCO by Greece, Italy and Norway to require the backfitting of segregated ballast capability on all existing tankers over 70,000 DWT, and requiring all new buildings over 70,000 DWT to be constructed with segregated ballast capability. Much of the impetus behind the proposal to require retrofitting came from tanker owners who wanted to reduce the oversupply of tankers that resulted from the oil embargo of 1973-1974. Segregated ballast requirements would reduce the productivity of a tanker by 20 to 25 percent and increase overall demand for tankers by an equal amount.

The approach used to determine the transportation energy consumption impact of a segregated ballast requirement consisted of four steps:

- Step 1—Determine the loss in DWT associated with retrofitting segregated ballast
- Step 2—Determine the potential for increased speed or reduced horsepower due to loss in deadweight
- Step 3—Determine the impact on specific fuel consumption due to off design operation
- Step 4—Calculate the impact on tanker energy consumption.

1. STEP 1—DETERMINE THE LOSS IN DWT ASSOCIATED WITH RETROFITTING SEGREGATED BALLAST

The dedicated ballast capacity of a conventional tanker varies between 15 and 30 percent of its deadweight (DWT) as shown in Figure V-1. The amount of ballast carried by a tanker varies with:

- Vessel characteristics
- Weather conditions.

Of these, weather conditions have the most significant impact.

U.S. Study I sampled tanker log books on major routes and found that two ballast conditions generally prevailed:

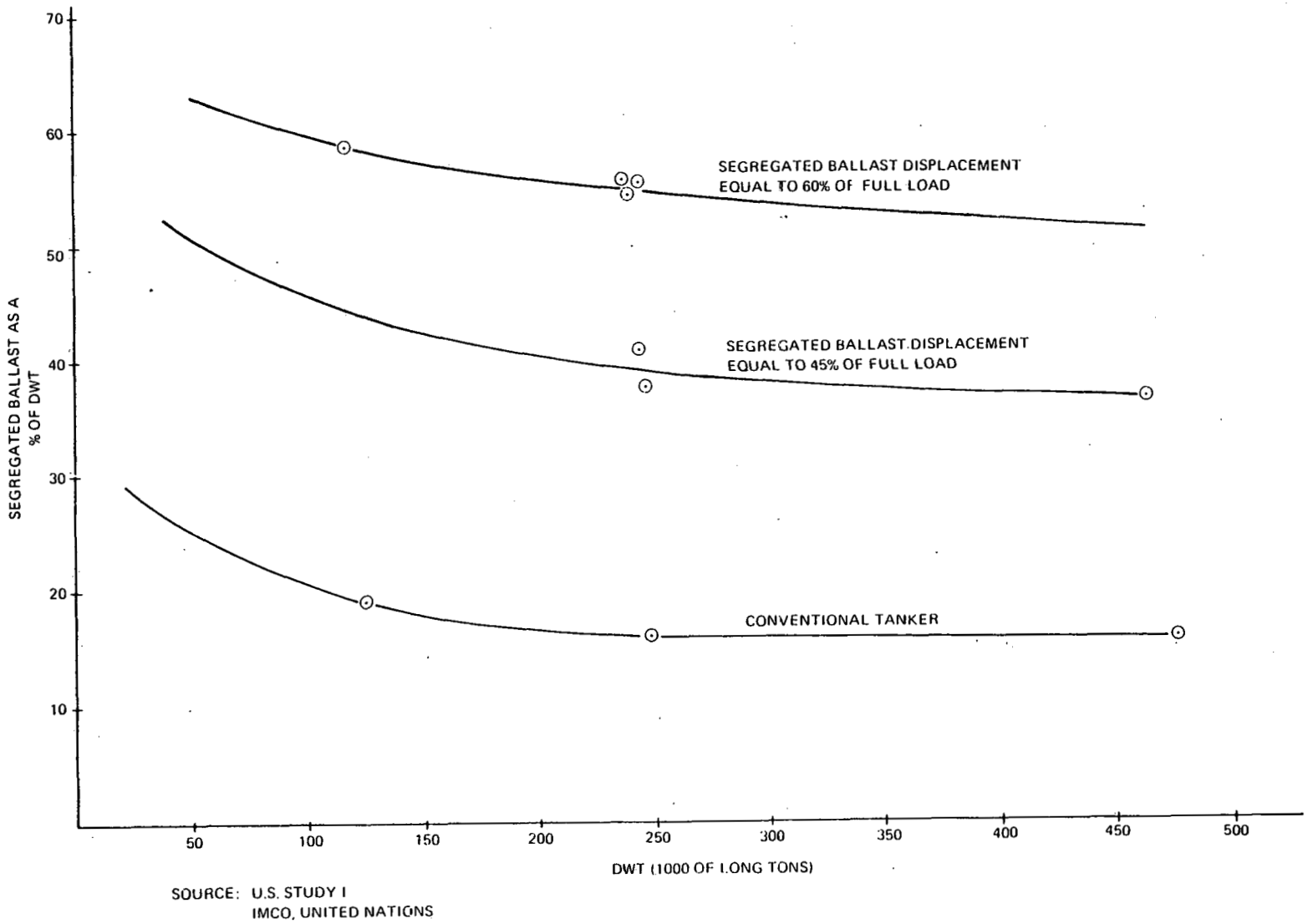
- Calm weather, Beaufort 5 or less
- Heavy weather, Beaufort 5 or greater.

The amount of ballast carried on board for these two conditions corresponded to an amount necessary to keep the ballast displacement equal to 45 to 55 percent of full load displacement with greater quantities taken on board in extremely heavy seas.

In response to the proposal to IMCO mentioned above, that would require retrofitting all existing tankers over 70,000 DWT with segregated ballast capability, the U.S.C.G. published an Advance Notice of Proposed Rule Making on May 13, 1976 in which the existing rules requiring segregated ballast on all new U.S. flag tankers would be extended to all tankers, U.S. and foreign, over 70,000 DWT entering U.S. waters.

It was estimated in Task 1 of this assignment that tank vessels serving in the U.S. trade had the performance characteristics as shown in Table V-1.

The effect of requiring all tank vessels operating in U.S. waters to conform to a 45 percent full load draft segregated ballast rule would immediately reduce the carrying capacity (internal cubic available for cargo) by approximately 20 to 25 percent. For the same level of trade shown in Table V-1 above, this would increase the number of vessel trips by the same percentage in order to supply a constant number of loaded ton-miles.



SOURCE: U.S. STUDY I
IMCO, UNITED NATIONS

FIGURE V-1
Variation of Segregated Ballast Requirements
as a Function of Deadweight

TABLE V-1
Tank Vessels in the U.S. Trade

Shipping Sector	Estimated Number of Vessels Required	Millions of Tons Carried (1974)	Billions of Ton Miles (1974)	BTU's Per Ton-Mile (1974)	Total BTU's Consumed in 1974 (QUADS)
Ocean	500	296.5	1,565.0	213	.333
Great Lakes	59	4.5	7.0	714	.005
Coastal	134	144.0	199.8	355	.071
Totals		445.0	1,771.8	231	.409

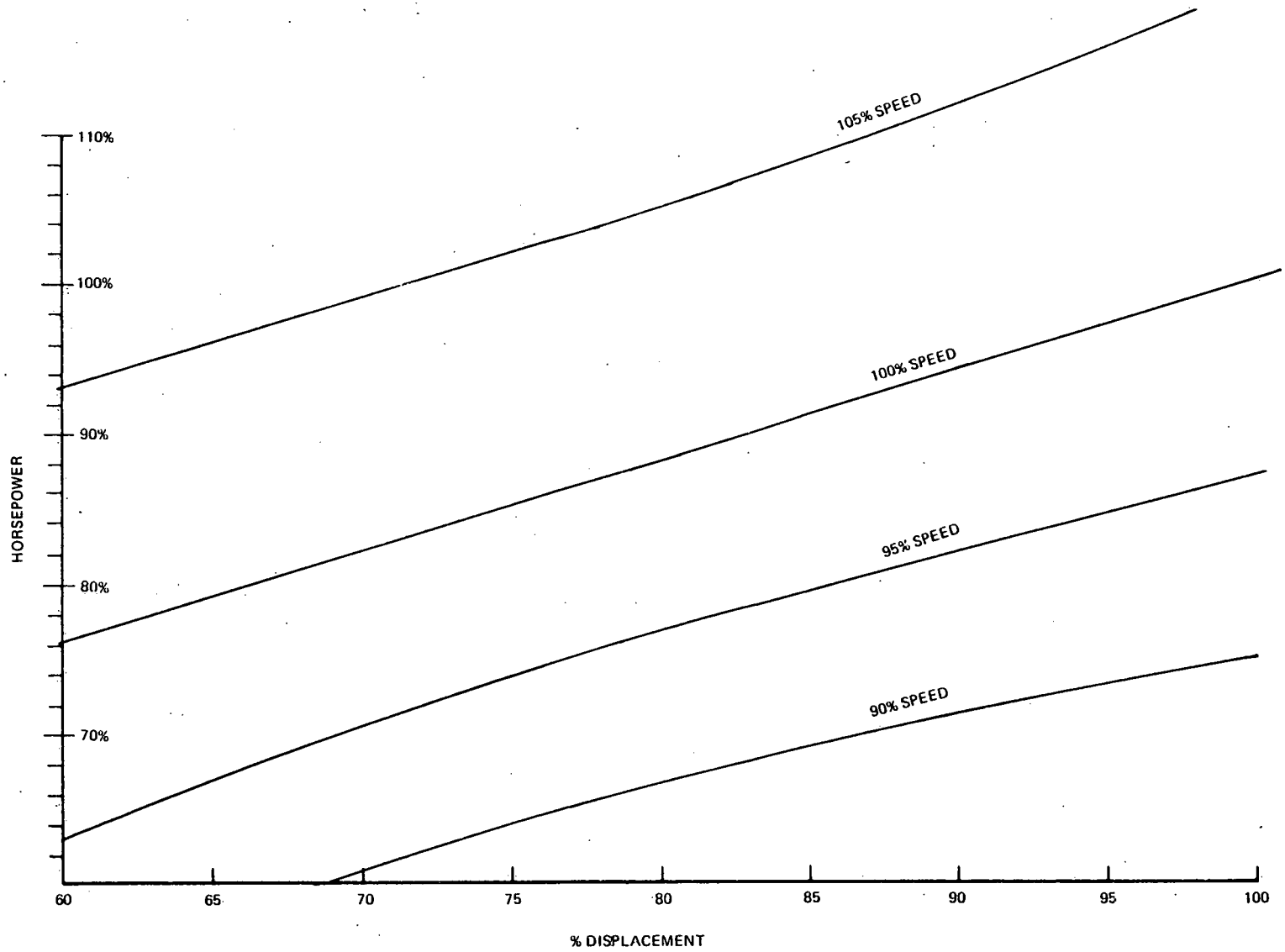
2. STEP 2—DETERMINE THE POTENTIAL FOR INCREASED SPEED OR REDUCED HORSEPOWER DUE TO LOSS IN DEADWEIGHT

The relationship between; the speed of a vessel and, the horsepower required to make that speed, change with the vessel's loading. A lightly loaded tanker could change its productivity—BTU's consumed per ton-mile of service—a number of different ways. Two extremes would be to operate at full power and higher speed, or lower power levels and reduced speed.

Another relationship exists between speed and power levels, such that as speed drops, the power required drops faster. For example, a 5 percent drop in speed could correspond to an 8 to 10 percent drop in required horsepower. As a result, the BTU's/ton-mile indicator will fall due to the numerator falling faster than the denominator. This interrelationship between vessel loading, speed and required horsepower is shown in Figure V-2.

3. STEP 3—THE IMPACT ON SPECIFIC FUEL CONSUMPTION DUE TO OFF DESIGN POINT OPERATIONS WAS DETERMINED

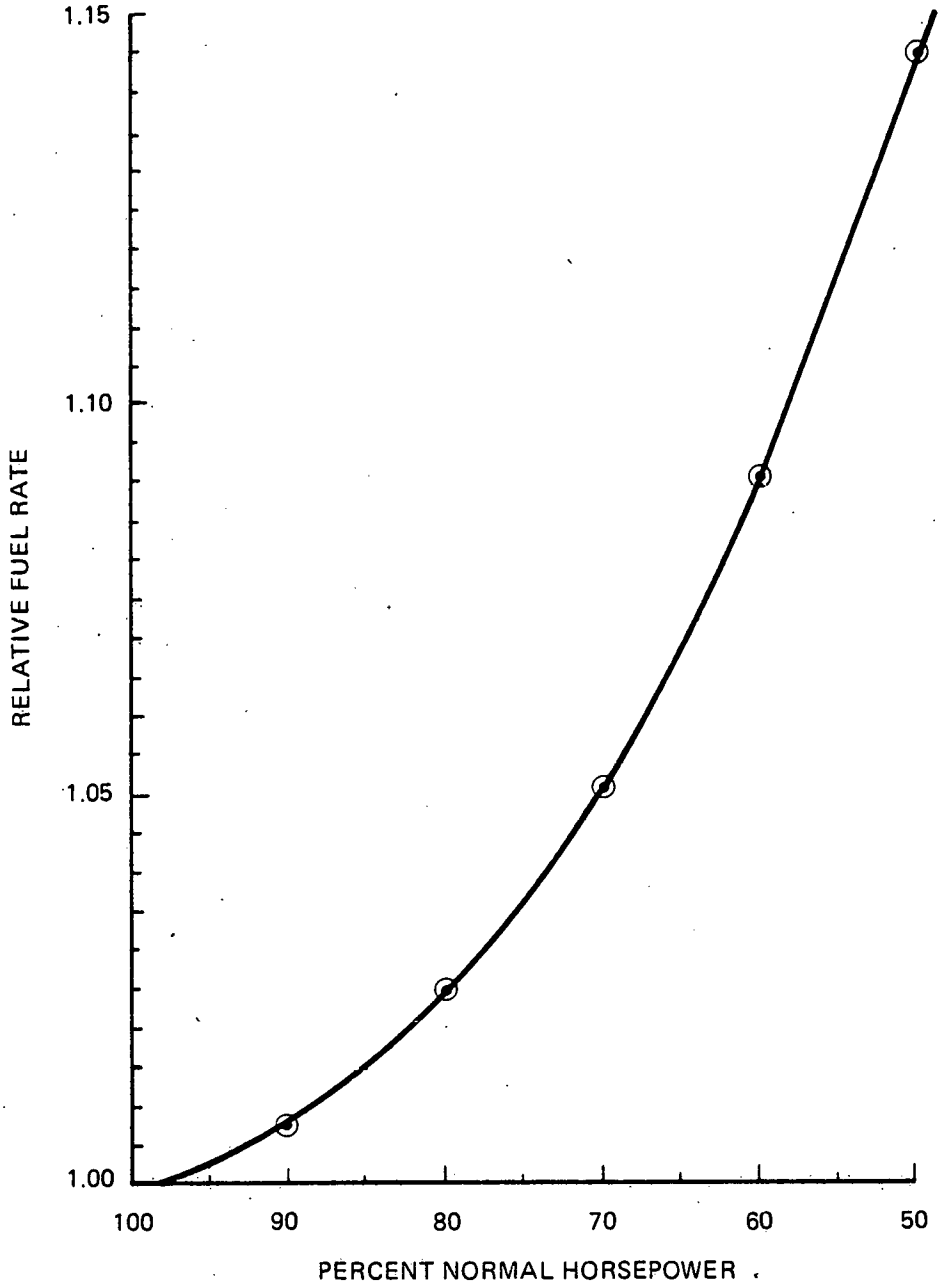
Operating at; reduced speed and off-design point power levels, adversely affects the specific fuel consumption of steam plants, as shown in Figure V-3.



SOURCE: "GENERAL CARGO SHIPS ECONOMICS AND DESIGN," HARRY BENFORD, UNIVERSITY OF MICHIGAN, 1965

FIGURE V-2

Relationship Between Speed, Power and Displacement for Full Hull Form, Block Coefficient of .80 at Even Keel



Source: "General Cargo Ship Economics and Design," Harry Benford, University of Michigan, 1965.

FIGURE V-3
Relative Fuel Rates at Partial Loads
(steam turbines)

4. STEP 4—THE ENERGY IMPACT OF SEGREGATED BALLAST REQUIREMENTS WAS CALCULATED

Using Figures V-1 through V-3, the energy impact of segregated ballast requirements was calculated for a number of different scenarios that attempted to minimize the overall adverse energy use impact. Seven scenarios were evaluated as shown in Table V-2.

TABLE V-2
Energy Impact of
Segregated Ballast Requirements

Case	Operating DWT as % of Normal	Horsepower as % of Normal	Speed as % of Normal	Specific Fuel Consumption as % of Normal	Combined Impact on Productivity (BTU's/ton-mile)
1	80	100%	104%	100%	+20.2%
2	80	88%	100%	101%	+11.1%
3	80	95%	102%	100.3%	+16.8%
4	80	85%	98%	101.5%	+10.0%
5	80	80%	97%	102.5%	+ 5.7%
6	80	75%	95%	103.6%	+ 2.2%
7	80	70%	92%	105.1%	0.0%

5. IMPOSITION OF SEGREGATED BALLAST REQUIREMENTS COULD RESULT IN AN INCREASED PETROLEUM TRANSPORTATION ENERGY REQUIREMENT BY AS MUCH AS TWENTY PERCENT

In Table V-3, the combined effect on productivity of the three interrelated factors:

- DWT
- Speed
- Horsepower

has been shown as the impact on the energy productivity of the marine transportation of petroleum. The impact could reach a 20 percent increase, however, as the average speed of the tankers

drops below their design speed (voluntary slowdown) the penalty due to the segregated ballast requirement is mitigated. If the average speed of the fleet serving the U.S. petroleum drops to the 14 to 15½ knot range (approximately 92 percent design speed for a 15 to 17 knot tanker) the impact on the BTU's/ton-mile value will be entirely offset.

VI. THE ENERGY IMPACT OF INLAND WATERWAY USER CHARGES

VI. THE ENERGY IMPACT OF INLAND WATERWAY USER CHARGES

In 1974, the Federal Government spent approximately $660 million providing support in the form of:

- River bank stabilization
- Dredging
- Construction, operation and maintenance of locks and dams
- Providing aids to navigation.

Of this amount, $385 million was spent on the inland river system. In the Presidential FY 77 budget, the Office of Management and Budget proposed levying an $80 million tax via river segment tolls and lockage fees on the shallow draft navigation system of the U.S. This tax was designed to recover one-half of the Federal operating, maintenance and repair (OM&R) expenditures in 1977. By 1979, it was proposed that the recovery level would be increased to 100 percent of OM&R.

Waterway user charge legislation has been introduced in Congress by every administration since the 1930's. User charges are proposed by some as necessary for equity in modal competition and opposed by others as unfairly taxing the efficient performance of the barge industry. A major concern of all parties involved is the impact on the inland river transportation industry.

1. THE IMPACT OF INLAND WATERWAY USER CHARGES WILL VARY DEPENDING UPON THE COST RECOVERY OPTION CHOSEN

There are four primary options that could be used to recover OM&R expenditures. They are:

- Fuel tax, either
  - Uniform
  - Segment specific

- Segment tolls
- License fees, either
  - Uniform
  - Segment specific
- Lockage fees, either
  - Uniform
  - Segment specific.

Each is discussed below. The basis for these discussions is a recent report* published by the Transportation Systems Center of the Department of Transportation.

(1) Fuel Tax

The fuel tax would be the option chosen if Federal OM&R expenditures were to be recovered based on a uniform tax per ton-mile of use. The fuel tax could be either uniform systemwide or segment specific. The uniform tax is preferred as very little is known about the variations in fuel burned per ton-mile by river segment. The fuel tax option would impact long haul cargoes (grain begin shipped from the upper Mississippi to New Orleans) much greater than the short haul or local traffic.

(2) Segment Tolls

Segment tolls would tax cargo movements on a specific river segment. Specific tax rates would be set for each river segment depending upon the current level of Federal OM&R expenditures. Impacts would be localized on the tributary, high cost rivers, such as the Arkansas, Kentucky and the Appalachicola/Chattahoochee/Flint, which may have segment tolls greater than three cents per ton-mile.

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* "Modal Traffic Impacts of Waterway User Charges," U.S. Department of Transportation Systems Center, Cambridge, Mass. 02142, Report No. SS-212-U1-32.

(3) License Fees

License fees would apply a fixed operating charge on both towboats and barges. They could be tailored to systemwide charges or be segment specific. The fee would grant operating rights to particular river segments.

Assuming that 59 percent of OM&R expenditures were recovered from barges and 41 percent were recovered from towboats, a ratio that reflects the ratio of capital investment, the registration fees would be:

- Barges - $3.13 per ton of load capacity
- Towboats - $18.40 per horsepower

Costs of a uniform license fee for a typical tow were estimated at 10 percent of current annual operating costs. It was found that license fees would tend to minimize overall traffic impacts because carriers could spread the costs over traffic most able to bear the burden, except in those cases where a tow is constructed for a particular contract trade. A tax on horsepower would also act as an energy conservation tool.

(4) Lockage Fees

A lockage fee would charge for each use of a lock by a commercial carrier. A uniform systemwide charge would be approximately $171.20 per lock cycle for 1972 traffic levels. The impacts would be concentrated over the low traffic locks with small chambers because the fee would be absorbed by fewer tons per lockage.

Variable lockage fees, where costs associated with a particular lock's operation would be recovered by traffic using this lock, would range from:

- Kentucky River - $31.09 per lock cycle
- Arkansas River - $3,510.90 per lock cycle

and would probably eliminate all commercial traffic from the high cost rivers. River traffic on the lower Mississippi would experience no impact at all under lockage fees.

In summary, the differences between uniform and segment specific cost recovery schemes is that uniform cost recovery schemes would impact long haul cargoes, however, the impacts would be spread over a more uniform geographic area and would probably be realized much more gradually. A segment specific cost recovery scheme would produce impacts that are highly localized and would be felt by that traffic that originated or terminated on a high cost river. The impacts would also be concentrated in the early phases of implementation.

2. DIVERSIONS OF TEN TO FIFTEEN PERCENT OF THE SYSTEMS TRAFFIC COULD BE EXPECTED UNDER A ONE-HUNDRED PERCENT OM&R COST RECOVERY SCHEME

The Transportation Systems Center has estimated that a segment specific charge that recovers 100 percent of the Federal OM&R expenditures could be expected to divert as much as 10 percent of the ton-miles carried on the inland rivers and gulf intercoastal waterway. The impacts would be localized and those high cost rivers that experience the heaviest impacts could possibly lose all commercial traffic and be forced to shut down.

The impact of uniform system charge was estimated to be a reduction of 12 to 15 percent of the total ton-miles carried on the inland rivers and gulf intercoastal waterway. Under both the uniform and segment specific tolls, the following major commodities would be affected:

- Corn
- Soybeans
- Fertilizer
- Petroleum products
- Crude oil
- Sand and gravel.

The long haul movements of grain and petroleum products are expected to sustain the heaviest losses under a fuel tax with sand and gravel a distant third.

The actual diversion of traffic to other modes will, in all probability, be less than the 10 to 15 percent that was estimated. The final amount will depend upon the rate increases by competitive modes effected in response to waterway user charges.

3. WATERWAY USER CHARGES COULD INCREASE TRANSPORTATION ENERGY USE BY APPROXIMATELY .003 to .005 QUADS

The energy impact of waterway user charges could amount to increased fuel consumption of .003 to .005 quads. These figures were calculated based on the following assumptions:

- Traffic levels on the inland rivers amounted to 185 billion ton-miles in 1974
- Traffic diversion would range from 10 to 15 percent
- All traffic diverted from the inland river systems would move to rail
- The relative energy intensiveness of water and rail are:
  - Water - 481 BTU's/ton-mile*
  - Rail - 655 BTU's/ton-mile
- The miles traveled of all traffic diverted from waterborne to rail would not change significantly.

Based on the above, a 10 percent diversion would require an additional .0032 quads and a 15 percent diversion would require an additional .0048 quads of transportation energy.

* BTU's/ton-mile for rail based on national averages from FMC Docket 73-38, waterborne figures calculated by Booz, Allen.

VII. THE ENERGY IMPACT OF CARGO POOLING AND SERVICE RATIONALIZATION

VII. THE ENERGY IMPACT OF CARGO POOLING AND SERVICE RATIONALIZATION

Containerization was introduced on the North Atlantic by Sea-Land in the mid-1960's. During the following four to five years, seven other companies, some being consortia of previous break-bulk shipping lines, entered the trade. In addition to these lines, other smaller operators offered vessels equippped for partial container service. The rush to containerization created a tremendous oversupply of container slots on the North Atlantic. A rate war started in 1969 which also included a number of illegal practices, such as rebates and lowered the revenues and profits of all carriers. This rate war eventually forced Moore-McCormack out of the trade in 1970. Cargo pooling and service rationalization has been identified as a means of reducing the excess capacity that has been committed to this trade.

1. CARGO POOLING AND SERVICE RATIONALIZATION CAN BE USED TO INCREASE THE EFFICIENCY OF A TRANSPORTATION SYSTEM

Cargo pooling or rationalization, as used in this case study, refer to actions on the part of shipping lines, offering liner service on a given trade which eliminate duplications and redundancies in the services offered while maintaining the level of service at the level of demand. Reduction or elimination of duplications and redundancies will, by definition, increase the efficiency or utilization of the entire system.

The U.S. Maritime Administration has recently completed a study* that evaluated the effects of rationalization in the container trade between the U.S. North Atlantic and Europe. This case study relies heavily on that analysis and in addition, expands that analysis to include the U.S. west coast/Far East container trade.

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* "The Possible Effect of Rationalization on Maritime Fuel Consumption," John Binkley, National Maritime Research Center Report No. NMRC-KP-147, dated October 1975.

2. BARRIERS EXIST TO RATIONALIZATION SCHEMES

There are two strategies available for rationalization:

- Reduction in the number of ships serving the trade or reduction in the speed of ships to match capacity with demand, however, multiple port sailing schedules would be kept

- Reschedule the existing fleet to achieve a maximum number of TEU slots offered per year then reduce vessels or speed to match capacity with demand.

There are a number of barriers to any rationalization scheme, not the least of which is the perceived need on the part of operators to offer all services to all shippers. Many port pairs generate enough cargo to justify the dedication of one or more vessels. But, more than one operator offers service on most trade routes, and one operator would not unilaterally rationalize service by either cutting the number of ports served or the speed of his vessels. If an operator called at only one port on either side he would lose the outport tonnage to the other lines operating on that route. Similarly, if the speed is reduced, voyages take longer, less frequent sailings are offered which the shipper sees as a reduction in the level of service and as a result would shift his business to other lines.

The Federal Maritime Commission requested on November 21, 1973, that:

> "It hoped that all carriers in America's foreign and domestic trade will voluntarily submit rationalization plans. The maritime industry, which understands the operational problems involved is best able to develop solutions to these problems."*

The position of the Federal Maritime Commission on rationalization is stated in a report from the FMC to the Honorable Henry M. Jackson, Chairman, Committee on Interior and Insulor Affairs, dated April 20, 1976, a required report under Section 382(a) (2) of P.L. 94-163, the Energy Policy and Conservation Act. This report reads in part:

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* Congressional Information Bulletin, Volume 77, Number 225 (November 21, 1973), page 5.

"From the outset, it must be emphasized that the Federal Maritime Commission's current statutory authority to mandate or impose specific operational practices by regulated carriers to reduce energy consumption is quite limited. Unlike the two other Federal transportation regulatory agencies, the Interstate Commerce Commission and the Civil Aeronautics Board, this Commission does not issue certificates of convenience and necessity to common carriers, which license such carriers to operate on particular routes. Furthermore, this Commission has no authority to assign routes, fix frequency of vessel sailings, or allocate port coverage in connection with transportation services provided by carriers. Therefore, under its existing limited authority, any efforts made by the Commission toward the implementation of fuel saving practices within the shipping industry could only be advanced indirectly, by encouraging voluntary cooperation among regulated carriers.

"Without doubt, the alteration of certain primary operational practices in ocean shipping would result in reduced fuel consumption. These practices include the following:

1) Reduction in vessel speed

2) Adjustment of sailing schedules

3) Adjustment of port coverage

4) Increased utilization of vessel and container capacity through space chartering between carriers.

The only way the Commission can now implement any of these fuel saving practices is through the approval of energy oriented shipping agreements, submitted to the Commission pursuant to section 15 of the Shipping Act, 1916, as amended. As with all shipping agreements, these energy agreements are entered into voluntarily, by carriers who choose to adopt fuel conserving methods of service. Commission approval of such so-called "rationalization" agreements thereby immunizes those practices from the application and enforcement of United States antitrust laws.

"Although rationalization agreements resulting in fuel conservation can be encouraged by the Commission as

being in the public interest, as previously noted there is no statutory basis for such standards to be ordered or mandated by the Commission as a condition to approval of an agreement. In this connection, it should be noted that fuel saving measures constitute but one of many considerations to be entertained by the Commission in deciding whether the particular set of facts and circumstances under review justify the granting of section 15 approval.

"Two inherent resultant defects in rationalization plans, which must also undergo careful scrutiny by the Commission in the course of its deliberations, are delays in service caused by vessel speed reductions, and the limitation of service itself through reductions in sailing schedules and port calls. In each instance of section 15 approval or disapproval, the Commission is statutorily bound to weigh the merits of numerous countervailing factors in determining those plans or actions of carriers that can be justified as being in the public interest, or conversely, that might be found to be detrimental to the commerce of the United States. In all cases, the desire for energy conservation must be balanced with the public's need for accessible, efficient, and affordable shipping services.

"Unfortunately, under existing conditions, unless all competing carriers in a given trade were parties to a rationalization agreement, nonparticipating lines could unfairly assert advantages to shippers at the expense of the cooperating lines, particularly in regard to the speed of cargo delivery. Therefore, as a practical matter, carriers have been, and will undoubtedly remain, reluctant to adopt and effectuate rationalization plans until such time as fairness in competition is statutorily guaranteed to such arrangements."

The practical difficulties of making a rationalization scheme work were identified by Binkley as:

- The approvals required under U.S. law are not easily obtained and the degree of difficulty increases as the significance of the trade increases

- A detailed and enforceable agreement must be worked out to assure that all parties abide by the terms of the agreement

- Across-the-board sailing reductions are generally not practical since some operators are already operating at their perceived minimum service level

- Allocation of shipping routes are not practical since some port pairs are more desirable than others.

In addition to these competitive-based problems there exist others which hinge on equipment, vessel type, contractual and political considerations:

- Not all containers are interchangeable

- Some markets need Ro/Ro or alternate service

- Contractual arrangements exist between port authorities and carriers for pier facilities

- Political considerations, including flag share will delay implementation

- Certain percentages of military and preference cargo must be shipped on U.S. flag carriers.

3. SOME RATIONALIZATION SCHEMES HAVE BEEN PROPOSED

However, during the last three years, some rationalization schemes have been proposed. Binkley evaluated the energy effects of the North Atlantic Pool Agreement, FMC Docket 72-17 from an energy savings viewpoint.

This study evaluated a number of potential solutions, the case that yielded the greatest energy savings first rationalized service and then reduced vessel speed to bring capacity offered to just above service demand. The results of this analysis were:

- Direct port calls per year were reduced from 3,552 to 1,517 or a reduction of approximately 57 percent

- All vessels were operated at 15 knots, a reduction in speed ranging from 44 percent to 17 percent depending on the particular vessel

- The average number of port calls per voyage dropped from 7 to 3.

4. THE POTENTIAL FOR FUEL SAVINGS COULD REACH .073 QUADS

The fuel savings projected for the North Atlantic by Binkley under this scenario, were approximately 50 percent with fuel consumption dropping from 37.47×10^{-4} to 18.53×10^{-4} bbl's/container mile.

The total container-miles carried in the foreign trade of the United States in 1974 is given in Table VII-1.

Table VII-1
Container-Miles in the U.S. Foreign Trade

Trade Routes	Number of Containers on the Trade Route in 1974	One Way Distance (nautical miles)	Container-Miles (millions)
5, 7, 8, 9	463,000	4,000	1,852
29	457,000	6,750	3,085
12	164,000	11,750	1,927
10	144,000	5,000	720
16	65,000	12,000	780
21	61,000	5,000	305
26	67,000	8,000	536
11	47,000	4,500	212
4	43,000	2,500	108
6	24,000	4,000	96
All others	115,000	5,000	575
	1,650,000		10,196

The potential for large savings in fuel consumption only exists on those highly developed container trade routes where the competition has forced a number of liner operators to offer all services to all shippers, creating redundancies and inefficiencies within the system. Three trade routes; 5 - 7 - 8 - 9; 29 and 12, together accounted for 56 percent of all containers moved and 67 percent of the container-miles carried in 1974. These three trade routes are the most highly developed container trades.

Assuming that an effective and practicable working rationalization scheme could be developed and:

- A 40 percent reduction in BTU's per container-mile could be achieved for trade routes 5 - 7 - 8 - 9; 29 and 12

- A 10 percent reduction in BTU's per container-mile could be achieved for all other trade routes.

The potential energy savings would be .073 quads or 12 percent of all liner consumption.

VIII. THE ENERGY IMPACTS OF THE AVAILABILITY OF INTERMODAL CONTAINER TRANSPORTATION SERVICES

VIII. THE ENERGY IMPACTS OF THE AVAILABILITY OF INTERMODAL CONTAINER TRANSPORTATION SERVICES

The Far East minibridge service, inaugurated in 1972, is an intermodal transportation service offered by water carriers in conjunction with the railroads. Containerized cargo moves by rail from Altantic/gulf coast ports to and from west coast ports, then by water to and from Far East ports, as shown in Figure VIII-1. A similar situation exists involving containerized cargo movements via minibridge from west/gulf coast ports to European ports, known as the EuroCal minibridge, and from the Far East to Europe, known as the landbridge.

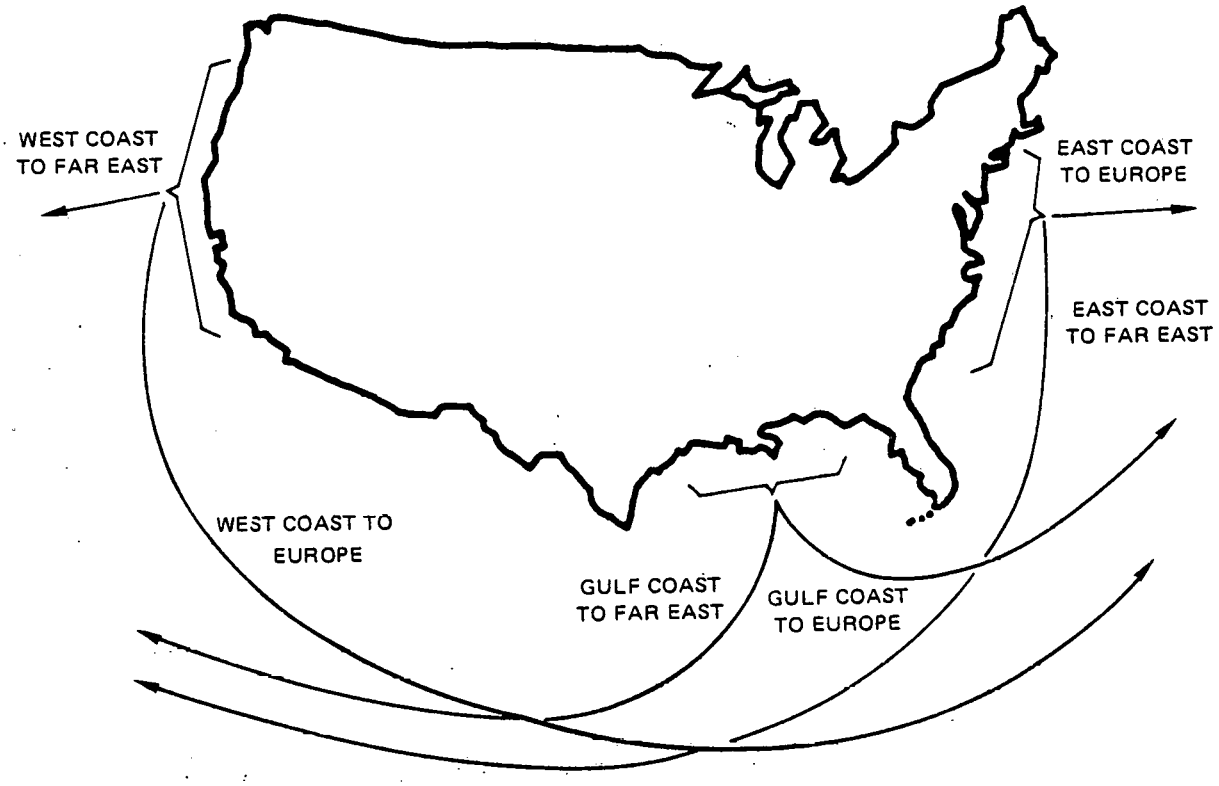
1. MINIBRIDGE OFFERS THE SHIPPER INCREASED FLEXIBILITY AND FREQUENCY OF SERVICE

The alternatives to minibridge service are all-water movements from Atlantic/gulf coast ports to and from the Far East and west/gulf coast ports to and from Europe. Minibridge service offers the advantage of cheaper and faster delivery of goods over the all-water alternative, while increasing the cargo deadweight utilization of minibridge water carriers. The all-water alternatives will deliver goods from New York to Yokohama in 25 to 30 days. Minibridge service will deliver the same cargo in 20 days. The effect of Far East minibridge services has been to provide shippers with an increase in the frequency of service, as shown in Table VIII-1.

The flexibility that Far East minibridge service has provided has had the effect of putting east coast shippers in a better competitive position vis-a-vis Midwest and West Coast shippers. The disadvantages of the Far East minibridge service are that it diverts cargo from east/gulf coast ports resulting in losses in port income, and the joint rail-water rates on tariffs discriminate against west coast shippers.

The all-water alternative offers simplified documentation with the single bill of lading as does minibridge service, but the cargo is handled only once. The more cargo is handled, the greater are the chances for damage and pilferage.

Situation Before Minibridge and Landbridge



Situation With Minibridge and Landbridge

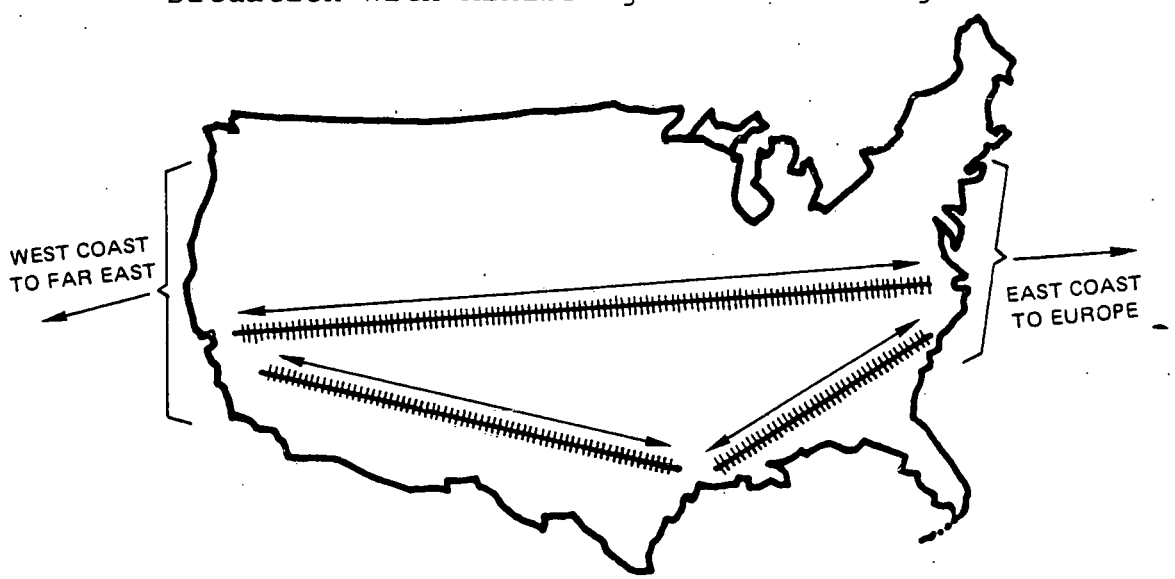


FIGURE VIII-1
Minibridge and Landbridge Service

TABLE VIII-1
Number of Sailings in the U.S. - Far East Trade[1]

Far East Conference				Pacific West Bound Conference	Total	Ratio of West Coast to East and Gulf Coast Sailings
Year	Atlantic Coast	Gulf Coast	Subtotal[2]	Pacific Coast[3]		
1970	461	336	715	1623	2338	2.3
1971	402	208	626	1306	1932	2.1
1972	487	270	695	1519	2214	2.2
1973	424	265	616	1727	2343	2.8
1974	375	166	490	1534	2024	3.1

1 Sailings include all lines

2 Subtotal not the sum of Atlantic and Gulf Sailings because a single voyage sometimes includes loadings in both ranges of ports.

3 Counts multiple port calls as one sailing.

Sources; Far East and Pacific Westbound Conferences.

2. THE LEGALITY OF THE FAR EAST MINIBRIDGE SERVICE HAS BEEN CHALLENGED

The Federal Maritime Commission instituted a comprehensive investigation of Far East minibridge operations in Docket 73-38 and issued an environmental impact statement following complaints by various North Atlantic shipping interests. The parties involved in this dispute are listed in Table VIII-2. Nine of the respondent carriers provide both a Far East minibridge service and an all-water service. The complainants argue that; the minibridge tariffs serve to draw high cargo away from Atlantic/Gulf ports, the rates are non-compensatory, and the rates discriminate against West Coast shippers in violation of:

- Sections 15, 16, 17, and 18 of the Shipping Act of 1916
- Section 8 of the Merchant Marine Act of 1920.

The legal alternatives open to the Federal Maritime Commission are to:

- Declare the service unlawful
- Declare the service lawful
- Declare the service lawful with certain provisions.

3. FAR EAST MINIBRIDGE SERVICE OFFERS A 25 PERCENT ENERGY SAVINGS OVER THE ALL-WATER OPTION

The transportation energy requirement was calculated for the two alternatives; all-water, and rail/water for the 1974 level of minibridge traffic , shown in Table VIII-3. Since its inception in 1972, the Far East minibridge has transported an average of 25 percent of the total number of containers moving to the Far East from the Atlantic and Gulf coasts. The results of the energy consumption analysis are presented in Table VIII-8. They indicate that there is a 25 to 26 percent energy saving using minibridge.

The all-water indirect option assumes that a vessel will make a port call at Los Angeles before continuing on to the Far East, while the all-water direct option assumes continuous steaming from Atlantic/Gulf ports to the Far East via the Panama Canal.

TABLE VIII-2
Parties Involved in Far East
Minibridge Case

Complainants	Respondents
Council of North Atlantic Shipping Associations (CONASA) International Longshoreman's Association, AFL-CIO Delaware River Port Authority Massachusetts Port Authority	American Mail Lines American President Lines Japan Lines Kawasaki Kisen Kaisha, Ltd. Mitsui O.S.K. Lines Nippon Yusen Kaisha, Ltd. Orient Overseas Line Pacific Far East Line Phoenix Container Lines Sea-Land Service, Inc. Seatrain Line Showa Shipping Companu United States Lines Yamashita-Shinnihon Steamship Company Zim-Israel Navigation Company

TABLE VIII-3
Container Cargo Carried in 1974

Trade Route	Tonnage in Long Tons (000)
12 (U.S. Atlantic/Far East) 22 (U.S. Gulf/Far East 29 (U.S. Pacific/Far East)	2141.2 36.4 5748.7
Cargo Attributable to Far East Minibridge[1/] TR 12 TR 22	 505 312

1/ Figures represent a 36 percent increase over 1973 Minibridge Tonnage Figures in FMC Docket 73-38.

TABLE VIII-4
Energy Comparison of Far East Minibridge Alternatives

Option	Mode	Distance	BTU/ Ton-Mile	$\frac{\text{BTU's}}{\text{Ton X } 10^6}$
Minibridge (N.Y.-Yoko)	Rail	3082	655	2.02
	Water	5572	720	4.01
All Water (Direct)	Water	11169	720	8.04
All Water (Indirect)	Water	11249	720	8.10
Total Minibridge				6.03
Total All Water				
Direct				8.04
Indirect				8.10
Energy Savings with Minibridge				(25% to 26%) Δ2.01 to 2.07
Minibridge (Gulf-Yoko)	Rail	1901	655	1.25
	Water	5572	720	4.01
All Water				
Direct	Water	9126	720	6.57
Indirect	Water	9929	720	7.15
Total Minibridge				5.26
Total All-Water				
Direct				6.57
Indirect				7.15
Engery Savings with Minibridge				(20% to 26%) Δ1.31 to 1.89

Note: BTU/ton-mile for rail based on national averages from FMC Docket 73-38

BTU/ton-mile for water based on "Lancer" class vessel, SFC = .497 lbs/SHP/hr, 27,000 SHP, at 22 knots
85 percent cargo deadweight utilization.

BTU's/container-mile assumes average TEU = 12 long tons.

The vessel chosen to represent the all-water (direct and indirect) options and the water portion of minibridge is the United States Lines "Lancer" class containership. The "Lancer" class is the most efficient vessel type serving the Far East trade, and as a result, the energy analysis yielded the maximum energy savings that could be expected to be realized from minibridge. All movements from Atlantic ports are represented by appropriate New York to Yokohama distances, movements from Gulf Coast ports are represented by New Orleans to Yokohama distances, and West Coast movements are represented by Los Angeles to Yokohama distances. The actual calculations were performed, as shown in Table VIII-5.

TABLE VIII-5
Sample Energy Calculations

1.	Energy Required to Move One Ton from New York to Los Angeles by Rail	= (Distance x BTU's Per Ton-Mile) = 3082 x 655 = 2.02 x 10^6 BTU's
2.	Energy Required to Move One Ton from Los Angeles to Yokohama by Containership	= (Distance x BTU's Per Ton-Mile) = 5572 x 720 = 4.01 x 10^6 BTU's
3.	Total Energy Required to Move One Ton from New York to Yokohama by Minibridge (Rail/Water)	= 6.03 x 10^6 BTU's
4.	Total Energy Required to Move 1974 Lelel of Far East Minibridge Cargo (Diverted from TR 12) by (Rail/Water) Option	= (BTU's Per Ton x Tonnage) = 6.03 x 10^6 x 505,000 = 3.05 x 10^{12} BTU's

4. ADDITIONAL ENERGY SAVINGS ARE OFFERED BY THE EUROCAL MINIBRIDGE AND THE EUROPE/FAR EAST LANDBRIDGE

Two other multimodal container movements offer the potential for significant energy savings while offering faster service. They are the EuroCal minibridge and the Europe/Far East landbridge.

In the EuroCal minibridge, containerized cargo's originating on the West and Gulf Coast destined for Europe move by rail to Atlantic Coast ports by rail and then by water to Europe. The Europe/Far East landbridge involves cargo moving by water between Europe and the U.S. East Coast, then by rail between the U.S. East and West Coasts, and by water again between the U.S. West Coast and the Far East.

In Tables VIII-6 and VIII-7, the potential for energy savings using these two alternatives to the all-water routes are given. The EuroCal minibridge offers a fourteen percent energy savings over the all-water route and the Europe/Far East landbridge offers a two percent energy savings over the all-water route.

TABLE VIII-6
Energy Comparison of Eurocal
Minibridge Alternatives

Option	Mode	Distance (Statute Miles)	BTU's/ Ton-Mile	BTU's/ Ton x 10^6
Minibridge (L.A.-Europe)	Rail	3082	655	2.02
	Water	3900	720	2.80
All-Water (L.A.-Europe)	Water	7741	720	5.60
Minibridge (Gulf-Europe)	Rail	1000	655	0.66
	Water	3900	720	2.80
All-Water (Gulf-Europe)	Water	4854	720	3.50
TOTAL MINIBRIDGE (EuroCal)				4.82
TOTAL ALL-WATER (EuroCal)				5.60
ENERGY SAVINGS WITH MINIGRIDGE				0.78 (14%)
TOTAL MINIBRIDGE (Euro-GULF)				3.46
TOTAL ALL-WATER (Euro-GULF)				3.50
ENERGY SAVINGS WITH MINIBRIDGE				0.04 (1%)

TABLE VIII-7
Energy Comparison of Europe/Far East
Landbridge Alternatives

Option	Mode	Distance (Statute Miles)	BTU's/ Ton-Mile	BTU's/ Ton x 10^6
Landbridge	Rail	3082	655	2.02
	Water	9472	720	6.81
All-Water	Water	12566	720	9.05
ENERGY SAVINGS WITH LANDBRIDGE				0.22 (2%)

Table VIII-8 compares the five intermodal container transportation options and the estimated potential for maritime transportation energy conservation associated with each.

TABLE VIII-8
Energy Savings Potential of Intermodal
Container Transportation Systems

Option	Mode	BTU's/Ton	Savings (BTU's/Ton)	1974 All Water Container Movement (Long Tons)		Potential for Energy Savings (BTU's x 10^6)	
				Trade Route	L. Tons	High	Low
1. Minibridge N.Y. to Yokohama	Rail	2.02		12	2,141,200	4.48	4.35
	Water	4.01		½ of 18	20,800		
Total		6.03					
All water direct	Water	8.04	2.01 to 2.07	Total	2,162,000		
All water indirect	Water	8.10	(25% to 26%)				
2. Minibridge Gulf Coast to Yokohama	Rail	1.25		22	36,400	0.11	0.07
	Water	4.01		½ of 18	20,800		
Total		5.26					
All water direct	Water	6.57	1.31 to 1.89	Total	57,200		
All water indirect	Water	7.15	(20% to 26%)				
3. Far East to Europe Landbridge	Rail	2.02			Unknown	Unknown	Unknown
	Water	6.81					
Total		8.83	0.22 (2%)				
All water	Water	9.05					
4. Los Angeles-Europe Minibridge	Rail	2.02					
	Water	2.80		26	819,000		
Total		4.82	0.78 (14%)	65	68,600	0.69	0.69
All water	Water	5.60		Total	887,900		
5. Gulf Coast to Europe Minibridge	Rail	0.66		21	891,500	0.04	0.04
	Water	2.80		13	122,500		
Total		3.46	0.04 (1%)	Total	1,014,000		
All water	Water	3.50					

IX. THE ENERGY IMPACT OF CAPACITY LIMITATIONS AT LOCK AND DAM 26 ON THE MISSISSIPPI RIVER

IX. THE ENERGY IMPACT OF CAPACITY LIMITATIONS AT LOCK AND DAM 26 ON THE MISSISSIPPI RIVER

Lock and Dam 26 (L&D 26), located on the Mississippi River at Alton, Illinois, is a structure with two locks, the dimensions of which are:

- The main lock - 110 feet x 600 feet
- The auxiliary lock - 110 feet x 360 feet.

This facility is described as a bottleneck by the Army Corps of Engineers that is limiting the amount of traffic that can move between the upper Mississippi-Illinois River systems and the Ohio-lower Mississippi River systems. There is currently a question concerning the structural integrity of the present facility. The controversy currently surrounding this facility centers on the option to be used to deal with the structural problems. The two options are:

- To repair, and the extent and method of repairs, or to replace the structure

- To retain the existing 110 feet x 600 feet main lock or increase the capacity and lock size to 110 feet x 1200 feet.

The facility immediately down river from L&D 26 is L&D 27, having a 110-foot x 1200-foot main lock and 110-foot x 600-foot auxiliary lock. Immediately up river from L&D 26, the river traffic splits between the upper Mississippi River and the Illinois waterway. The Army Corps of Engineers (COE) has placed a capacity of 45 million tons per year at the locks upstream of L&D 26 on the upper Mississippi and 63 million tons on the southernmost dams on the Illinois waterway. This situation is shown in Figure IX-1, giving a total upstream capacity of 108 million tons per year.

The COE has estimated the upper capacity limit of L&D 26 at 73 million tons. The capacity of L&D 27, immediately down river is estimated by the COE at 135 million tons. In theory, then, L&D 26 is undersized.

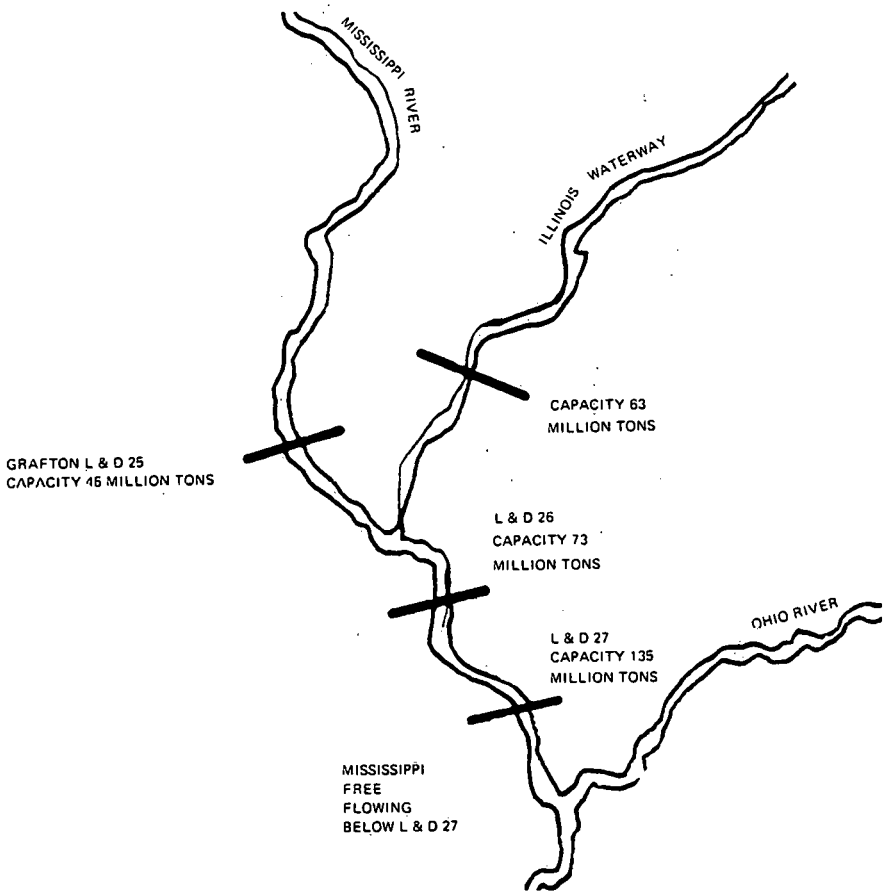


FIGURE IX-1
Location and Capacity of Lock and Dam 26
and Adjacent Projects

1. THE CONTROVERSY SURROUNDING LOCK AND DAM 26 IS A MODAL DIVERSION QUESTION

The participants and their positions in this controversy are:

- Railroads and allied conservation interests that want to restrict work on L&D 26 to a minimum repair of the existing facility with no increase in capacity

- The Army Corps of Engineers and allied river towing interest and farmers' groups that wish to replace the existing facility with a new, larger lock and dam two miles downstream of the present site. This proposal is shown in Figure IX-2.

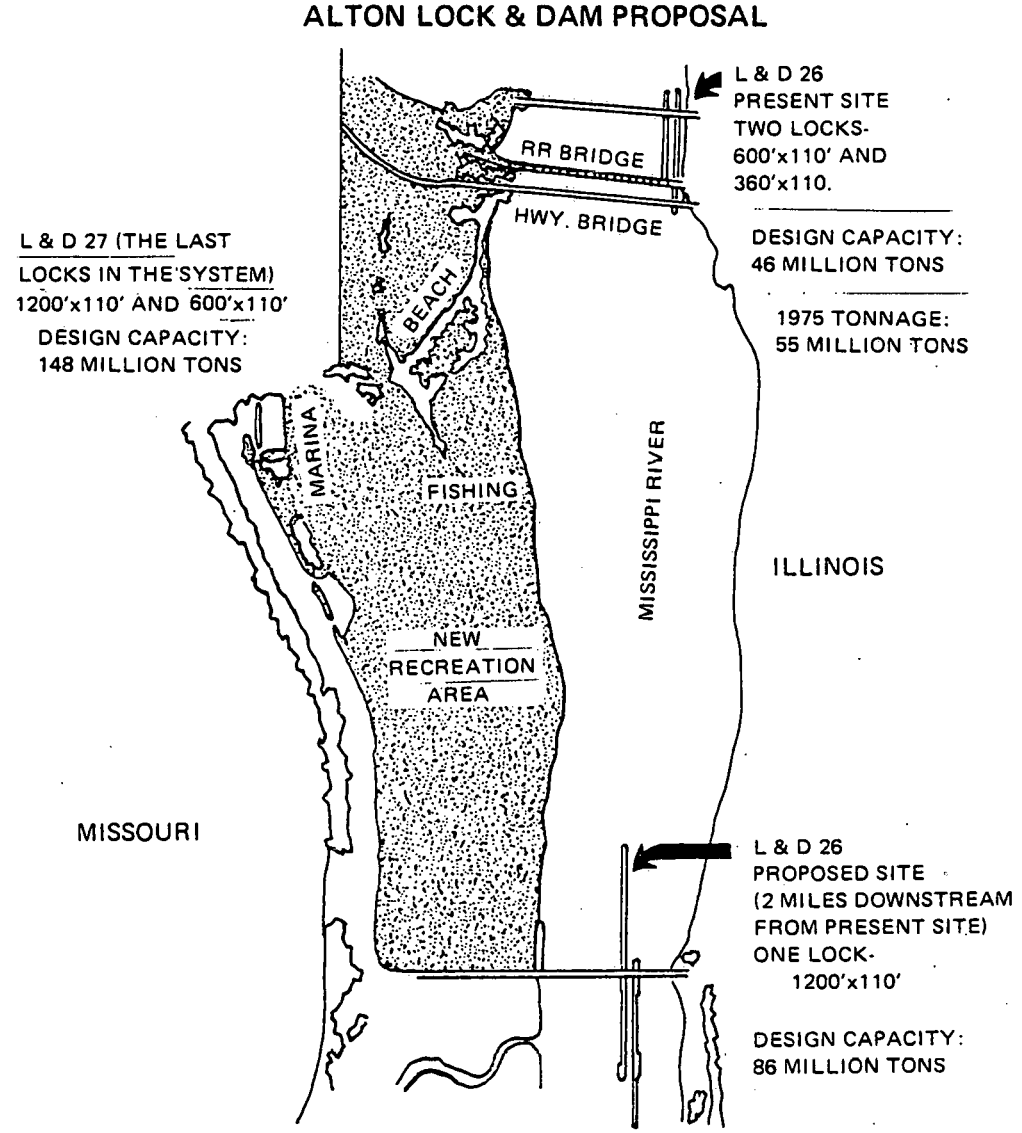


FIGURE IX-2
Alton Lock and Dam Proposal

The position of the COE is that the repair of the present facility will take almost as long and cost almost as much as building a completely new facility two miles downstream. The opponents of the new facility wish to limit the capacity of the inland river system and argue:

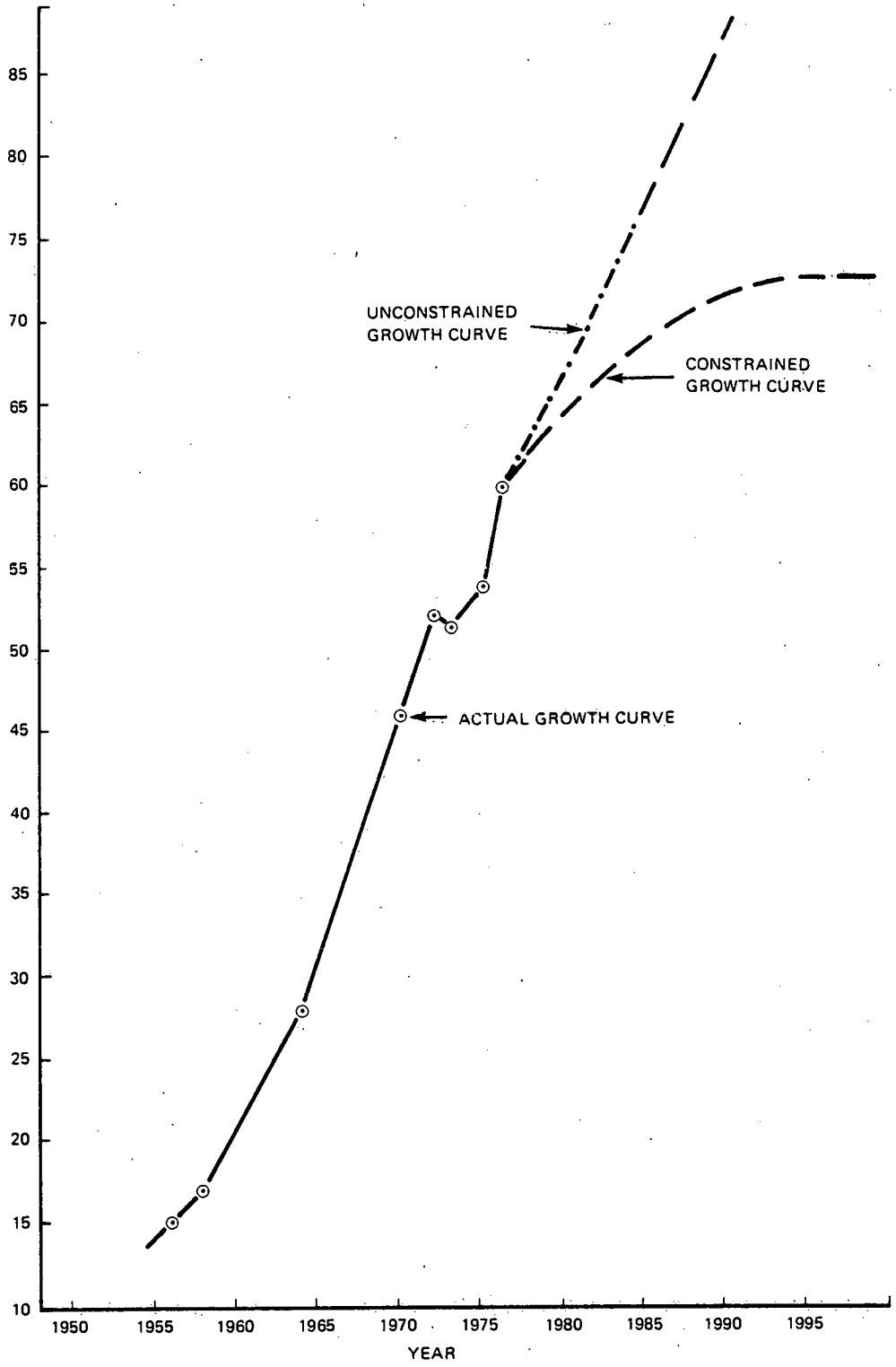
- Extensive repair is not necessary
- Existing capacity could be increased with locking procedural changes
- The proposed new facility is the first step in an overall system expansion and therefore, is by definition, environmental harmful.

2. THERE IS AN ENERGY CONSEQUENCE OF NOT PROVIDING INCREASED CAPACITY AT LOCK AND DAM 26

The question under consideration in this case study is the inland waterway transportation energy use consequence of not providing a new expanded facility as proposed by the COE. The actual growth of traffic through L&D 26 is established and the fact that it is approaching its capacity is shown in Figures IX-3 and IX-4. Figure IX-3 shows the growth trend of traffic through L&D 27 from 1958 through 1976. Traffic grew from 15 million tons in 1958 to 60 million tons in 1976. This is an increase of 300 percent.

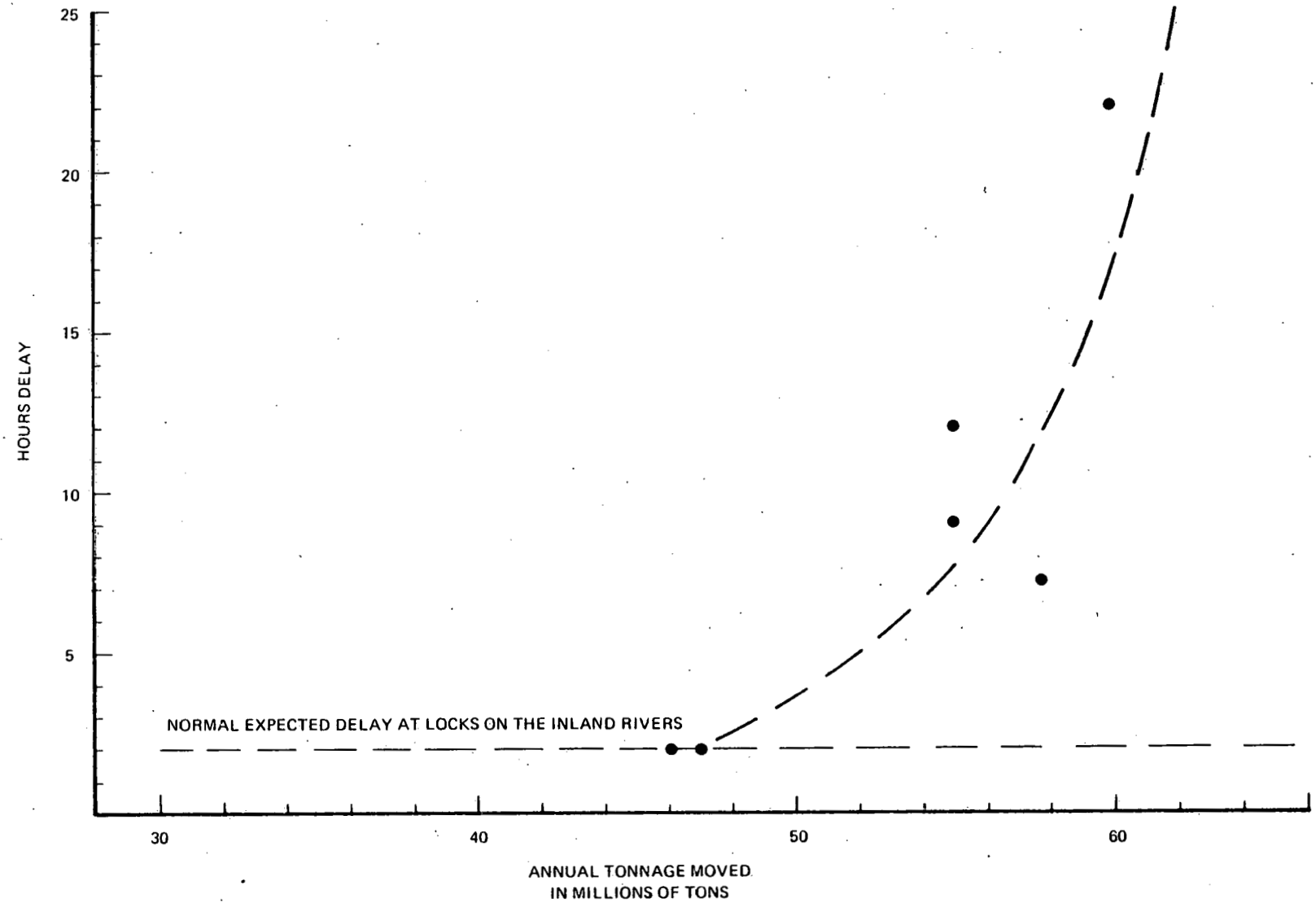
The fact that the capacity limit of L&D 26 is being reached is shown in Figure IX-4. The average delay reported at an annual traffic level of 60 million tons in 1976 was 22 hours. It is this delay factor that impacts energy consumption. Standard river towing practice is to "never shut down main engines" but to leave them idling. The primary reason behind this practice is to avoid the heat cycling of shutdown/startup. The energy consumed during these delay periods can be calculated. However, there exists a potential for an even greater energy impact. This is the potential for diversion of cargo that would normally move via the inland river systems to the railroads. The approach used to estimate the energy impact of not expanding L&D 26 took the following steps:

- Step 1 — Estimate the delays associated with various capacity levels
- Step 2 — Estimated the cargo that would be diverted to railroads should the expansion of L&D 26 be postponed
- Step 3 — Calculate the energy impact.



SOURCE: LOCKS & DAM 26, HEARINGS BEFORE THE SUBCOMMITTEE ON WATER RESOURCES OF THE COMMITTEE ON PUBLIC WORKS, U.S. SENATE, 94TH CONGRESS, 94-H45

FIGURE IX-3
Projected Growth of Traffic Transiting Lock and Dam 26



SOURCE: LOCKS AND DAM 26, HEARINGS BEFORE THE SUBCOMMITTEE ON WATER RESOURCES OF THE COMMITTEE ON PUBLIC WORKS, U.S. SENATE, 94TH CONGRESS, 94-H45

FIGURE IX-4
Estimated Delays at Lock and Dam 26 as a Function of Traffic Levels

3. STEP 1 — THE CAPACITY OF LOCK AND DAM 26 WAS ESTIMATED

There is an intense controversy surrounding the measurement of the capacity of L&D 26, as shown in Table IX-1.

Table IX-1
Various Capacity Figures for Lock and Dam 26

Agency	Estimated Capacity
Army Corps of Engineers	73 million tons
Peat Marwick & Mitchell	77 million tons
Opponents	88 million tons

Source: Locks and Dam 26, hearings before the Subcommittee on Water Resources of the Committee on Public Works, U.S. Senate, 94th Congress, 94-H45.

Some of the assumptions that impact the measurement of capacity include:

- Size of the average tow
- Length of operating year
- Seasonality of shipping demand.

The high capacity figures estimated by the opponents to the COE proposal are based on the following assumptions:

- Traffic is always willing to wait
- Twelve-month operation
- High average tow sizes
- Questionable locking techniques
- Shipping demand remains constant over the year.

In actuality, L&D generally operates approximately 10.5 months out of the year and ceases operation when the upper Mississippi and Illinois waterway close due to icing. This closure did not occur in the winters of 1975 and 1976. The Peat Marwick Mitchell study stated that:

> "As the lock utilization (or percent operating time) increases above the 70 to 80 percent range, the delays encountered by tows increase exponentially. Thus, when the lock utilization increases from 60 to 70 percent, the total monthly delay increases by about 20,000 minutes per month; when the lock utilization increases

from 80 to 90 percent, the total monthly delay increases by about 115,000 minutes per month — 575 percent more. This observed empirical relationship is confirmed by queuing theory which indicates that as the utilization of the lock approachds 100 percent, the delay will approach infinity.

"...The 100 percent utilization of the main chamber and the 75 percent utilization of the auxiliary chamber assumed in this capacity analysis imply a relatively low level-of-service to the towing industry. That is, if the lock chambers were operating at these utilization levels, the towing industry would encounter extremely large delays prior to being served at Lock No. 26. If lower utilization levels were assumed to estimate the capacity of Lock No. 26, the capacity of the locks would be correspondingly reduced."

The 88 million ton figure is also based on an average tow size of 7,400 tons. The COE estimate was based on an average tow size of 6,250 tons. The 7,400 ton figure was based on 1976 figures that the COE calls higher than usual due to a cessation of local switching traffic caused by high delays at L&D 26. This local traffic was made up of small tows that generally use the auxiliary lock.

Based on the volume/delay curve developed in Figure IX-4, cargo diversions to rail were assumed to start after the annual throughput reached 60 million tons and the average delay passed 16 hours.

4. STEP 2 — CARGO DIVERSIONS DUE TO CONGESTION AT LOCK AND DAM 26 WAS ESTIMATED

In Figure IX-3, the actual growth of tonnage moving through L&D 26 has been plotted through 1976. Based on data obtained from an A.T. Kearney report,* unconstrained growth of cargo movements through L&D 26 was estimated at 3 percent per year. Growth through the existing facility was estimated to continue at an decreasing level until an annual volume of 73 million tons per year was reached. Both the constrained and unconstrained growth curves have been shown on Figure IX-3.

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* U.S. Department of Commerce, Maritime Administration, "Domestic Waterborne Shipping Market Analysis," prepared by A.T. Kearney, February 1974.

The amount of cargo diversion was estimated as the difference between the constrained and unconstrained curves.

5. STEP 3 — THE ENERGY USE IMPACT OF NOT CONSTRUCTING NEW FACILITIES AT LOCK AND DAM 26 WERE CALCULATED

Projecting forward to 1980, the diversion of cargo from the inland waterways to the railroads is estimated at 2.6 million tons (see Figure IX-4) based on the following:

- Cargo moves on the inland waterways at 481 BTU's/ton-mile
- Cargo moves on the railroads at 655 BTU's/ton-mile
- The average length of haul for diverted cargo is 1,200 miles (Minnesota to New Orleans)
- The length of haul of the diverted cargo would have been the same either by rail or by barge
- The average delay at lock and dam 26 at a cargo volume of 65 million tons is 25 hours, however towboats would move to the bank and tie up and shutdown main engines if the expected delay exceeded 8 hours
- The average towboat size is 3,000 HP with fuel consumption of .52 lb/HP-hr. at 5 percent of rated BHP
- Average tow size of 6,500 tons.

6. CONSTRAINING TRAFFIC GROWTH THROUGH LOCK AND DAM 26 ON THE MISSISSIPPI RIVER COULD RESULT IN INCREASED TRANSPORTATION ENERGY CONSUMPTION DUE TO DIVERSION OF CARGO TO RAIL

Based on the above assumptions the amount of additional energy consumed due to not increasing the capacity of L&D 26 was calculated to reach 0.666×10^{12} BTU's by 1980 as shown in Table IX-2. The actual amount of cargo diverted from the inland rivers to rail would probably be less than that estimated in Figure IX-3. The actual amount of cargo diverted would depend upon increases in rail tariffs, that would follow increased demand for rail service.

Table IX-2
Additional Energy Consumed (1980) Resulting From
No Additional Capacity at Lock and Dam 26

Item	Energy (BTU's)
Additional energy due to idling of towboats	$.120 \times 10^{12}$
Additional energy due to cargo diversion to rails	$.546 \times 10^{12}$
TOTAL	$.666 \times 10^{12}$