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THE RELATIONSHIP BETWEEN THE CLEAN AIR ACT AND GREAT LAKES SHIPPING

By

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ABSTRACT

THE RELATIONSHIP BETWEEN THE CLEAN AIR ACT AND

GREAT LAKES SHIPPING

By

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The complexity of the coal and electric utility industries in the United States poses difficult challenges for strategic planners, market analysts, and policymakers. Changes in the Clean Air Act of 1990 further impact this relationship. While the Act codifies emissions trading, low sulfur coal is presently more central to the workability of regulating power plant emissions. On average 10 to 12 million net tons of Western coal are shipped annually to lower Lakes utilities. As utilities respond to Clean Air Act compliance requirements, waterborne coal demand could increase to as much as 40 million tons per year by the end of the decade.

This research examines the geographical, conceptual, and logistical linkages between the low-sulfur coal deposits of the Powder River Basin in Montana and the electric utility industry via the Great Lakes Shipping industry. The central question researched is whether the increased demand for waterborne clean coal by lower lakes utilities can be accommodated by current U.S flag fleet shipping capacity with its competing commodities.

The approach of this study is to evaluate various government and industry forecasts for increased demand for coal, iron ore, and limestone in the Great Lakes basin to the year 2000, to quantify growth rates, develop forecasts, and compare this

composite dry bulk demand to U.S. dry bulk fleet carrying capacity. The basic concept employed is supply and demand. Low cost waterborne fuel and non-fuel minerals are in increasing demand by American utilities and by manufacturers, but supply of vessels is limited.

From a purely numerical standpoint, composite forecasts indicate that there will be no capacity shortfall before the year 2000, but when the fleet is examined by vessel size a different picture emerges. Excess capacity exists primarily in the smaller vessels which, because of economies of scale, are not engaged in long distance, high volume transport. In reality, several new thousand foot vessels will indeed be required throughout the nineties, the number of which depends upon which growth scenario is more correct.

ACKNOWLEDGEMENT

This Research is dedicated to my advisor, mentor, and friend, Peter Kakela without whose support and guidance this project would not have been possible, and to those members of my family who could not understand why I should undertake such a tortuous adventure, but who nevertheless acknowledged that it's OK to be uncommon if you can.

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AN OVERVIEW

CHAPTER 1.

I. INTRODUCTION.

In a March 1991 interview Mr. George Ryan, President of the Lake Carriers' Association, stated that "two or three new 1,000-foot coal carriers will be needed to move Western coal" by the year 2000 (Seaway Review, 1991a). In a February 1992 address to the Lake Carriers' Association, Mr. John Ethan, President of Superior Midwest Energy Terminal in Superior, Wisconsin repeated this concern indicating that depending on the movement of other commodities on the Great Lakes, a vessel capacity problem for 1000-foot vessels could exist in the near future. Since 1984 Superior Midwest Energy Terminal has been the largest volume U.S. flag coal port on the Great Lakes. As of summer 1993 there is very little economically feasible excess capacity remaining in the U.S. Great Lakes Flag fleet. The question addressed by this research is: As a result of the Clean Air Act Amendments of 1990 how will the shift toward Western coal change the demand for Great Lakes ship capacity?

a. Coal and Electricity.

In the U.S. the utility sector is by far the largest market for coal. Steam coal accounted for 87% of total domestic consumption in 1990. Because of interactions between these two closely-coupled industries, attempts to analyze either one in isolation are necessarily incomplete. Yet the complex characteristics of these industries often strain the limits of traditional analytic methods. In fact one well known financial analyst has recently labeled the forecasting of energy demand as an enormous intellectual challenge at best.

Both coal and electric utility industries face rapidly changing markets. Recent years have brought about dramatic changes in the growth of electricity demand, price of alternative fuels, cost of nuclear plant construction, and much more. Market conditions have swung broadly from under capacity to over capacity. The markets continue in a state of transition, and the importance of understanding the timing and magnitude of such changes is great.

Furthermore both industries are heavily influenced by a wide-range of government policies and regulations. Government regulation affects nearly every aspect of each of these industries including environmental protection, miner health and safety, transportation, taxation, price regulation, and ratemaking. The implications of possible policy changes are substantial and government and industry planners place great value on understanding these effects.

The complexity of the coal and electric utility industries in the United States poses difficult challenges for strategic planners, market analysts, and policymakers. Numerous uncertainties regarding changing economic trends and future government policies increase the difficulties of forecasting future market condition. Demand side management and its impact on future generating needs, the potential of retail wheeling, variable fuel and labor costs, sulfur emissions compliance, and a proposed carbon tax are but a few of these issues. Others include altering the dispatch of generating units, advancing the retirement date for facilities with high emission rates and replacing them with new ones having lower rates, building new generating equipment, building new transmission lines to facilitate additional power purchases and acquiring capacity and energy from non-utility sources.

b. Acid Rain Legislation.

Changes in the Clean Air Act of 1990 (CAA90) further impact the relationship between coal and electricity. Title IV of the Act specifically regulates power plant emissions which are believed to contribute to the acid rain problem. Acid rain may form when emissions of sulfur dioxide and various oxides of nitrogen, primarily from the burning of fossil fuels, mix in the upper atmosphere and are transformed into sulfates and nitrates. These compounds in turn react to become sulfuric and nitric acid when combined with water.

Acid rain has been connected with acidification of lakes and streams, particularly in the northeastern United States and Canada, with resulting damage to fish and wildlife, as well as damage to various elements of the natural and man-made environments. Although the extent and severity of these effects and the precise types and combinations of emissions that ultimately cause them have been much disputed, the 1990 amendments assume that such effects exist, that they are serious effects, and that they need to be addressed.

In the early part of this century emitting sources typically had short smoke stacks and emissions fell to the earth in surrounding neighborhoods, blackening real estate, marring auto finish, and creating serious respiratory problems for residents. The mid-century evolution of tall smokestacks solved these problems but resulted in far ranging windborn emissions that are presumed to incorporate sulfur and nitrous oxides into the hydrological cycle. The pre-1990 Clean Air Act took into account neither these chemical transformations, nor interstate and international pollution, nor the resulting environmental impacts.

Title IV of the Clean Air Act as amended, known as the acid rain provision, is a complex two phase program which regulates stationary emission sources and imposes limits on emissions that cause acid rain. Eighty percent of these sources are coal fired electrical power generation facilities. Central to the strategy of both phases is low-sulfur coal.

c. Research Focus

This research examines the geographical, conceptual, and logistical linkages between the low-sulfur coal deposits of the Powder River Basin in Montana and the electric utility industry via the Great Lakes Shipping industry. The central question researched is whether the increased demand for waterborne clean coal by lower lakes utilities can be accommodated by current U.S flag fleet shipping capacity with its competing commodities. In this context rail costs are compared to vessel ton-mile costs and the controversy over the environmental impact of extended season navigation is reviewed.

The eight state East North Central coal consumption region is the largest user of utility coal in the nation. Total share is about 33%. ENC is composed of Wisconsin, Illinois, Indiana, Kentucky, West Virginia, Western Pennsylvania, Ohio and Michigan. Low-sulfur Western coal is supplied to the region by rail and by water and because of its low cost is expected to play a major role in allowing midwestern electric utilities to meet Phase I and Phase II compliance requirements. Compliance strategies will in part require replacing an undetermined amount of currently used high sulfur coals from the Appalachian and Interior regions with low-sulfur Western coal.

Western coals' intermodal routing as examined in this study is rail delivery to Superior with unloading to ground storage then reloaded to vessel with shipment directly to the ultimate user or to a lower Lakes dock that will receive the Western coal and blend it with Eastern coal for ultimate rail delivery to a utility. Most Eastern utility boilers are not designed to burn Western coal but by blending Western low sulfur with Eastern mid-sulfur a technically and environmentally acceptable fuel results. Utility Operations Divisions have been slow to acknowledge this but economic justification in terms of $/Btu is creating a substantial climate of change in an otherwise inertia-bound industry.

II. STATEMENT OF THE PROBLEM.

a. Dry Bulk Shipment on The Great Lakes System.

Because of the operating efficiencies involved over the past 20 years larger ships with greater cargo capacity and greater speeds have been built to replace smaller vessels. In fact, Lake vessels larger than 760 feet cannot continue beyond Lake Erie to the St. Lawrence Seaway due to size limitations at the Welland locks. The availability of iron ore, coal and limestone in the Great Lakes area has been responsible for the development of one of the largest industrial concentrations in the world. Because of the low cost of water transportation, iron ore and steel production are brought together very economically.

Likewise the very existence of the many iron and steel dependent industries situated on the shores of the Great Lakes are due largely to the availability of low cost water transportation. Shipment by Great Lakes freighter is by far the cheapest form of transportation available for the bulk commodities produced on or near to the shores of the Great Lakes. Where possible electric utilities also tend to situate on Great Lakes shores and tributaries in order to take advantage of the economies associated with waterborne transportation of coal. Although geographically, Duluth is 240 miles further inland in a westerly direction and 450 miles further inland in a north-westerly direction than Chicago, Duluth is only 93 miles further from the Atlantic Ocean than Chicago by steamer. As a transportation system the Great Lakes are well positioned to handle enormous quantities of coal for export.

b. Shipment of Dry Bulk Commodities Will Increase.

While coal, iron ore, limestone and grain continue to be the major dry bulk Great Lakes commodities, wood chips and particularly coal for export also have significant market potential. In 1991 the first shipment of Western coal to Europe via the Great Lakes occurred. Depending on a number of factors this could place further demands on a transportation system that has the capacity in a very short time to become critically stressed.

Additionally, the iron ore industry's demand for higher quality fluxed pellets will require that limestone be transported north to the iron mines then shipped south again as pellets to lower lake blast furnaces. Therefore, for iron ore, shipping needs will increase even if iron ore demand remains stable.

Relatively abundant low-sulfur coal reserves exist in Appalachia as well as the Powder River Basin (PRB) producing regions. Total Appalachian low-sulfur recoverable reserves are approximately 12 billion tons, compared to Wyoming's 68 billion and Montana's 120 billion tons. PRB coal is much more accessible, but transportation costs play the pivotal role in determining delivered price per ton. Taking into account total dry bulk cargo, this study is concerned primarily with that portion of PRB coal that comes by rail from Wyoming or Montana, is transhipped at Duluth, and is brought across the Great Lakes to midwestern utilities for power generation.

On average 10 to 12 million net tons of Western coal annually are shipped through SMET to lower Lakes utilities. At the present time three 1000 foot lake boats are dedicated to this task. During the mid to late 1990s as utilities respond to Clean Air Act compliance requirements, waterborne coal demand could increase to as much as 40 million tons per year by the end of the decade (Ethan, 1992).

To accommodate this shift there must be either more ships or the shipping season must be extended into the fragile winter period. This system is fragile, in that biologists are concerned that the passage of large lake ships through ice-covered narrows and shallows may disturb vital fish beds and the reproductive cycle of other critical organisms in the lakes. The balance, then, is between cleaner air as required by law and the increase in potentially disruptive ship traffic on the Great Lakes as the shortage of capacity requires an extended shipping season.

III. METHODOLOGY - A DETERMINATION OF SUPPLY AND DEMAND.

The approach of this study is to evaluate various government and industry forecasts for increased demand for coal, iron ore, and limestone in the Great Lakes basin to the year 2000 and to compare the composite demand to current U.S. bulk fleet carrying capacity. In the context of the relationship between the electric utility industry and the coal industry this study identifies and analyzes the various factors that can impact the need for increased Great Lakes shipping and determines the extent of increased demand.

The basic concept of this study is one of simple supply and demand. Fuel and non-fuel minerals are in increasing demand by American utilities and by manufacturers, but supply of vessels may soon be exceeded. In addition to analyzing demand factors fleet utilization rates have been obtained from the Lake Carriers' Association and verified through major shipping company personnel. Variations on the annual potential volume transported are dependent on the number of trips each vessel makes per season which in turn depends on the average length of trip and the length of shipping season.

Forecasting coal consumption patterns through the end of the decade depends heavily on both rate of economic growth and compliance choices made by utilities. Each choice is extremely sensitive to price, particularly the effects of transportation costs which can cause different compliance strategies to come within a penny of each other. At a certain point it makes economic sense for a utility to install costly scrubbers rather than pay the price of shipping low-sulfur coal from distant regions.

Although 80 to 90% of Phase I decisions have already been made by utilities in regards to scrubbing versus switching, blending, or buying allowances, the highly volatile nature of the choices makes forecasting uncertain.

In preparing their own forecast for U.S. coal to the year 2000, the National Coal Association quotes the Department of Energy's Annual Outlook - 1988 thus: "The forecast levels of coal production and consumption represent expectations of what would occur under a given set of assumptions. They do not provide unqualified predictions of the future. If conditions change, the forecasts will be affected accordingly. The uncertainty inherent in the forecasts contained in this report should be recognized, so that they can be used in the proper context" (NCA, 1989a). The numbers arrived at here after scrutinizing agency, industry, and consultant reports are based on logical assumption concerning projected increase in demand for electricity.

In addition to coal demand, forecast values have also been examined for iron ore and limestone consumption as well as the potential for moving new bulk commodities in the Great Lakes basin for the next decade. The forecast values used have resulted from numerous conversations with sources in industry, academia, and state regulatory agencies. The approach relied upon here draws on traditional economic policy analysis and in general the techniques employed hinge on orthodox fact finding with no need for proof or validation.

IV. ALTERNATIVES.

a. Coal Slurry.

After the Clean Air Act of 1970 it was expected that increasing amounts of low-sulfur Western coal would be shipped to Midwestern utilities. As an alternative to rail and water shipment coal slurry pipelines were anticipated as a way of reducing transportation costs. Interest still remains in local slurry pipeline in some circles, and it may indeed be economically feasible to develop this method of coal transportation under some conditions and circumstances. There have been however certain fundamental changes in the market since coal slurry was first proposed by the Kennedy administration in 1961.

The original economic conditions necessary to make such an enormous infrastructural investment profitable depended heavily upon rising world oil prices, which did not continue to rise as expected. Also the mandating of scrubber installation in the Revised New Source Performance Standards reduced demand for Western coal.

When slurry transportation was proposed there was a very distinct cost advantage per ton-mile. Railroad's however continually reduced rates while also refusing to grant right of way for slurry lines. Because of the Staggers Act which approved the entering into of contracts between shippers and customers, rail rates today are lower than when the economic advantages of coal slurry were first proposed. Utility contracting practices have also changed. In the 1970s it was not uncommon for a 20 to 30 year contract to be developed between a utility and a coal company. This was done to establish a stable purchase rate and often was negotiated for the expected life of a utility (Kline, 1992, 1993). Now a 5 to 10 year contract is more the norm and this short life span is unsettling to pipeline operators who need long term commitments before undertaking very high capital outlays.

From an environmental regulatory standpoint it is not inconceivable that congress would institute a significant carbon tax on fossil fuels in order to curb demand and encourage alternative fuels development. Such an uncertainty bodes ill for slurry pipeline development. Also given the extremely high demand for water that slurry pipelines require and the resultant contamination that occurs, it is not a certainty that slurry pipeline transportation is an entirely benign technology.

Over the past 30 years railroads have lobbied furiously against slurry lines. Although they have not changed their position, they now feel there is no longer a need for this opposition. Presently there is very little activity in the marketplace for coal slurry pipeline construction and the fierce competition among intermodal shippers in the Midwest does not make the construction of a pipeline running east from the Powder River Basin a very appealing notion currently (Vasy, 1993).

b. Coal by Wire.

Although present economies of electrical transmission become cost prohibitive at distances greater than 400 miles, burning coal at the mine mouth and sending the power through high voltage lines to the Midwest is a potentially workable alternative to shipping coal itself. To some extent this is being done already with power being supplied to the West coast from PRB mine mouth generation. Using this technology as a model it is conceivable that an enormous coal by wire unit could be situated at the head of the Lakes i.e., Duluth, to be used to supplement power supply to the Midwest.

With such a facility, costs associated with generation and transmission of electrical power would be offset somewhat by savings in fuel transportation costs. At the present time though the national average capacity utilization factor for electric utilities is about 46% and it is expected to increase to only 52% by the end of the decade (EIA, 1992a). Given this excess capacity and the highly reliable power supply and distribution network already existing in the Midwest, the notion of a coal by wire facility is not economically or politically feasible before the end of the next decade. EIA expects the use of industrial steam coal to increase after 2010, and it is possible that a peak load generating station could be built if coal transportation costs increase significantly along with a growing Midwestern demand for Powder River coal.

THE CLEAN AIR ACT AND THE ELECTRIC UTILITY INDUSTRY

CHAPTER 2.

I. INTRODUCTION.

For the present decade fossil fuels, and coal specifically, will remain as the workhorse of steam electrical generation. This is due in part to the failure of cheap, safe, and abundant nuclear energy to materialize as promised. Also hydropower generation has peaked, and other forms of renewables have not been supported sufficiently. Coal accounted for the largest share of domestic energy production in 1949-1951 and again in 1982 and in 1984-1991. In the interim, first crude oil and then natural gas dominated domestic production.

In 1991 coal production totaled 22 quadrillion Btu. Dry natural gas production totaled 18 quadrillion Btu and crude oil production totaled 16 quadrillion Btu. Even with demand side management modulating growth, U.S. demand for coal fired electrical energy is projected to keep growing at 2% per year for the foreseeable future.

Historically Lake Erie ports have always led the Lakes in U.S. flag coal shipments. This was so until 1987 when for the first time Lake Superior shipments exceeded Lake Erie shipments. Table 2.1 and Figure 2.1 depict this trend for the past 8 years. Detroit Edison is by far the largest single consumer of waterborne Great Lakes Western Coal. It is Edison's quest to lower SO_2 emissions that accounts for most of the shift from high-sulfur Appalachian coal to low sulphur Western coal.

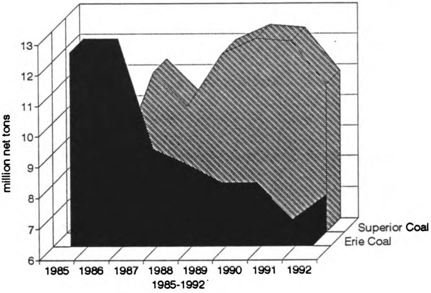
If other lower Lakes utilities follow Edison's lead a shipping capacity problem will likely develop. The magnitude of the shortage will depend on how the utilities react to a number of factors brought about in part by the 1990 Clean Air Act Amendments. The issues examined in this chapter are integral to assessing demand for Western coal.

Table 2-1. U.S. FLAG COAL SHIPMENTS.

(million net tons/yr.)

Year	Total Coal	Erie	Superior
1985	19.3	12.3	7.0
1986	20.5	12.3	8.2
1987	19.9	8.7	11.2
1988	18.3	8.2	10.1
1989	19.4	7.6	11.8
1990	19.9	7.6	12.3
1991	18.6	6.4	12.2
1992	18.0	7.2	10.8

Source: LCA Annual Reports



Source: LCA Annual Reports

FIGURE 2-1. WESTERN COAL REPLACING ERIE COAL

II. TITLE IV OF THE CLEAN AIR ACT.

a. Market Approach versus Command and Control.

Since its beginnings in the early 1970s the EPA through the Clean Air Act has regulated airborne emissions by issuing and enforcing strict guidelines. No allowances were made for individual differences and those who failed to play by the often irrelevant rules were punished.

"The adversarial relationship that now exists between environmentalism and pollution control ignores the real complexities of environmental and business problems", Caleb Solomon quoting Carol Browner, head of EPA, in The Wall Street Journal, March 23, 1993, and continues "the EPA...doesn't often measure emissions...It enforces regulations spelling out what equipment a plant must have...based on old or over-generalized information, and rarely allow for adjustment to individual cases. To what extent the rules are actually reducing pollution at a given site-and whether they are doing so in the most proficient or efficient way-are normally not at issue. Nor does the regulated industrial company generally measure actual pollution. It focuses on the rules it must meet".

What's really new with the Amendments of 1990 is that instead of being assigned rigid emissions limits, power plants have been allocated transferable emissions allowances that are based on each plant's annual average baseline fuel consumption from 1985-1987. Each allowance gives the holder the right to pollute; to emit up to one ton of sulfur dioxide annually.

Title IV of the act is targeted specifically at stationary pollution sources, 80% of which are coal burning electrical generation sites. Reaching the nationwide emissions cap of 8.9 million tons of sulfur dioxide by the ;year 2000 is being done in two major steps. For Phase I the EPA has distributed 5.7 million permits among the 110 worst polluters. After December 31, 1994 it will be a violation of the Act for any of these utilities to emit more SO_2 than the quantity for which they holds allowances.[1] Yearly thereafter the annual allowable limit is reduced for all utilities. By January 1, 2000 all remaining stationary sources will have come under regulation and an annual emissions cap of 8.9 million tons of sulfur dioxide will have been reached nationally.[2]

Central to the workings of this strategy is the creation of a pollution market with tradeable emissions credits where allowances can be bought, sold, auctioned and banked from year to year. Because the market approach encourages firms with low-cost pollution control technologies to clean up more, the overall costs of complying with the statute through the implementation regulations are lower than the costs of complying with the statute in the absence of the implementation regulations (ICF, 1992a). EPA costing models show that a well-functioning allowance trading system will reduce the costs of

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[1]To encourage energy conservation and pollution prevention Title IV provides an incentive. For each ton of SO_2 emissions avoided by an electric utility through the use of demand side management the utility will be given one allowance. A total of 300,000 allowances are available on a first come first serve basis until December 31, 2000.

[2]The statute also provides for a $2.4 billion continuous emissions monitoring program which will ensure target levels are met. Under this requirement all units must be equipped with continuous emissions monitors and must submit data quarterly.

the SO_2 emissions reductions mandated by the statute in 1990 dollars by up to \$13.8 billion, with total costs for the program ranging from \$12.2 to \$20.0 billion (ICF, 1992b).

Also unique to the 1990 amendments is the inherent reliance on the use of low-sulfur coal rather than mandatory flue-gas desulphuriza- tion. By definition low-sulfur coal contains no more than 1.2 lbs of sulfur dioxide per million Btu. Although substantial reserves of compliance coal exist in parts of Appalachia, Powder River Basin low-sulfur coal is the least expensive to mine, but transportation costs become of strategic importance.

b. Emission Control Options.

There are a number of options available for each individual utility to choose from when seeking to comply with emissions allowances. Those who are geographically positioned to receive low-sulfur coal by water have additional flexibility in deciding their fuel/emissions mix. Because this study is concerned with increased shipments of Western coal on the Lakes it is necessary to identify the various ways in which the waterborne Western coal option can be influenced.

"Retail wheeling" has the potential for significant impact on midwestern power generation. Wheeling is the process whereby local utilities meet local peak power demands by purchasing extra power from distant utilities. Federal law requires intermediate producers to allow transmission of these wholesale purchases without cost.

With increased competition a strong attempt is being made at a retail application involving direct purchases by end users from distant sources at reduced prices.

The traditional captive market of utility suppliers is thus coming under siege with supplier pitted against more distant supplier. A landmark Michigan case will be decided in November of 1993 that involves a group of large industrial consumers who have banded together for high volume retail purchasing, bypassing higher priced local sources (Beck, 1992).[3] Should this developing effort be successful the potential interstate retail flow of electricity will result in either lower local rates or a total restructuring of the generating pattern around the Lakes. This is particularly true for Michigan which artificially maintains a $/kwh rate well above the competitive power market rate while at the same time being the Midwest's leading consumer of Western steam coal.

Besides wheeling or switching to PRB coal, utilities who exceed emission allowances have other options. In regions such as Illinois expensive smokestack scrubbers have been installed in order to preserve local coal mining jobs. Scrubbing is expensive because it does not rely on mere physical processes such as crushing and washing, but on the maintenance of a large-scale chemical reaction requiring continuous supervision.

A scrubber is a 70-foot test tube which on a typical day may consume 400 tons of limestone and thousands of gallons of water to remove over 200 tons of SO_2. As exhaust gases go up the smokestack, they are exposed to a lime or limestone solution that

[3]Final hearings occurred in October 1993 before a Michigan Public Service Commission administrative law judge. Cases are numbered U-10143 and U-10176 and a final ruling is due out before the end of the year.

is sprayed in their path. Sulfur dioxide in the gas reacts with the spray and goes into solution, from which it is later removed, dewatered, and extruded in the form of sludge, which then must be disposed of.

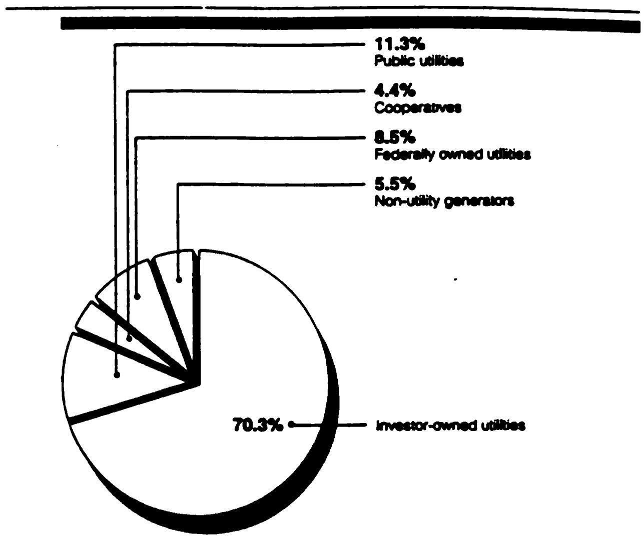
Another way of reducing emissions is to switch to natural gas or to develop a combustible blend of high and low-sulfur coal. The biggest uncertainty related to switching and blending is the degree to which Eastern high and mid-sulfur bituminous-only coal-fired boilers will be able to accommodate natural gas or Western low-sulfur sub-bituminous coals.

A final basic way of meeting emission allowances is related to the development of marketable pollution rights. Utilities may in fact opt to do nothing regarding pollution abatement other than to purchase additional emissions allowances from cleaner competitors either directly, through a broker, or the Chicago Board of Trade. For downwind states, particularly New York and the New England area, this is a worrisome feature of the Clean Air Act Amendments.

III. THE ELECTRIC UTILITY INDUSTRY.

a. Serving a Captive Audience.

The U.S. electric utility industry is composed of nearly 3,000 companies. Two hundred and six of these are investor-owned and account for over 70% of the total electricity generated in the United States (Figure 2-2). Additionally there are over 3,500 non-utility projects which produce more than five percent of total U.S. electrical power. These are a result of the 1978 Public Utility Regulatory Policies Act (PURPA) which opened the way for non-utility power producers and cogenerators to produce and sell power to utilities at set prices, radically changing the notion that electric utilities should be the only suppliers of electricity.



Source: Energy Information Administration.

Figure 2-2. U.S. ELECTRIC POWER GENERATION 1990.

Federal regulation of the electric utility industry is largely through the Federal Energy Regulatory Commission under the authority of the Federal Power Act. Under FPA, authority is limited to wholesale transactions and interstate transactions. FERC shares responsibility for the national transmission grid system with industry groups such as NERC and local authorities.

Most U.S. electric utilities have monopolies provided by state or local authorities and are the only supplier of electric power within their service territories. In exchange for the advantages provided by the franchise, utility rates are subjected to regulation by state authorities who generally allow for prudently incurred expenses plus reasonable profits on invested capital. If as part or an overall emissions reduction strategy Western low-sulfur coal is available at a lower delivered price, utilities who renew contracts with suppliers of more expensive Appalachian coal may find that their state regulatory agencies will not judge their costs to prudently incurred.

This is especially true with the regulatory climate changing in the direction of free market regulation. With this increase in competitiveness large customers are seeking to purchase fuel from non-traditional sources. For example Wisconsin Electric Power Company in the Fall of 1992 signed a 15 year contract for an annual purchase of 2 million tons of bituminous low sulfur (.9 lbs/MMBtu) coal from the Ratton Basin in New Mexico, to be delivered by the Santa Fe and the Chicago North-Western Railroads to Milwaukee. This purchase replaces a blend of Western Pennsylvania and Illinois basin bituminous.

As the staid electric utility industry moves closer to January 1, 2000 their inherent resistance to change may become a stampede off the beaten path. In this sense prudent fuel procurement costs to meet clean air demands will cause more of them to look seriously at Powder River Basin Coal.

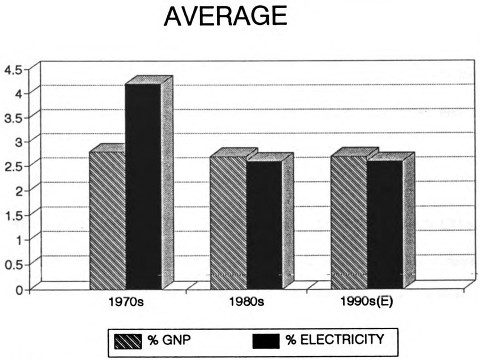
b. Future Demand

Second only to weather, variations in economic growth exert the most influence on demand for electricity. Because electricity is used in the production and consumption of most goods and services, as well as directly by consumers, the demand for electricity increases during times of high economic activity. Ten year trends however indicate that increased emphasis on energy efficiency in the 1980s acted to curb demand for electricity even as the economy expanded.

From 1970 through 1980, GNP grew at an average annual rate of 2.8 percent per year, while sales of electricity grew on average by 4.2 percent per year. During the 1980s, however, increased emphasis on energy efficiency led sales of electricity to grow by 2.6 percent annually while GNP grew at an average annual rate of 2.7 percent. This overall trend, illustrated in Table 2-2 and Figure 2-3 is expected to continue for the 1990s (EIA, 1992b).

Table 2-2. GNP GROWTH AND ELECTRICITY GROWTH 1970-2000

	1970s	1980s	1990s(e)
GNP	2.8%	2.7%	2.7%
ELECTRICITY	4.2%	2.6%	2.6%



Source: EIA, 1992a

Figure 2-3. GNP GROWTH AND ELECTRICIY GROWTH 1970-2000.

During the 1990s electric utilities have proposed o add 42,853 megawatts in new units to their systems. Thirty six percent of this increase will be from coal. Annual coal use by utilities for electricity production in the United States is projected to increase by more than 124 million tons (16%) over the 1991-2000 period (NERC, 1991a). The accuracy of this projection is to a certain extent a function of the degree of success of the variety of ongoing conservation projects.

Conservation, or demand side management, includes programs designed to modify the hourly, daily and seasonal variations in electricity demand for a utility, and to generally increase the efficiency of production and consumption. Also included are informational efforts, time of use and interruptible rate programs, and rebates to customers for adopting more efficient appliances and equipment.

IV. REGIONAL VARIATIONS IN EASTERN AND WESTERN COAL.

As with all minerals coal does not have much value as long as it remains in the ground but really only has value when it is mined, transported and processed. As people dig it out of the earth, purify and process it, ship it, insure and finance it, make policies and agreements to regulate its use, and stand up for its rights and its owners' interests in courts of law, jobs are created. Whether by rail, by road, by water, by pipeline, coal in this country is marvelously available, cheap, safe, abundant. But also dirty.

Fossil fuel critics rightly argue that the burning of coal dumps toxics into the air, water, and over the land. It also makes the nostrils smart, the eyes blur, the chest heave, the earth wilt and the waters bitter. Fish don't like it, nor does old masonry, nor do our neighbors to the north. But to date coal is America's most cost effective source of thermal energy and is directly responsible for setting modern households free from the mundane tasks of daily existence. No more chopping wood and boiling water just to take a bath, for instance.

How to make good use of the time we save is perhaps the overriding question in this age of electricity; but a question not taken up here. Rather the question examined here has to do with the future of coal's movement on the Lakes and the regional variations which influence that movement.

a. The Appalachian, Interior and Western Coal Regions.

Coal accounts for a greater share of U.S. primary energy production than any other fuel, having surpassed petroleum in 1984. The federal Energy Information Administration projects that 75% of the new base capacity after 2000 will be coal-fired.

Eastern coal production is concentrated in two geographic regions. In Appalachia, the region contains very substantial quantities of mid- and low-sulfur coal, particularly in Southern West Virginia and Eastern Kentucky. The second region centered in Illinois, Indiana and Western Kentucky contains high-sulfur coal.

As noted, the spectrum of emission reduction alternatives is broad and only as the full array of options are exercised over time will the picture for Eastern low-sulfur coal markets become clear. It is anticipated that under acid rain legislation with emissions trading, near-compliance mid-sulfur coals will have considerable value.

The Energy Information Administration expects Central Appalachian compliance coal to be available at the mine for under $35 per ton in 1989 dollars through the early 2000's. Large quantities of low-sulfur reserves also remain in outcrops on mountainsides to be tapped by new small drift or punch mines, which can be opened today at a cost of roughly $25 to $27 per ton. It should thus not be necessary to mine from very deep or thin seams for years to come.

By contrast Western PRB coal has very low extraction costs and is available in extremely large quantities. At minemouth prices of under $5 per ton, PRB coal is very competitive on a delivered basis in some areas east of the Mississippi, and particularly in the Great Lakes Region.

b. Blending of Regional Coals

Besides implementation of CAA90 other major variables that effect patterns of coal consumption include development of clean coal technologies and coal-based synthetic fuels, the evolution of world coal trade, possible effects on coal mining employment from technological and productivity changes, fossil fuel's impact on global climate change. To be compatible with future environmental goals, increased reliance on coal in the Nation's energy mix may hinge on the success of Clean Coal Technology initiatives[4].

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[4] The DOE Clean Coal Program is a $5 billion joint effort of the Federal government and private sector to encourage the rapid development of new technologies for emissions control. Program structure includes 5 solicitations, III is underway and IV is being sought. Companies involved include experienced and newcomers. A broad range of technologies are being explored including sorbent injection, coal gasification, nitrogen oxide controls, and fluidized bed combustion.

Detroit Edison's experience has shown that when Western and Eastern coals are blended it is possible to achieve emissions compliance at lowered costs and without retrofitting. Out of this experience a very substantial interest in blending has developed at four coal handling ports on the Lower Lakes in addition to the SMET facility located in Superior, Wisconsin. These are Burns Harbor, Indiana; Toledo, Ohio; Conneaut, Ohio; and Buffalo, New York.

As seen in Table 2-3 in the first quarter of 1992 Michigan, Ohio, Indiana, Illinois, Pennsylvania and New York received a total of 49.6 million tons of coal at electric utility plants. Of this amount 33.3 million tons were mid- or high-sulfur while only 7 million tons were low-sulfur coal of PRB origin (DOE, 1992a). Yet delivered price per Btu is lower for waterborne Western coal.

Table 2-3. FIRST QUARTER COAL - 1992.

Origin of Coal Received at Electric Utility Plants - 1st Qtr 1992

million net tons

Table 2-3.
ORIGIN OF COAL RECEIVED AT ELECTRIC UTILITY PLANTS - 1ST QTR 1992
million net tons

Michigan	**4.2**	Pennsylvania	**10.1**
Appalachian	3.2	Appalachian	10.1
Interior	-	Interior	-
Western	1.0	Western	-
Ohio	**13.4**	New York	**2.4**
Appalachian	13.3	Appalachian	2.4
Interior	.005	Interior	-
Western	.013	Western	-
Illinois	**6.8**		
Appalachian	.7	**Total**	**49.6**
Interior	4.2	**Appalachian**	**30.6**
Western	1.9	**Interior**	**5.2**
		Western	**7.2**
Indiana	**12.7**		
Appalachian	1.0		
Interior	7.4		
Western	4.3		

Source: DOE Quarterly Coal Report January-March 1992.

Source: DOE Quarterly Coal Report January-March 1992.

A market analysis done for Burns Harbor, Indiana by Resource Data International, Inc. indicated that 1995 could see a potential for 19.4 million tons of blended coal from the Burns Harbor facility with the year 2000 having a potential for 40.7 million tons of blended. Burns Harbor is geographically the most well suited for a new blending facility; forty-five percent of all steam coal is consumed in its 4 state hinterland.

Conneaut, Ohio is also prepared to convert to more blending capacity if long term contracts with Eastern power plants are signed. Buffalo and Toledo are aggressively looking for a share of the blended trade. Because a blending facility is market driven ports have to be prepared to quickly adapt as contracts develop. Port Managers are watching which direction utilities will take in order to comply with CAA90 (Seaway Review, 1991). Whether increased Western coal for blending is supplied by vessel or by rail will have much to do with transportation rates and possibly shipping season restrictions.

WINTER NAVIGATION

CHAPTER 3.

I. THE EXTENDED SHIPPING SEASON.

a. Introduction.

The five Great Lakes together with their connecting channels and the St. Lawrence River provide a national and international route for the movement of waterborne commerce to ports situated on the Great Lakes as well as to costal and overseas ports. Commerce on the Great Lakes is primarily the movement of bulk commodities. Connecting channels are the St. Mary's River, Straits of Mackinaw, the St. Clair River, Lake St. Clair, the Detroit River and the Welland Canal. During the winter months, from January to March, interlake shipping is largely suspended.

From the point of view of commerce, downtime on the Great Lakes transportation system because of ice-over means less cash flow to meet financial obligations. Ice-over results in wasted port facilities, unemployment, diversion of traffic to alternate routes, disrupts planning of services, and underutilizes shipping capacity. While ice control technology has developed to address physical and safety problems of winter navigation, the extent of environmental impacts of extended shipping have yet to be measured and controlled to the satisfaction of the environmentalists.

There is a 20 year controversy between defenders of the environment and proponents of industry. At issue is the fight to allow dry bulk carriers the length of three football fields to sail through three to six feet of ice in ecologically sensitive straights and narrows.

Winter navigation increases fleet carrying capacity by extending the length of the shipping season by 60 to 90 days. There are actually two questions to be addressed with winter navigation: determination of a season closing date and also of an opening date. The question regarding a closing date has largely been solved by Corps of Engineers decree. Opening date resolution appears to be near as well, depending on the strength of the opposition.

The chief benefit of extended lock operations is derived from reduced stockpiling costs for ore, coal and stone. Savings are based on the interest costs of maintaining a smaller stockpile. With a longer shipping season smaller stockpiles are required at both shipping and receiving ends while assuring adequate iron ore and coal supplies during winter freeze up. If stockpile inventories can be kept smaller, then fewer financial resources are tied up in non-productive assets.

b. Fixed Opening and Closing Dates Required by Shippers.

Historically navigation stopped during the winter season when ships could no longer reach the locks. The closure was not required by law but by nature.[5] As the needs of commerce increased so did pressure to lengthen or establish a predictable shipping season. Until 1967 the duration of this shutdown was on the average from December 15 to April 1.

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[5]The natural red ores that made up the bulk of all shipments well into the 1960s contained enough moisture that they would freeze solid in the Lake boats or rail cars making unloading impossible. Until the advent of taconite pellets mining itself shut down for the winter.

Table 3.1 shows a range of 32 days in shipping season length over the last 12 years. Industry and shipping concerns have continually requested a fixed opening and closing date arguing that being able to plan for an additional month of shipping activities would eliminate or reduce winter stockpiling. The Corps of engineers has supported this position. In a letter dated March 2, 1988 to the U. S. Fish and Wildlife Service the Army Corp of Engineers notes that "...most of the benefits for extending operation of the locks results from reduction of winter stockpiling by the steel industry that are required should an extended season not occur" (COE, DEIS 1988a).

Table 3-1. SOO LOCKS - OPENING/CLOSING DAYS OF NAVIGATION.

Year	Open	Close	Season Length
1980	Mar 25	Dec 31	282
1981	Mar 23	Dec 31	284
1982	Apr 01	Dec 27	271
1983	Mar 29	Jan 01	279
1984	Mar 26	Jan 05	286
1985	Apr 01	Jan 02	277
1986	Apr 01	Dec 31	275
1987	Mar 22	Jan 15	300
1988	Mar 22	Jan 15	300
1989	Mar 15	Dec 28	289
1990	Mar 19	Jan 15	303
1991	Mar 21	Jan 10	296
1992	Mar 22	Jan 11	315

Source: COE FEIS 1989, p. 4-53

c. History of the Controversy.

Winter navigation on the Great Lakes has a been an issue since at least the late 1960s. At the center of the controversy has been the Federal lock facilities at Sault Ste. Marie. Any commercial navigation desiring to pass between Lake Superior and the lower Great Lakes must traverse the Soo locks. Cargo is primarily bulk commodities including iron ore and taconite, coal, grain, stone, and other miscellaneous commodities.

Beginning with the 1970 Rivers and Harbors Act Congress authorized a ten year Demonstration Project to determine feasibility of operating the locks for as long as year-round. The result was a Final Environmental Impact Statement issued by the responsible lead agency, U.S. Army Engineer District, Detroit, in July 1977, proposing continued year round operation in order to meet the needs of commerce. Congress did not approve these recommendations, but the extensive information generated resulted in Draft EIS Supplement I in October 1979: a compromise between environmental and commercial interests with a proposed fixed closing date of January 8 plus or minus 1 week.

With the expiration of the ten year demonstration period the Corps of Engineers agreed that sufficient information did not exist to rule out cumulative adverse impacts associated with such a fixed closing. For this reason additional extensive environmental and monitoring studies were undertaken, consistent with the NEPA provision that "unquantified environmental amenities and values may be given appropriate consideration in decision making along with economic and technical considerations." A formula of degree freezing days was applied during this time to determine if locks would close before January 8. The purpose of such a formula was to take into account environmental as well as commercial criteria.[6]

After an expenditure by the Corps of nearly 6 million dollars for impact studies Draft Environmental Impact Statement Supplement II was issued in March of 1988. This DEIS further described the environmental impacts of season extension and proposed a closing date for the Locks of January 31 plus or minus two weeks so as to meet the reasonable demands of commercial shipping. Otherwise commerce and industry dependent upon navigation would have to resort, during winter, to more expensive

[6]Daily recorded sub-freezing temperature lows are subtracted from 32 degrees F. When 550 cumulative degrees are reached, *and* Lake Nicolet has ice from shore to shore shipping must cease. The uncertainty of when these criteria would be reached in any given season was unacceptable to the Lake Carriers Association and to the needs of commerce, COE agreed.

dependent upon navigation would have to resort, during winter, to more expensive alternatives, such as stockpiling. Annual dates of lock operation were to be determined based primarily on the reasonable demands of commerce but also with consideration being given to ice, weather, and environmental conditions.

Draft Supplement II indicated that adverse environmental effects would indeed occur in the St. Mary's River area during the proposed period of extension, impact however was deemed to be of only minor consequence. "No significant adverse effects on fish and wildlife resources were observed although there were five years of year-round navigation, and nine years of navigation to the end of January (1978)...there is a wealth of ecosystem information available for this project...few environmental impact studies have such a wide base of information", (COE 1988b).

Various government agencies and environmental groups differ sharply with this conclusion and the controversy continues until the present time. "My staff and our expert witnesses, many of whom conducted the environmental studies for the Corps, have concluded that there are significant gaps in the data collected."[7] The concerns include: "possibility of vessel induced sedimentation, resuspension of flows, oil and hazardous substance spills, increased drift of seston and benthos, change in fish natural physical shelters, fish and wildlife disturbance, wetlands vegetation destruction or removal, and the alteration of fish breeding and migration behavior" (COE, 1988c). Because the majority of these environmental impacts would occur in Michigan, the primary agencies

[7]Contained in a letter from MDNR dated February 16, 1993. The quote to follow is referenced in the letter.

with which the Corps of Engineers has coordinated are the U.S. Fish and Wildlife Service and the Michigan Department of Natural Resources.

d. Opposite Conclusions from Incomplete Data.

In the early 1980s a portion of the analysis proposed by FWS was funded by the Corps and major baseline studies were carried out by FWS on the St. Mary's River. In addition MDNR proposed studies and collected two years of extensive winter and summer fisheries baseline data on the St. Clair River, Lake St. Clare and the Detroit River. In all, nearly 18 million dollars in studies were requested, about a third of which was approved. This has set the stage for significant controversy with both sides drawing opposite conclusions from the same incomplete data. At the end of the studies the East Lansing Field Office of the U.S. Fish and Wildlife Service submitted several documents listing numerous objections to an extended shipping season.

The following is a summary of their views: "none of these potential project impacts will likely create immediate devastating effects on the system. Rather each of these impacts will have subtle, long-term effects. For example, following the Demonstration Program, during which the Navigation Season was extended for a period in the 1970s no catastrophic changes in fish and wildlife communities were observed. This is not surprising given our present level of knowledge of large river and lake ecosystems. Several authors have noted that impacts on fish community structures in large rivers are often not observed for ten to twenty years following a major alteration of the system, such as a large dam and reservoir" (COE, 1988d).

The Corps replied by affirming their opinion that the program of study undertaken had resolved the essential information problems related to environmental impact analysis and that "unidentified subtle, long term effects are not likely to occur" (COE, 1988d). A Final EIS Supplement II (to the July 1977 Final EIS) was issued in September 1989 with a proposed fixed season closing date of January 15.

This date varies from the draft proposal date of 31 January. The position taken by the Lake Carriers' Association in support of a January 15 closing probably was influential in this regard. The Final EIS lists full compliance with as many as 15 relevant Federal Statutes as well as 5 separate Executive Orders and various Memoranda, (COE, 1989). In the Fall of 1991 the Corps of Engineers signed a Record of Decision establishing January 15 as the end of the shipping season.[8]

e. Present Controversy.

March 21 plus or minus two weeks has been proposed as a fixed opening date for the start of the navigation season. The COE Draft EIS issued in February, 1993 relies completely upon all previous studies to come to the conclusion that "in an analysis of opening dates, based on the demands and past usage of the shipping industry, the relative insignificant adverse environmental impacts to the project area, and the optimal economic

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[8]The State of Michigan opposes fixed dates for opening and closing of the shipping season, preferring rather that environmental criteria be employed (freezing degree days) along with the need of commerce. The Governor's office has threatened litigation if environmental criteria are violated. In 1992 weather conditions were such that the issue was not forced. In 1993 environmental criteria were violated but a technicality prevented action from being taken.

benefits, opening the locks on 21 March appears to be the optimal date and is therefore the recommended proposed plan" (COE, 1993).

Officially the shipping season opens April 1 though it usually takes several more weeks for all of the river ice to melt. At the request of shippers the 45 mile long Saint Mary's River is regularly opened earlier by COE icebreakers. Prior to the March 21, 1993 opening, more than 20 carriers were waiting to move $36 million of cargo through the locks and down the river. This amounted to 975,000 tons of iron ore and coal destined to lower Lakes steel mills and electric generation facilities (Lansing State Journal, 1993).

Environmental groups take strong issue with a March 21 fixed opening date because the conditions of navigation in March are very different from those prevailing in early winter. March 21 is within the average time of maximum ice thickness on the St. Mary's River. Further, under the present proposal, only the needs of commerce are used to justify early opening with no consideration being given for environmental impact.

Environmental groups charge that the draft EIS was written to justify the proposal, and that it gives little objective analysis of alternatives (Shaeffer, 1993). The Great Lakes Natural Resource Center of the National Wildlife Federation and the Michigan United Conservation Clubs are requesting that opening date approximate the time of natural ice-out on the St. Mary's River below the Soo Locks and that the determination be made by an inter-agency committee of representatives from state and federal natural resource agencies. Likewise, Michigan Department of Natural Resources has requested the state Attorney General to file a suit to stop the action. The DNR lawsuit though is opposed by Michigan Departments of Commerce and Transportation who join with the Lake Carriers' Association in support of the economic benefits of early opening. The U.S. Department of the Interior has supported East Lansing FWS's non-concurrence of the plan and is considering referral to the Council on Environmental Quality if mutually agreeable environmental criteria are not developed. "We believe that the proposed early opening...is environmentally unsatisfactory and meets the criteria for referral...based on its severity, geographical scope and the availability of environmentally preferable alternatives" (Kevetski, 1993). Given the change of administration it is possible that new baseline studies will be required before the Corps can proceed with a fixed opening date.

ANALYSIS OF U.S. FLAG FLEET DRY BULK CAPACITY.

Chapter 4.

I. Introduction.

This section examines current dry bulk carrying capacity of the U.S. flag fleet and includes reserve capacity. The primary reference for this determination is the combined Annual Reports of the Lake Carriers' Association as well as telephone interviews with shipping company representatives. LCA represents 98% of all U.S. flag shippers on the Great Lakes. Table 4-1 lists dry bulk freight moved in U.S. flag vessels during 1992 by month. Total volume was 93.5 net tons, or 83.5 gross tons. Excluded from this calculation are iron ore transhipments, cement, potash, and liquid bulk. This is in accordance with LCA fleet utilization reporting.

Table 4-1. U.S.-FLAG DRY-BULK CARRIAGE BY MONTHS.

(million net tons)
1992 Navigation Season March 10, 1992 - January 19, 1993

COMMODITY	3	4	5	6	7	8	9	10	11	12	1
Iron Ore	1.2	4.8	6.1	6.1	6.2	5.8	5.2	5.1	5.0	4.7	.8
Coal	.02	1.4	2.2	2.5	2.1	2.6	2.2	2.5	2.1	.81	-
Limestone	.07	1.9	2.8	2.9	2.8	2.6	2.4	2.6	2.4	1.6	-
Salt	-	-	.08	.07	.08	.12	.08	.09	.03	.05	-
Sand	-	-	.02	.03	.08	.08	.07	.06	-	-	-
Grain	-	.11	.11	.09	.11	.08	.14	.16	.14	.11	-
TOTAL	1.3	8.2	11.3	11.7	11.3	11.3	10.1	10.5	9.6	7.3	.8

Year:1992	
Iron Ore	51.0
Coal	18.4
Limestone, Gyp	22.1
Salt	.6
Sand	.3
Grain	1.1
SEASONAL TOTAL	93.5 Net Tons
	83.5 Gross Tons

Source: LCA Annual Report 1992

There have been no new 1,000 foot vessels built for the Lakes trade since 1981 when three 1,000 foot super-carriers were delivered. Because it is proprietary information shipping companies will not discuss plans. Lake Carriers' Association President George Ryan, however, is quoted in Seaway Review that when an additional three million tons of cargo capacity are permanently needed, real planning for a new 1000 footer will begin (Seaway Review, Jan-Mar, 1991). Of course any financial equation for building a new vessel must factor in customer rates that can compete with railroads.

a. Historical Overview of the U.S. Great Lakes Fleet.

The Great Lakes shipping industry has been in a pattern of fleet replacement since 1855 when the locks at Sault Ste. Marie were opened. Over the years this replacement has continued in response to changes in industrial activity. In the 1970s the U.S. flag fleet launched a major new construction program. At that time the U.S. flag fleet was composed of 240 vessels. Combined trip capacity was 2.8 million gross tons. Average per vessel carrying capacity was 11,713 gross tons.

To capitalize on the economies of scale offered by the opening of the Poe lock in 1969, thirteen 1,000 foot self unloaders were built in the ensuing years with per trip capacities ranging from 52,000 to about 63,000 gross tons (up to an additional 5,000 tons have been carried in open water when transiting the Soo lock was not required). In 1992 the U.S. flag fleet was composed of 66 vessels, of which 57 haul dry bulk cargo. Total gross ton carrying capacity was 1.9 million ton, with an average vessel capacity of around 33,000 tons (LCA, 1970, 1992).

Significance of the 1000 footers cannot be overemphasized since, stated another way, the economy of scale made possible by the Poe Lock accommodation of 1,000 footers would require the largest non-Poe class vessel to complete two and one half voyages just to equal the hauling power of a single 1,000 footer.

All told, between 1972 and 1982, 31 new ships were added to the LCA fleet. At the same time 16 older vessels were lengthened and/or converted to self-unloaders. This fleet modernization was largely geared to meet the transportation needs of the iron mining industry's expansion of taconite processing facilities in Minnesota and Michigan.

The full fledged recession that took hold of the U.S. economy in 1982 resulted in a year where the combined U.S. and Canadian fleet moved only 43 million tons of iron ore, the lowest since 1938. Correspondingly, capacity existed in the Lakes fleet, and this naturally led to the scrapping of older, less productive vessels.

Between 1982 and 1987, 52 vessels were slashed from LCA's roles. The larger self-unloading vessels survived but the standby fleet shrank. As of April 1993 the standby fleet consists of one ship, the John Sherwin, with a mid-summer capacity of 31,500 gross tons.

In 1982 shipments of major bulk commodities fell to the lowest total since 1938 as the foreign steel onslaught continued combined with the general economic recession and the substitution of lighter materials in the auto industry (Table 4-2). Inspite of depressed iron ore tonnages the fleet's modernization/expansion program of the 1970s and 1980s doubled the average loading for iron ore. It was this increase in efficiency that was largely responsible for the fleet's ability to adjust to decrease in demand, while stabilizing mid- season active fleet at around 60 vessels.

Table 4-2. COMBINED GREAT LAKES BULK COMMERCE.

(million net tons)
includes Canadian tonnage

YEAR	Iron Ore (Gross tons)	Coal	Stone	Grain	Total
1900	18.6	8.9	----	5.6	33.1
1905	33.5	24.4	----	6.1	63.7
1910	42.6	26.5	----	5.8	74.9
1915	46.3	26.2	3.8	11.1	87.4
1920	58.5	26.4	7.8	6.7	99.4
1925	54.1	28.1	11.3	13.3	106.9
1930	46.6	38.1	12.4	9.8	106.9
1935	28.3	35.3	12.1	7.4	83.1
1938	19.3	34.6	8.2	10.7	72.8
1940	63.7	49.3	14.9	9.6	137.5
1945	75.7	55.3	16.3	18.7	166.0
1950	78.2	57.6	23.4	9.3	157.5
1955	89.2	53.4	29.7	10.8	183.1
1960	73.1	46.7	27.2	14.1	161.1
1965	78.6	54.6	30.8	21.9	185.9
1970	87.0	49.7	38.5	23.8	199.0
1975	80.0	39.2	37.7	24.5	181.4
1976	86.6	37.5	38.2	23.5	185.5
1977	67.1	39.0	37.2	26.0	169.3
1978	88.9	37.8	39.6	32.1	198.4
1979	92.1	45.8	37.0	28.9	203.8
1980	73.0	41.3	28.0	31.5	173.8
1981	74.9	39.1	24.6	28.2	166.8
1982	38.5	36.8	15.1	28.3	118.7
1983	52.1	36.6	18.4	28.8	135.9
1984	57.3	43.1	23.2	28.2	151.8
1985	52.2	36.3	25.0	20.1	133.6
1986	45.6	36.3	27.2	20.2	129.3
1987	55.1	37.7	33.2	22.3	148.3
1988	61.0	40.5	35.5	19.1	156.1
1989	59.6	39.5	35.1	15.0	149.2
1990	61.5	38.0	33.8	15.8	148.8
1991	57.4	35.3	27.6	18.6	138.9

Compiled from LCA Annual Reports.

b. Fleet Composition.

Corps of Engineers vessel classification consists of 10 classes. Classes five through ten are reserved for dry bulk carriers while classes one through four are for cement carriers and tankers. In the dry bulk carrier division, classes eight through ten are Poe sized vessels. Subdivisions within these classes further break down vessels based on length as seen in Table 4-3.

Table 4-3. Vessel Classification.

CLASS	LENGTH
I	735' to 1013'
II	680' to 730'
III	less than 680'

Class III vessels are 680 feet in length and with mid-summer capacities of between 5,500 to 24,000 gross tons. Class III cargo's can be sand, grain, salt, or cement, petroleum in tankers, or small loads of coal, limestone and iron ore.

Class II vessels are generally between 680 and 730 feet in length and have capacities ranging roughly from 24,500 to 37,200 gross tons. Class II cargo generally consists of coal, limestone and iron ore.

Class I vessels, Poe class, range from 731 feet up to 1013.5 feet in length.[9] Vessels of this size generally haul only iron re and coal although on rare occasion a load of limestone will be transported.

When a vessel is returning to port without cargo it must take on water as an aid to proper navigation. This travel without payload is referred to as ballast time. Because of flexibility in haulage, Class III vessels require less ballast time between loads and consequently rates can be kept low. It is on the long hauls that class III's become prohibitively expensive unless they are able to find suitable backhaul.

Because of the large demand for backhaul cargo to Duluth, it is cheaper to bring a load of limestone from Rogers City to Duluth than to bring the same load from Rogers City to Saginaw Rates for Class I and II vessels are based on sailing time from loading port to loading port plus vessel operating costs. Of the 57 vessels that moved 96 million net tons on the Lakes in 1991, less than one in ten had cargo going north. Rates are thus based on running in ballast while returning to loading port.

In 1992, 31 vessels were of Poe class. These 31 vessels provided 1,308,297 gross tons. These 31 vessels account for 77% of the total active dry bulk fleet capacity. Total available dry bulk capacity in 1992 was 1,797,058 gross tons.

Table 4-4. accounts for all available vessels whether active, inactive, enrolled, disenrolled, or active non-member. In 1992 active dry bulk U.S. flag capacity was 1,710,488 gross tons. An additional 86,574 gross tons of capacity is registered but not

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[9]Although COE Class VII vessels range from 700 to 730 feet in length they are also considered as Poe class vessels in the LCA fleet roster as are two of the Class VI vessels.

active. Since these vessels are available there tonnage is included in Table 4-4 totals as part of total dry bulk capacity.

Table 4-4. VESSELS ENROLLED IN LCA FLEET - 1992

Class	Enrolled Vessel	Length	GRT	Mid-Summer Capacity G.T.	Year*
10	Paul R. Tregurtha	1013p	36,360	61,000	1981
10	Stewart J. Cort	1000p	32,930	58,000	1972
10	Indiana Harbor	1000p	35,923	61,390	1979
10	Edwin H. Gott	1004p	35,592	62,200	1978
10	Presque Isle	1000p	24,199	52,000	1973
10	Mesabi Miner	1000p	34,729	59,000	1977
10	Columbia Star	1000p	35,923	61,500	1981
10	George A. Stinson	1000p	34,569	59,000	1978
10	Edgar B. Speer	1004p	34,620	62,200	1980
10	Burns Harbor	1000p	35,652	61,000	1980
10	James R. Barker	1000p	34,729	59,000	1976
10	Oglebay Norton	1000p	35,652	61,000	1978
10	W.J. McCarthy, Jr.	1000p	35,923	61,390	1977
				778,680	
9	Roger Blough	858p	22,041	43,900	1972
8	Lee A. Tregurtha	826p	14,672	29,100	1978
8	Charles M. Beeghly	806p	16,285	31,000	(1981)
8	Philip R. Clarke	767p	12,342	25,300	(1982)
8	Arthur M. Anderson	767p	12,342	25,300	(1982)
8	Armco	767p	12,448	25,500	(1982)
8	St. Clair	770p	27,482	39,560	1976
8	Reserve	767p	12,358	25,500	(1983)
8	Cason J. Callaway	767p	12,310	25,300	(1982)
8	Kaye E. Barker	767p	11,949	25,360	(1981)
8	John G. Munson	768p	15,179	25,550	(1976)
				277,470	
7	Joseph L. Block	728p	14,956	37,200	1976
7	H. Lee White	704p	14,499	30,577	1974
7	Middletown	730p	13,206	24,600	(1982)
7	Edward L. Ryerson	730p	12,170	27,500	1960
7	American Mariner	730p	15,396	31,770	1980
				151,647	

Table 4-4 cont.

6	Adam E. Cornelius	680p	15,674	27,340	1973
6	Charles E. Wilson	680p	13,862	29,260	1973
				56,600	
	Total Poe Capacity			1,308,297	
6	Buckeye	698	11,691	23,200	(1980)
6	Herbert C. Jackson	690	12,292	24,800	(1975)
6	Courtney Burton	690	11,422	22,425	(1981)
6	Wilfred Sykes	678	11,701	21,500	(1957)
				148,525	
5	John J. Boland	639	12,557	20,109	(1953)
5	George A. Sloan	620	9,706	15,800	(1967)
5	Richard Reiss	620	9,790	15,173	1964
5	Calcite II	605	8,188	12,650	(1961)
5	Myron C. Taylor	604	8,233	12,450	(1956)
5	F.R. White Jr.	635	11,689	24,100	1978
5	Crispin Oglebay	620	8,421	15,600	(1973)
5	William R. Roesch	630	9,640	19,700	1973
5	J. L. Mauthe	647	11,472	21,400	1952
5	Sam Laud	635	11,619	23,407	1975
5	Joseph H. Frantz	618	9,589	13,600	(1965)
5	Buffalo	635	11,619	23,407	1978
5	Wolverine	630	10,037	19,700	1974
5	American Republic	635	12,158	24,270	1981
	Active - Not LCA Registered			260,986	
5	3 Straight-decker grain haulers			49,280	

ACTIVE DRY BULK CAPACITY (gross tons) 1,710,488

ENROLLED - INACTIVE

6	Elton Hoyt 2nd	698	10,970	22,300	(1980)
5	Paul Thayer	630	9,640	19,700	1973
5	J. Burton Ayers	620	8,796	15,670	1943
5	Robert C. Norton	620	8,421	15,600	1943
5	Samuel Mather	611	8,798	13,300	(1974)
				86,574	

TOTAL DRY BULK CAPACITY (gross tons) 1,797,058

Table 4-4 cont.

	Cement Carriers and Tankers				
3	J.A.W. Iglehart	501	9,460	12,300	1965
3	Alpena	519	8,018	15,265	(1991)
2	Crapo	402	4,769	8,900	1927
2	E.M. Ford	428	4,538	7,100	1956
2	Paul H. Townsend	447	4,302	8,400	1953
4	Medusa Challenger	552	6,967	11,300	(1967)
2	Gemini	432	5,854	7,860	1978
1	Saturn	384	3,903	5,550	1974
3	Michigan/Gt. Lakes	529	5,318	10,150	1982
				86,825	

TOTAL COMBINED FLEET CAPACITY (gross tons) 1,883,883

Compiled from LCA Annual Reports

p = Poe class
* parenthesis indicates year vessel was modified.

There are also 7 disenrolled inactive LCA member vessels that are not of Poe class. These 7 vessels are presented in table 4-4a but tonnage is not counted in Table 4-4. As mentioned, only one vessel, the John Sherwin, is able to be an economically productive dry bulk carrier. The others are either cement carriers, or in the process of being sold for scrap.

Table 4-4a. DISENROLLED VESSELS OWNED BY LCA MEMBER FLEETS.

Enrolled Vessel	**Length**	**Capacity GRT**	**Last Operated**
John Sherwin	806'	31,500	(1981)
William A. Reiss	622'	18,800	(1981)
Robert C. Norton	620'	15,600	(1980)
Irvin L. Clymer	552'	11,850	(1990)
Nicolet	535'	11,536	(1990)
#J.B. Ford	440'	7,400	(1985)
#Lewis G. Harriman	350'	6,300	(1980)
		102,986 Total disenrolled tonnage	
		- 71,486 Total not feasible	
Disenrolled, available dry bulk		31,500	

Compiled from LCA 1992 Annual Report

Both the Ford and the Harriman are cement carriers.

c. Dry Bulk Fleet Utilization Rate for 1992.

The 1992 season shut down on January 9 for Lake Superior and January 19 for Lake Michigan. Head-of-the-Lakes trade resumed on March 22. By April 1, there were 30 vessels in service which represented 52% of capacity. Total active fleet peaked in June with 55 ships at 91% utilization. On December 1, 51 vessels were still in service representing 85% of per trip capacity. The 1992 shipping season was thus 315 days in length during which time 83.5 million gross tons of cargo were moved. Calculations used to determine specific fleet averages for 1992 are displayed in Table 4-5, which in turn become determinates of utilization averages for five of the past six seasons (Table 4-5a). For 1992 the fleet capacity utilization rate was 78.9%.

Table 4-5. 1992 FLEET AVERAGES.

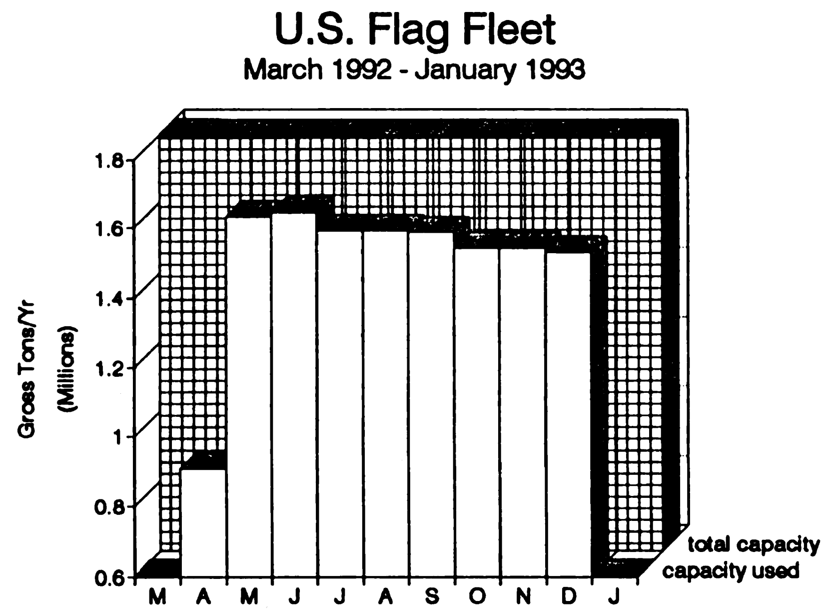
Total dry bulk tonnnage for 1992	=	83.5	million gross tons
Average utilization rate for 1991	=	78.9%	
Dry bulk carrying capacity	=	x 1.78	million gross tons
Total actual capacity used	=	1.40	million gross tons
Average number trips per vessel	=	$\frac{83.5}{1.40}$ = 59.64	
Average number days per trip	=	$\frac{315}{59.64}$ = 5.3	

Source: LCA 1991

Table 4-5a. 1987 - 1992 FLEET AVERAGES.

YEAR	total dry bulk	average utilization	carrying capacity	trips/year	days/trip
1987	88.1	77.9%	1.80	62	4.80 (300)
1988	94.7	89.4%	1.80	59	5.09 (300)
1989	information not available				
1990	92.7	91.0%	1.80	57	5.36 (303)
1991	86.5	82.8%	1.77	59	4.99 (296)
1992	83.5	78.9	1.78	60	5.28 (315)

As noted, the economy of scale made possible by the Poe class vessels is integral to the efficiency of the Great Lakes transportation system. It is of interest therefore that while total fleet rate was at 79% in 1992, Poe class utilization rate was 84%, while the period of May through December was at 91%. Of equal interest is the same period in 1991 when Poe vessel utilization was at 99%. In fact In 1990 additional mid-summer thousand-footer capacity would have resulted in a half million more tons of Western coal being shipped (Ethan, 1993). Figure 4-2 illustrates fleet dry bulk capacity. Table 4-6 presents a breakdown of vessel capacity by vessel class according to weighted average.



Compiled from LCA Reports.

Figure 4-2. **UTILIZATION OF CAPACITY**

Table 4-6. DRY BULK CAPACITY UTILIZATION - 1992 by Vessel Class.

CLASS	#	4	5	6	7	8	9	10	11	12	1	AVE
						(MONTH)						
X	(13)	62%	100%	100%	100%	100%	100%	100%	100%	100%	39%	91%
IX	(1)	100%	100%	100%	100%	100%	100%	-	-	-	-	60%
VIII	(10)	40%	100%	100%	100%	100%	100%	100%	100%	100%	31%	87%
VII	(5)	84%	100%	100%	100%	100%	100%	100%	100%	100%	63%	95

In 1992 seasonal weighted average utilization rate for Poe vessels was 89% while in the peak shipping season from May through December weighted average rate was at 98%.

VI	(7)	13%	87%	87%	57%	57%	57%	44%	44%	44%	44%	53%
V	(20)	33%	62%	65%	65%	65%	64%	70%	70%	66%	-	54%

Seasonal weighted average utilization rate for vessel classes VI and V was 54% with weighted average May through December rate of 64%.

Dry Bulk Capacity Utilization In 1991 By Vessel Class

CLASS	#	4	5	6	7	8	9	10	11	12	1	AVE
						(MONTH)						
X	(13)	70%	100%	100%	100%	100%	100%	100%	100%	100%	54%	92%
IX	(1)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
VIII	(10)	34%	82%	91%	91%	91%	100%	100%	100%	100%	29%	82%
VII	(5)	45%	100%	100%	100%	100%	100%	100%	100%	100%	43%	89%

In 1991 seasonal weighted average utilization rate for Poe vessels was 88% while in the peak shipping season from May through December weighted average rate was again at 98%.

VI	(7)	29%	87%	87%	71%	57%	87%	87%	85%	85%	29%	70%
V	(20)	13%	79%	79%	75%	75%	79%	79%	79%	79%	-	64%

Seasonal weighted average utilization rate for vessel classes VI and V was 65% with weighted average May through December rate of 78%.

Compiled from LCA data

By viewing vessel classes in this manner the nature of capacity shortage becomes apparent. Table 4-6 illustrates that excess capacity exists primarily in the smaller vessels, with nearly no excess Poe class capacity except for early season and late season.[10] To meet the needs of commerce as tonnage increases through the end of the decade, better use will have to be made of available capacity throughout the season.

d. Summary.

From the foregoing analysis we see that total dry bulk per-trip capacity is 1,797,058 gross tons with an additional 31,500 gross tons that is disenrolled, but available.

Total Dry Bulk cargo for 1992 was 83.5 million gross tons with a seasonal utilization rate of 78.9%. Fleet capacity at 100% utilization is 83.5/.789 = 105.8 million gross tons, excluding disenrolled vessels.

Having made this determination it now remains to analyze the flow of dry bulk cargo on the Great Lakes through the end of the decade and then to integrate these findings with fleet capacity.

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[10]During the extended shipping season from 15 December to 15 January or closing, the development of navigationally significant ice has a net effect of reducing total annual shipping capacity.

AN INVENTORY OF LAKESIDE POWER PLANTS.

CHAPTER 5.

I. Introduction.

Western coal is not used for metallurgical purposes because it is lower in Btu content, but it does produce cleaner steam generated electricity because it is lower in sulfur. After implementation of the Clean Air Act of 1970, increasing amounts of low-sulfur Western coal were shipped to Midwestern utilities. Between 1970 and 1990 Western region coal increased at an average rate of 12 percent per year compared with rates of less than 1 percent for Appalachia and less than 2 percent for the Interior Region. In 1990 over one-third of the Nation's coal production came from Western mines as compared with only 6 percent 20 years earlier (EIA, 1992c).

Total U.S. coal production in 1992 totaled 1,016 million net tons. Of this amount 913 million net tons were consumed domestically with 88% of this total going for electrical generation. Table 5-1 is adapted from a National Coal Association publication and shows that while over half of all coal shipments to electric utilities were by rail, the Great Lakes haulage was a mere 1.1%, (NCA, 1992b)[11].

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[11]If NCA figures were accurate, total Lakes tonnage would amount to about 9.5 million tons (994 x .87 x .011), rather than the 18.6 million net tons, or roughly 2% of total as reported by the Lake Carriers Association for 1991.

Table 5-1. COAL SHIPMENTS TO UTILITIES - by Mode of Transportation.

Year	Rail	River	Gt.Lakes	Tidewater	Truck	Tram, Conveyor and Slurry
1986	57.9%	14.7%	1.3%	1.2%	11.3%	13.6%
1987	57.9%	14.6%	1.3%	1.2%	11.0%	14.0%
1988	58.5%	13.6%	1.2%	1.2%	10.8%	14.6%
1989	58.1%	14.3%	1.5%	1.1%	11.2%	13.8%
1990	58.5%	14.8%	1.2%	1.0%	10.1%	14.4%
1991	58.9%	14.9%	1.1%	1.0%	9.7%	14.3%

Compiled from National Coal Association data.

To enjoy the economic advantage of waterborne shipping over rail shipping midwestern utilities must be sited on the lakeside. Transhipment costs from rail to vessel at Duluth is $2.00 to $2.25 per ton (Ethan, 1993) and it would be at least this much again for a midwestern utility to tranship to an inland destination. Thus only those utilities with generating units situated directly on the Great Lakes or their waterways can economically receive Western coal by water.

II. THE US POWER SUPPLY GRID AND WESTERN COAL.

The U.S. power supply grid is divided into 9 major regions (10 if Alaska is included). The principle coordinating body for these regions is the North American Electric Reliability Council (NERC). The council board is composed of 26 electric utility executives and their meetings are attended by observers from the U.S. Department of Energy, the Federal Energy Regulatory Commission, and the various utility industry's associations. The members of the 10 Regional Councils are individual electric utilities from all ownership segments of the industry. A very comprehensive database is maintained by the Reliability Council and it was this data for 1985-87 which EPA relied on in formulating CAA90 emissions allowances.[12]

The Great Lakes Region of NERC is made up chiefly of the East Central Area Reliability Coordination Agreement (ECAR). Member states which border the Lakes include Indiana, Ohio, Michigan and Pennsylvania. A second district, Northeast Power Coordinating Council (NPCC) includes the State of New York. A third district, Mid-America Interconnected Network (MAIN) includes Illinois, Wisconsin, Minnesota, and the Upper Peninsula of Michigan.

In order to arrive at current and projected Western coal consumption levels the three NERC regional executive directors were contacted. From information they provided and using the EIA publication "Inventory of Power Plants in the United States 1990" individual coal fired units were identified. Further contacts were then established with the various utility fuel supply managers and specific units were reviewed with them in relation to their use of waterborne western coal.

The ECAR annual report indicates that coal fired units produced 87% of the Region's electricity (NERC, 1991c). Of the three regions, only Michigan (ECAR) and Wisconsin (MAIN) have generating units located on the water that are using Western

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[12]In spite of the competition that would be fostered by granting more open access to transmission lines by distant utilities the Council opposes such action on the grounds that imbalance would develop between local rates and maintenance costs and reliability would suffer.

coal. At roughly eleven million tons per year Michigan is the largest consumer of Western waterborne coal. Wisconsin Power and Light is second at one million tons. Presently neither New York, Pennsylvania, Indiana, nor Ohio coal fired units have plans to use any Western coal. As EPA rules have unfolded many test burns have been carried out as individual electric utilities struggle with retrofit strategies to meet the tight schedule of Phase I compliance.

III. BLEND, SWITCH OR SCRUB DECISION FACTORS.

In determining appropriate fuel mix utilities must consider relevant economical, technological, and institutional factors. The dominant forces in these three domains are 1) delivered price per Btu, which includes transportation as well as extraction costs, 2) sulfur, moisture, and Btu content - a major factor in determining the feasibility of any given plant to convert to or blend low sulfur coal, 3) political climate - including corporate and union interests.

a. Delivered Price.

Western coal transportation costs can make up from 75% to 95% of delivered price while Appalachian coal is in the range of 30% to 35%. Due to slow-rising production costs what PRB coal loses in transportation cost it makes up for in extraction cost. Because of this differential, utilities increasingly look for ways to cost effectively switch or blend at more of their locations.

The current mine-mouth price for Western coal varies between $4.50 and $5.00 per ton. This contrasts with Appalachian low sulfur that has a spot price of $23.00

per ton and which is projected to rise to $33.00 (in 1990 dollars) by 2010 (EIA, 1992d). Presently Lake vessel price is at about a half cent per ton mile compared to rail costs of 1 to 1.2 cents per ton mile (Ethan 1992). CNW Railroad has indicated that their coal delivery cost is as low as 7.5 and 10 mills per ton mile when using utility owned railcars (Vasy, 1993).

Intermodal routing of Western coal to the lower Lake utilities is by rail delivery to Superior and vessel to a lower Lakes port. Rail distance from Billings, MT to Superior, WI is 1018 miles. Detroit, for example, is an additional 726 miles.

To illustrate the role played by transportation costs in fuel choice an example from Consumer's Power is useful (Snyder, 1993). Rail delivery of Eastern low sulfur coal (.68 lbs. sulfur per MM Btu) from Toledo to Consumer's Muskegon plant is $1.40 to $1.50 per million Btu. From Toledo to Muskegon by Great Lakes the cost is $1.25 to $1.30 per million Btu. While delivered price of PRB with a .4 sulphur content is $1.12 per million Btu. Figures released in the DOE Quarterly Coal Report for January - March 1992 are slightly higher (see Table 5-2). The point is, while Appalachian coal by water is cheaper than Appalachian coal by rail from Toledo to Muskegon, low sulfur Powder River coal delivered from the mine to Muskegon by water is lower still.

Table 5-2. ORIGIN OF COAL RECEIVED AT ELECTRIC UTILITIES.

JANUARY-MARCH 1992, 1991

State of Destination State of Origin	Receipts 1,000 short tons		Sulfur Content		Price ($/MM Btu)	
	1992	1991	1992	1991	1992	1991
MICHIGAN	4,215	4,210	.69	.70	1.59	1.69
KENTUCKY	1,322	1,697	.77	.77	1.78	1.78
MONTANA	96	153	.36	.34	1.14	1.50
PENNSYLVANIA	394	325	1.12	1.11	1.55	1.56
WEST VIRGINIA	1,470	1,471	.68	.64	1.67	1.77
WYOMING	933	564	.32	.36	1.10	1.15

Source: EIA Quarterly Coal Report, Jan-March 1992.

b. Characteristics of Fuel.

Technological capability of power plants are effected by fuel characteristics in several ways. Because boilers are constructed with a particular fuel in mind substitutability depends on variance in ash and moisture content, Btu and sulfur levels. Blending of Western with Appalachian coal has proven to be most successful but boiler age is also an important factor. Without varying degrees of modification the older 1950's and 1960's vintage units have problems accepting lower Btu fuel. Even with modifications idiosyncratic features make it impossible to predict ability to blend or switch.

c. Political Climate.

Another factor is local mining interests. Those utilities whose states are coal producers are caught between wanting to lower costs per kilowatt hour by burning low sulfur Western and keeping local miners working. There is much interest from unions, and governments at all levels regarding how final fuel blends will be worked out. It is partly for this reason that individual utilities are guarded concerning how much information they are willing to share.

It is the general opinion of analysts that presently it is very difficult to know the real tradeoffs being made by utilities with regard to fuel mix strategy. The interests of local and regional coal producers, as well as employee unions and state legislative action all impact on utility decisions. Further, the increased costs of cents per kilowatt hour which are passed on to consumers as a result of having a more expensive fuel source is not of importance for most residential consumers. With industrial consumers it is altogether another story. It is precisely at this point that we may see a significant increase in the demand for Western coal as utilities become more cost conscious in an attempt to ward off competition brought on by the move to delimit transmission access.

As an example of the effect of non-cost factors on fuel mix decisions, Illinois is a case in point. The State of Illinois mandates that locally produced coal be burned first. To meet CAA90 requirements scrubber technology is employed. While more expensive, scrubber technology is seen as the price to pay for securing regional mining and related employment. Wyoming on the other hand has filed suit in Federal district court protesting the Illinois rule as a violation of interstate commerce.

The forces involved in fuel mix determination are numerous and powerful. Understandably, the guarded positions maintained by the majority of fuel supply managers is thus reflective of the posturing which is going on across the board as the practical outworkings of the Clean Air Act are being decided.

IV. STATUS OF WESTERN COAL USAGE BY LOWER LAKES UTILITIES.

a. Western Coal is Presently Not Competitive in New York State.

Five of the eight power companies in New York burn coal. Of these five only Niagara Mohawk has units situated on the Lakes. The newest is the 700 MW Sommerset Plant which has an operational scrubber and which burns Pennsylvania coal received by unit train. In the Rochester area is an old 50 MW plant on Lake Ontario. There are no plans to burn Western coal at this location. A third plant is Dunkirk located on Lake Erie with three units totaling 500 MW. All were built in the 1950's. Presently Dunkirk units 3 and 4 will switch to Appalachian Low Sulfur for Phase I compliance.

Dunkirk's fuel requirement is about 1.4 million tons per year. Western coal test burns indicate that a 70/30 Eastern/Western blend would be required to use PRB coal. This would represent less than a half million tons annually. Presently waterborne Western costs are coming down but are not yet competitive with rail delivered costs of Appalachian low-sulfur. Superior Midwest Energy Terminal has indicated that they are working to overcome this barrier but another obstacle is lack of a proper unloading/ handling facility at Dunkirk.

A fourth facility composed of 6 generating units, the 800 MW Huntley plant, is a candidate for Western waterborne coal but being located on a Great Lakes tributary cannot receive large Lake boat deliveries. Transhipment costs would seem to rule out Huntley.[13] An additional concern in New York is Non-Utility Generation (NUG) capacity which currently is 20% of total supply and goes up to 40% in the summer when overall demand drops. Originally NUG's were guaranteed 6 cents per kw hour. This is above utility cost of generation.

b. Allegheny Electric Coop Does Not Rule Out Transhipments.

In the State of Pennsylvania there is only one power company that has service territory on the Lakes. The single facility actually located on the Lakes however was shut down several years ago. This was the 120 MW Front Street facility in Erie.

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[13] Regarding emissions trading, because of prevailing winds there is a tendency to sell rights to the East but not to the West. Trading tends to be looked at as a right to pollute without lowering emissions, and as sanctioning continued emission levels by purchasing another regions rights. This regional impact works at cross purposes with delivering cleaner air, the purpose of CAA90.

While there is currently no waterborne Western coal being burned in Pennsylvania at least one Electric Coop has indicated that in the past they have received Western transhipments from Lake Erie and would not rule out doing so in the future depending on pricing.

c. Ohio is Still Looking but has Closed One Facility Because of CAA Requirements.

All units located on the Lakes in Ohio are operated by either Centerior Energy Corporation or by Ohio Edison. There are significant low sulfur reserves in West Virginia of 1.2 to 1.6 compliance coal that can be shipped up the Ohio River. Centerior is taking some of this but currently does not plan to use any Western coal through the end of the decade.

As of January 1993 Ohio Edison made the decision to close down their only facility located on Lake Erie, The Edgewater (Lorain) facility which has a capacity of 171 MW. After a test burn there using Western coal which had arrived by river route Ohio Edison purchased emission allowances from ALCOA in the summer of 1992. With the purchase of these allowances and by closing the Edgewater plant they have overcomplied with Phase I and will bank the excess. Since the effects of overcompliance are cumulative Ohio Edison hopes to meet Phase II requirements in the year 2000 without the need for many additional adjustments.

d. Indiana Utilities Currently Receive Low Sulfur Coal via Rail.

Northern Indiana Public Service Commission has three plants located on Lake Michigan that are coal fired. The Dean H. Mitchell station includes 4 coal fired generating stations that have a capacity of 465 MW, plus a 17 MW gas fired facility. Total burn is about 1,000,000 tons per year. Eighty percent of this is PRB and 20% is low sulfur WVA. The Bailey Station burns high sulfur coal and has installed a new scrubber that is operational. The Michigan City Station burns a total of 1,000,000 tons per year at 3 separate units with combined capacity of 469 MW.

By 1995 a decision must be made whether to bring sulfur content down to 2.5 pounds of sulfur per million Btu's as required by State Implementation Plan, or to go as low as 1.2, in which case an 80/20 PRB/WVA mix would be used. Otherwise a 100% 2.5 Illinois seam would be used. At the present time all of the Western coal comes by rail and the three plants located on the water do not plan to construct facilities that would accommodate self unloaders.

e. Wisconsin's New Mexico Contract Creates Surplus Vessel Capacity.

Waterborne PRB Coal consumption among the three separate Wisconsin utilities with generating units on the Lakes is 1,000,000 tons annually. Of these, Wisconsin Electric Power Company's Sheboygan generating unit has 800MW's of capacity but does not have facilities for vessel deliveries and burns PRB coal delivered by CNW Railroad out of Chicago. Wisconsin Public Service Corporation's Pulliam plant has 250MW's of capacity and burns 770,000 tons of coal annually. Western coal use currently is minimal but the goal is to convert to 100% PRB. Pulliam can receive coal either by rail or by water.

Wisconsin Electric Power Company has 1050MW's of capacity at their South Oak Creek plant which is situated on Lake Michigan. In the Fall of 1992 after competitive bidding a 15 year contract was signed to purchase annually 2 million tons of bituminous low sulfur (.9 lbs/MMBtu) coal from the Ratton Basin in New Mexico. Delivery is by Santa Fe Railroad to Chicago, and CNW to Milwaukee. Prior to this switch Oak Creek was burning a blend of 2/3 Western Pennsylvania and 1/3 Illinois bituminous. By switching to New Mexico coal excess vessel capacity of up to 1.3 million tons has been created.

The Port Washington and Valley plants are also situated on the Lakes with combined capacity of 600MW. These two facilities burn 600,000 tons of Appalachian bituminous medium sulfur coal which at 2.4 lbs/mmbtu meets Phase I compliance requirements. Three of nine units located in Marquette, Michigan currently burn one million tons of Montana PRB coal annually. There is potential for up to 200,000 additional tons to be blended for consumption by the remaining six units there, depending on the outcome of test burns.

f. Michigan has Already Complied.

Michigan has had a 1% sulfur content requirement since 1973. Detroit Edison has been burning Western coal since 1976. At the current level of approximately 10 million tons per year Edison has adjusted to the SO_2 requirements of Phase I and will have to make only a few changes for Phase II. Demand for Western coal by water may increase slightly, but it is noted that Detroit Edison currently receives 3.5 million tons per year by rail with plans to increase to 4.1 million tons. Pricing variations in rail versus water shipment will be an important factor in determining future transportation modes.

Consumer's Power has two plants that burn Western coal. The Muskegon plant consumes 450,000 tons per year with a 50 to 60% blend with low-sulfur Eastern. The other facility is located near the mouth of the Saginaw River and burns 100,000 tons per year. Due to the draft requirements of a fully loaded 1000' vessel the Saginaw plant coordinates shipments of Western coal with Detroit Edison. In this case, after half the load is dropped in Detroit, the vessel can then enter the Saginaw River where the other half of the load is dropped.

Detroit Edison uses between 40%, 60% and up to 100% Western coal as needed. Even with lower sulfur and lower Btu and higher moisture, Detroit Edison's experience has shown that Western coal can be burned without retrofitting if the proper blend is used. One analyst has indicated that should Ohio, Pennsylvania and New York choose to blend as Detroit Edison has done each state could require up to 3 million tons of Western coal per year.

g. Present Usage Level Verified.

Based on information provided by the utility fuel supply managers and confirmed by the Superior Midwest Energy Terminal manager, present consumption level of waterborne Western coal is thus approximately twelve million tons per year. This compares roughly with Lake Carriers' 10.8 million tons of Western coal and National Coal Association extrapolations of 9.5 million tons.

In an industry that extracts over one billion tons of coal annually 12 million tons is of very minor consequence. A comprehensive 1992 study conducted by the U.S. Geological Survey which estimates effects on coal transportation rates as a result of

Federal coal leasing policy does not even mention a Great Lakes coal transportation network (Watson, 1991). Not so however for those regional power suppliers whose strong commitment to reliability depends on this plentiful flow of clean low cost coal.

V. A DOZEN DIFFERENT VIEWPOINTS.

In addition to personal contact with fuel supply managers various external sources have been consulted in arriving at an estimate of Western coal consumption through the end of the decade. About the only agreement among analysts is the notion that the limitations of 1995 and 2000 have many individual utilities still looking at the Western coal option. To date no consensus has emerged; neither with regards to increased use of PRB coal, nor the increased percentage of that amount which may come through the Lakes. This point is illustrated in the following cases.

1. The Oak Ridge National Laboratory in conjunction with the University of Tennessee has developed a linear programming model for analysis of coal switching as a result of CAA90 requirements. Though the biggest gains are with the PRB region their final report of September 1992 indicates that the information most difficult to estimate is the delivered price of different coals and thus which regions will show increases or decreases in production. Their study concludes that of critical importance to MidWestern demand for both high- and low-sulfur Appalachian coal is the availability and delivered cost of low-sulfur coal from the Powder River Basin. Another major consideration is the ability of Appalachian producers of low-sulfur coal to expand production

at prices comparable to present levels. If they cannot, they will lose potential markets to PRB and also to scrubbed high-sulfur coal, (Hillsman, 1992).

2. Seaway Review reported on a 1990 study indicating that coal consumption in Illinois, Indiana, Wisconsin and Michigan is expected to grow at an average annual rate of 2.4% over the next ten years (SeawayReview, 1991).

3. This is in contrast to a 1991 North American Electric Reliability Council of an expected 1.3% annual growth in electricity demand for the ECAR region with a corresponding 1% annual increase in coal demand through the year 2000 (NERC, 1991b).

4. Some analysts feel that because of early installation of scrubbers by Midwestern utilities the Central Region will receive an increasing share of its coal from mines in the Interior Region with nearly all the share gained by Central producers lost by Appalachian producers.

5. Others look for central Appalachia to meet most of the increased demand for low-sulfur coal east of the Mississippi River at a lower overall delivered cost than that of Western low-sulfur coal. This is because of high transportation costs associated with long haulage distances and additional costs and problems posed in the conversion of existing plants to burn subbituminous coal.

6. From a cost standpoint, however, the delivered prive of low sulfur Western coal in Michigan was less that two thirds the proce of Appalachian coal on a per Btu basis (DOE, 1992b) as shown in Table 5-2.

Table 5-2. ORIGIN OF COAL RECEIVED AT ELECTRIC UTILITIES.

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KENTUCKY	1,322	1,697	.77	.77	1.78	1.78
MONTANA	96	153	.36	.34	1.14	1.50
PENNSYLVANIA	394	325	1.12	1.11	1.55	1.56
WEST VIRGINIA	1,470	1,471	.68	.64	1.67	1.77
WYOMING	933	564	.32	.36	1.10	1.15

Source: EIA Quarterly Coal Report, Jan-March 1992.

7. Part of the cost differential seen in table 4.3 is due to geographic location of inland power plants that lose the cost advantage of waterborne transport. Fuel procurement specialists indicate that some of the differential is a result of commitments to long-term coal contracts. For example Detroit Edison's Monroe facility has contracts exceeding 5 million tons of Appalachian coal. These expire in 1994 and 1995 (EIA, 1991a), as seen in Table 5-3. Based on boiler modification costs, fuel ash and Btu characteristics, and storage and

handling facilities, the decision could be made to replace these with Western Contracts.

8. Railroads are very optimistic concerning the volumes of Western coal that will be required East of the Mississippi. The Burlington Northern for example estimates an increase of 60 million tons over the next 10 years. Should demand reach this level, economies of scale will certainly weaken the ability of the Great Lakes transportation system to compete for future volumes (Beck, 1992).

9. In 1992 virtually all of the 12 million tons of Western coal that went on the Lakes were transhipped by Superior Midwest Energy Terminal. The SMET forecast through the end of the decade for increased Western coal is in the range of twenty to twenty-five million tons, excluding possible exports. This is a revision downward from last years estimate of 25 to 30 million tons by the year 2000 (Ethan 1992, 1993).[14]

10. Another independent consultant feels strongly that whether through Duluth, Chicago, or barged down the Mississippi, 35 million tons per year will be an absolute maximum from all Western sources, with an absolute maximum

[14]Export potential through the St. Lawrence Seaway System is significant but is of no consequence for purposes of this study unless future shipments involve U.S. flag Lake vessels. Such activity would involve transhipment of cargo to ocean going vessel in the St. Lawrence Seaway and would require vessels capable of traversing the locks through the Welland canal.

increase of 15 million tons from the present tonnage coming across the Lakes by the year 2000 (Price, 1992).

11. A market analysis done for Burns Harbor by Resource Data International, Inc. indicated that 1995 could see a potential for 19.4 million tons of blended coal from the Burns Harbor facility with the year 2000 having a potential for 40.7 million tons of blended (Seaway Review, 1991).

12. The strategically located KCBX Terminals Company in Chicago has an active market strategy for increasing Western low sulfur tonnage yet officials believe that the market is far from mature. Their attitude best summarizes the current indecisiveness: "I don't think the market will stabilize with all the chess pieces placed on the board until 1995 when we get into phase one of the Clean Air Act regulations. Once the compliance strategies are set we will see a more defined arena. Both the utilities and their suppliers will be in a test pattern until then" (Seaway Review, July/Sept 1992 pages 23-25).

Meanwhile perhaps the best we can do is to look at increased coal usage in the Midwest region as a function of economic growth with the understanding that a growing economy consumes more energy and vice versa. Such an approach does not take into account any net increase of waterborne Western coal as a result of the Clean Air Act Ammendments but does provide a base for looking at the adequacy of the dry bulk carrying capacity of the U.S. flag Great Lakes fleet from which growth estimates for Western coal can easily be made.

ANALYSIS OF DRY BULK CARGO

Chapter 6.

I. TRENDS IN DEMAND FOR DRY BULK CARGO ON THE GREAT LAKES.

Ninety-four percent of all cargo on the Lakes is dry bulk cargo and 97% of dry bulk cargo is made up of coal, limestone and iron ore (LCA, 1992). This chapter will analyze this big three trade with the goal of determining future demand through the end of the decade. Since this research is concerned with unintended consequences of the Clean Air Act the major effort is focused on exploring the relationship between the electric utility industry and coal supply.

In 1992 total coal movement on the Lakes by U.S. flag vessels totaled 18,776,036 net tons. Of this amount 10,791,702 net tons was Western coal which came through Superior, Wisconsin. Another 7,984,334 net tons entered the Lakes by way of the four loading ports on Lake Erie and a very small portion entered Lake Michigan at Chicago.

a. Increase of Coal Consumption can be Tied to Increase of GNP.

Over the last 20 years GNP growth has averaged 2.6% annually. On one hand a recent study by the The Energy Information Administration considers 2.6% to be a high growth rate producing the highest energy demand while 1.8% is considered a low growth rate corresponding to sluggish industrial activity, high unemployment and low levels of travel. The EIA base case assumes a mid-level trajectory for world oil prices, and sets GNP annual growth at 2.2% with electricity growth closely paralleling GNP at

2.0%. Attempts are made to take into account conservation and efficiency trends as well as current legislation (EIA, 1992e).

National Coal Association on the other hand expects the growth rate for real GNP through 2000 to be at 2.3 percent. NCA is quick to point out that during the expansion phase of the industrial cycle, demand for electricity may exceed rate of economic growth. This has indeed been the trend in the past as we saw earlier in Chapter 1. From 1970 to 1980 GNP grew at an overall rate of 2.8 percent per year. During that time sales of electricity grew on average by 4.2 percent annually. During the 1980's increased emphasis on energy efficiency led sales of electricity to grow by 2.6 percent per year while GNP grew at an average annual rate of 2.7 percent (EIA, 1992b).

NCA's average annual growth in electricity demand forecast through the year 2000 for the East North Central region is also 2% but steam coal consumption is forecast to grow at a rate of 1% annually as a result of below average growth in generation, increased nuclear generation and inroads by gas (NCA, 1989b).

By comparing Energy Information Administration forecasts with National Coal Association forecasts a conservative estimate of annual increase in coal consumption ranges from 1.0% to 2.0%, as depicted in Table 6-1. If either of these rates of growth are accurate there will be no shipping capacity shortfall from the standpoint of coal's contribution to total demand.

Table 6-1. GROWTH IN COAL DEMAND ON THE LAKES THROUGH 2000.

(million net tons)

Actual Coal Shipments 1985-1992		Estimated Coal Shipments 1993-2000	1.0% (NCA)	2.0% (EIA)
1985	19.7	1993e	18.9	19.2
1986	18.6	1994e	19.2	19.6
1987	19.9	1995e	19.4	20.0
1988	18.3	1996e	19.6	20.4
1989	19.4	1997e	19.8	20.8
1990	19.9	1998e	20.2	21.2
1991	18.6	1999e	20.4	21.6
1992	18.8	2000e	20.6	22.0

Complied from LCA Annual Reports.

b. Increase of Coal Consumption According to some Industry Experts.

As of August 22, 1993 Western coal shipments were 142,949 tons below the corresponding year's total (Skilling's, 1993). It is not likely that a large increase will occur in the remainder of 1993. For the period 1994 through 2000 however Western coal might well increase in the higher range as expected by Ethan (20 to 25 million tons) and by Price (27 million tons maximum) from the 1992 total of 10.8 million tons. Reaching 20 to 27 million tons over 7 years (1994 - 2000) would require annual growth rates of 9.2% and 14.0% as seen in Table 6-2.

Table 6-2. EXPERT OPINION - WESTERN COAL TONNAGE INCREASE

1994 - 2000
(million net tons)

			Annual Increase	
			9.2%	**14.0%**
1987	11.2	1994e	11.8	12.3
1988	10.2	1995e	12.9	14.0
1989	12.2	1996e	14.1	16.0
1990	12.3	1997e	15.4	18.2
1991	12.2	1998e	16.8	20.8
1992	10.8	1999e	18.3	23.7
1993e	10.8	2000e	20.0	27.0

The equations for these determinations are as follows:
$10.8(1 + r)^7 = 20$, and $10.8(1 + r)^7 = 27$

Compiled from LCA Annual Reports.

If Western coal does increase at the above rates it will likely be at the expense of Lake Erie coal haulage, especially after January 1, 1995 when the push will begin to meet Phase II emissions requirements. While Table 6-3 shows Erie (Appalachian) coal continuing to grow at a 2% rate through the end of the decade, it also shows an increasing substitution of Western coal beginning in 1995 at a 15% replacement rate and stabilizing in 1998 at a 45% replacement rate. This range has been arrived at after consultation with various industry personnel.

Table 6-3. LAKE ERIE COAL REPLACED BY SUPERIOR COAL 1992-2000.

(1,000 net tons)

2.0%	Annual Increase				After Replacement
1992*	7.98		%		
1993e	7.98	x	1.0	=	7.98
1994e	8.28	x	1.0	=	8.28
1995e	8.42	x	.85	=	7.16
1996e	8.56	x	.75	=	6.42
1997e	8.71	x	.65	=	5.66
1998e	8.86	x	.55	=	4.87
1999e	9.01	x	.55	=	4.95
2000e	9.16	x	.55	=	5.04

* From Table 2-1.

Table 6-4 and Figure 6-1 show combined adjusted annual Erie coal increases with the two higher levels of increase from Table 6-2 to reach a final determination for the four different rates of annual increase of waterborne coal through 2000.

Table 6-4. ANNUAL INCREASES FOR ALL WATERBORNE COAL.

1994 - 2000
(million net tons)

	1.0% (NCA)	2.0% (EIA)	9.2% + Erie	14% + Erie
1993e	18.9	19.2		
1994e	19.2	19.6	11.8 + 8.1 = 19.9	12.3 + 8.1 = 20.4
1995e	19.4	20.0	12.9 + 7.2 = 20.1	14.0 + 7.2 = 21.2
1996e	19.6	20.4	14.1 + 6.4 = 20.6	16.0 + 6.4 = 22.4
1997e	19.8	20.8	15.4 + 5.7 = 21.2	18.2 + 5.7 = 23.9
1998e	20.2	20.2	16.8 + 4.9 = 21.7	20.8 + 4.9 = 25.7
1999e	20.4	21.6	18.3 + 5.0 = 23.1	23.7 + 5.0 = 28.7
2000e	20.6	22.0	20.0 + 5.0 = 25.0	27.0 + 5.0 = 32.0

Source: Lake Carrier's Association Annual Reports.

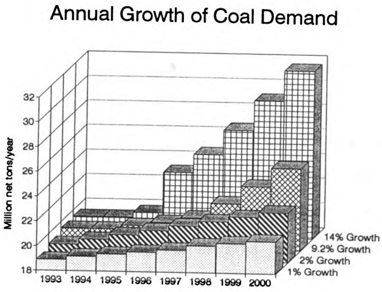

Figure 6-1. ESTIMATED GROWTH OF COAL DEMAND.

II. IRON ORE WILL INCREASE, THEN RETURN TO PRESENT LEVELS.

For over 100 years the largest bulk commodity on the Lakes has been iron ore which has accounted for more than 50 percent of all cargo carried by U.S. flag lakers. Cyclical highs and lows have been characteristic of annual bulk tonnage, but until the upheavals of the 1980s the iron ore industry had experienced 25 years of fairly steady growth. In 1979 the ore float topped 106 million long tons (Kakela, 1993).

In 1982 the economic recession coupled with materials substitution and foreign competition combined to lead to the painful downsizing of a serious overcapacity that existed in the domestic iron and steel industries. Between 1980 and 1988, 55% of iron mining jobs were lost and 41% of U.S. iron ore pellet capacity had been eliminated as mines and mills aggressively restructured to become competitive with any producer in the world on a per ton basis (Kakela, 1993).

The heroic cost reduction efforts by domestic ore and steel producers paid off. The challenges of the 1980s were met by increasing productivity while reducing excess capacity and manpower. As a result demand for domestic pellets stabilized, grew a little at the end of the 80s, and is now forecasted to pick up through the mid-nineties.

As seen in Table 6-5 and Figure 6-2 iron ore demand is forecasted to swell beginning in late 1993 and to peak in 1995 before returning to present levels in 1999. This 15% (8.7 million ton) increase in pellet production will translate directly into an equal increase in demand for vessel capacity for the mid-nineties. Because this capacity is not expected to be sustained, iron ore demand taken alone will not lead to a need for increase in vessels.[15]

Table 6-5. U.S. IRON ORE PELLET PRODUCTION THROUGH 2000.

(million net tons)

1985	52.4	1993e	60.5
1986	41.1	1994e	64.0
1987	50.4	1995e	66.0
1988	61.3	1996e	65.0
1989	62.9	1997e	61.6
1990	60.5	1998e	60.5
1991	60.7	1999e	56.0
1992	57.3	2000e	58.2

Source: Kakela (1993 p.50)

[15] Since 96% of all cross Lakes trade with Canada is by Canadian vessel Table 6-7 does not include any Canadian tonnage. Also excluded is the average annual 5.6 million tons of ore that are transhipped on the Cuyahoga River.

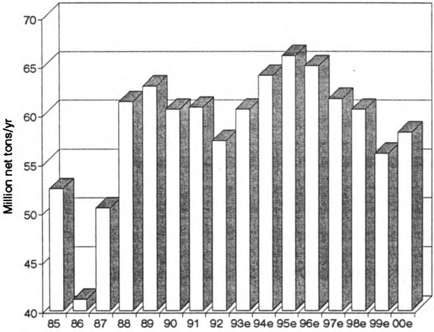

Figure 6-2. IRON ORE PELLET DEMAND THROUGH 2000.

While the forecasted rise in iron ore shipment through 1996 does reflect pent-up demand as the economy comes out of recession, the drop in demand that follows (1997-2000) is more than cyclical variation. This drop represents a permanent reduction in pellet demand as a result of the impact of mini-mill technology.

With the mini-mills becoming progressively more efficient at producing high quality flat-rolled thin-slab steel from scrap they are expected to encroach ever more into the historic market of the integrated steel mills. While total demand for raw steel is not expected to decrease, the mini-mill recycling of scrap is expected to account for this permanent decrease in demand for waterborne pellets. By the year 2000 iron ore capacity is expected to be reduced by 10 to 12 million tons and production is forecasted to be at roughly 1992 levels (Kakela, 1993). The final result of this shift will be to ease pressure on the Great Lakes fleet.

III. MULTIPLE USES OF LIMESTONE.

Limestone is an essential commodity in modern life, not only going into highways and sidewalks, but also as a basic component of the steelmaking process. In this sense limestone is a part of every refrigerator, bridge, highrise and automobile. Limestone is a highly regional commodity in that trucking costs limit distribution to about thirty miles. For example it is cheaper to ship limestone three hundred miles from Port Inland in the U.P. to Detroit, than it is to truck limestone the 60 miles from Toledo to Detroit (Siekierski, 1993).

In terms of dry bulk commodity tonnage on the Great Lakes, limestone is number two. In 1992, 22.1 million tons were shipped. Among the six loading ports on the Lakes there is presently 10 million tons of excess capacity that resulted from a shrinking of demand in the 1980s. As this shrinking demand began, competition became so fierce that the limestone trade association was dissolved. Consequently there is no detailed aggregate reporting of Great Lakes limestone other than annual net tonnage reported by Skilling's and by the Lake Carrier's Association.

On average roughly half of all limestone is used in chemical applications (metallurgical, scrubbers, manufacturing, etc.) and the other half is used as construction aggregate. Since 1987 annual stone shipments have been consistently strong as the economy recovered from recession and after stabilizing with the downsizing of the domestic iron and steel industries.

Situated on the Lakes, in the vicinity of quarry operations, are over a dozen lime plants where typically two tons of stone are required to produce one ton of lime. These plants account for about half of all metallurgical uses of limestone.

Another metallurgical use of limestone is for smokestack scrubbing as a way of meeting Phase I and II sulfur emissions requirements. Two and a half tons of limestone are required to remove one ton of sulfur. With a total reduction requirement of 10 million tons by 2000, 12.5 million tons of limestone would be required to scrub away even half of the 10 million tons. Industry specialists indicate that Phase I requirements have not caused much increase in scrubber technology use. Impact of Phase II requirements are presently too far off. As other technologies such as fluidized bed combustion become cost competitive, limestone demand will be increased.

With the recent passage of the Highway Bill and other proposed construction stimulus packages non-metallurgical uses for limestone could burgeon. Industry personnel expect increased reliance on crushed limestone for construction filler as a result of shortage of new supplies of gravel.

Waterborne limestone is price competitive only if final destination is less than thirty miles inland from the port of delivery. Otherwise inland quarries shipping by truck can deliver at a lower cost. Chicago, Detroit, Cleveland and Buffalo are the only major metropolitan areas located on the water. Their demand will be significant but as a percentage of the total growth, will be limited. The Great Lakes limestone industry has a capacity of 33.5 million tons per year. Some shipping experts however do not expect demand to rise above where it was in 1988-89 by the year 2000, unless shipping capacity increases to accommodate a larger steel industry.

Given the transitory nature of all of these factors a conservative estimate of growth in demand for limestone was used by the limestone industry, i.e., a rate that closely follows the twenty year average GNP growth rate of 2.6%. Michigan Limestone Operations, which handles 40% of the stone trade, indicates that in an expanding economy metallurgical use of limestone grows with GNP but at a lesser rate, while non-metallurgical uses grow with GNP but at a much greater rate. Thus a growth rate equal to GNP growth is realistic. James Young, Vice President of Operations and Marketing for Presque Isle Corporation, and Jerry Siekierski of Specialty Minerals Inc. concur. Limestone growth is represented in Table 6-6 and Figure 6-3.

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Table 6-6. ESTIMATED LIMESTONE TONNAGE THROUGH 2000.

(million net tons)

Actual		Estimated	
YEAR		**YEAR**	**2.6% Growth**
1985	21.0	1993e	22.7
1986	21.0	1994e	23.3
1987	26.2	1995e	23.9
1988	27.9	1996e	24.5
1989	27.2	1997e	25.1
1990	26.0	1998e	25.7
1991	24.4	1999e	26.4
1992	22.1	2000e	27.1

Based on LCA Reports

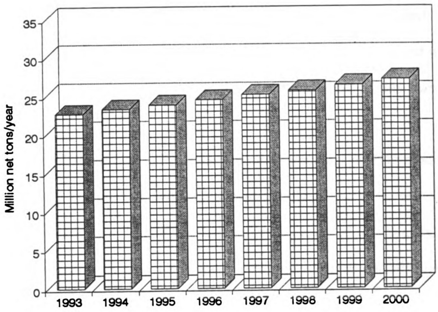


Figure 6-3. ESTIMATED LIMESTONE TONNAGE THROUGH 2000.

IV. FLUXED PELLET PRODUCTION AND LIMESTONE CONSUMPTION.

Beginning in 1987 mines in Minnesota and northern Michigan began fluxing iron ore pellets with limestone at the mine sites rather than at the steel mills on the Lower Lakes. This fluxing process burns off about half the limestone and what remains becomes added to downbound cargo weight. In essence half of this stone is shipped twice (Beck, 1991a,b).

In 1992 about 10% of the total limestone shipment went to produce the 40% of iron ore pellets that were fluxed. Some experts believe that in the next several years there may be a market for 75 to 80% of all pellets to be fluxed. Such a doubling would result in a 10% increase in total limestone shipment with half of this 10% increase being added to downbound cargo weight. Table 6-7 illustrates this by adding flux increase to the annual limestone growth estimates from Table 6-6. By assuming that the 80% growth rate will begin in 1993, Table 6-7 portrays flux growth at a slightly faster rate than will actually occur. Even under these conditions, total available vessel capacity is not significantly effected.

Table 6-7. LIMESTONE GROWTH - 80% Fluxed Pellet Production.

(million net tons)

Year	2.6% Growth	+	80% Flux Increase *	=	Total	+	(downbound) 1/2 of Flux	=	
1992	22.1	+	2.21	=	24.3	+	1.1	=	2.54
1993e	22.7	+	2.33	=	25.0	+	1.2	=	26.2
1994e	23.3	+	2.46	=	25.8	+	1.2	=	27.0
1995e	23.9	+	2.54	=	26.4	+	1.3	=	27.7
1996e	24.5	+	2.50	=	27.0	+	1.3	=	28.3
1997e	25.1	+	2.37	=	27.5	+	1.2	=	28.7
1998e	25.7	+	2.33	=	28.0	+	1.2	=	29.2
1999e	26.4	+	2.16	=	28.6	+	1.1	=	29.7
2000e	27.1	+	2.24	=	29.3	+	1.1	=	30.4

* $\frac{\text{92 iron ore}}{\text{93 iron ore}} \times \frac{\text{10\% Lstone 92}}{\text{(X) Lstone 93}}$

IV. SAND, SALT AND GRAIN.

The combined four year average for sand, salt and grain taken from Table 6-1 is 2.2 million net tons annually. This is assumed to be a constant amount throughout the forecast period.

Chapter 7 presents various combinations of dry bulk demand that are set against vessel capacity through the end of the decade.

TONNAGE VERSUS CAPACITY

Chapter 7.

I. TOTALS.

As noted, total dry bulk fleet capacity is 105.8 million gross tons. Converted to net tons we get: 105.8 x 1.12 = 118.5 million net tons. This includes all registered tonnage plus non-registered active vessels, but not the 31,500 gross tons of the John Sherwin that is available but disenrolled capacity from Table 4-4a. LCA personnel indicate that the John Sherwin is indeed ready to go into service when needed.

In Table 4-5, and as was calculated in Chapter 4, we saw that average trip length per vessel in 1992 was 5.28 days and that each vessel averaged 60 trips per season. Because of the great variations in individual transits, these figures are not adequate for determining entire fleet movement, but are useful to estimate additional annual tonnage capacity that would be added to the fleet if the 31,500 gross tons of disenrolled capacity were activated: 31,500 x 60 = 1,890,000 gross tons. This in turn becomes 2,286,900 net tons of additional capacity which when combined with the 118.5 million net tons of active capacity pushes the U.S flag dry bulk capacity to 120.8 million net tons.

Table 7-1 is a composite presentation of all anticipated dry bulk tonnage to the year 2000. The five columns under "Totals" represent combined annual totals of dry bulk cargo. Columns A-D differ from one another only in terms of the amount by which coal increases, while column E represents high limestone growth and high coal growth. This table shows that active vessel capacity of 118.5 million net tons is exceeded only in the final year of the high coal growth forecast, column D, and in years 1996, 1998, and 2000 of column E, high coal and high limestone growth.

Table 7-1. DRY BULK COMPOSITE.

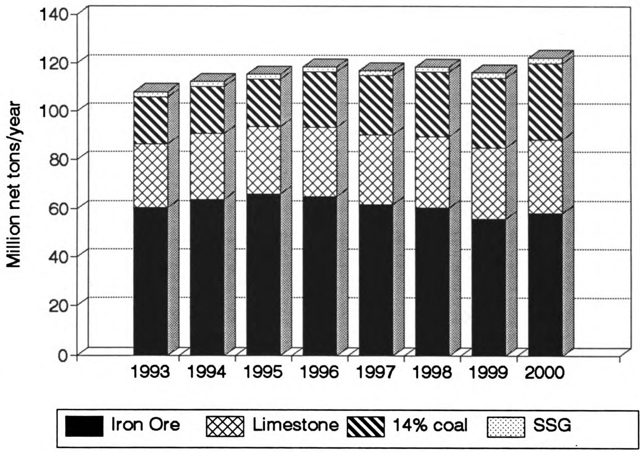
(million net tons)

YEAR	NCA	EIA	Coal Growth 9.2% (includes Erie)	Coal Growth 14% (includes Erie)	Iron ore	Limestone Low	Limestone High	SSG
1993e	18.9	19.2	19.5	19.5	60.4	22.7	26.2	2.2
1994e	19.2	19.6	19.5	19.5	64.0	23.3	27.0	2.2
1995e	19.4	20.0	19.8	19.9	66.0	23.9	27.7	2.2
1996e	19.6	20.4	20.1	23.2	65.0	24.5	28.3	2.2
1997e	19.8	20.8	20.5	24.7	61.6	25.1	28.7	2.2
1998e	20.2	21.2	21.7	26.7	60.5	25.7	29.2	2.2
1999e	20.4	21.6	23.1	29.1	56.0	26.4	29.2	2.2
2000e	20.6	22.0	24.6	31.6	58.2	27.1	30.4	2.2

TOTALS

	A NCA Estimate	B EIA Estimate	C 9.2% Coal	D 14% Coal	E High Limestone High Coal
1993e	104.2	104.5	104.8	104.8	108.3
1994e	108.7	109.1	109.0	109.0	112.7
1995e	111.5	112.1	111.9	112.0	115.8
1996e	111.3	112.1	111.8	114.9	118.7
1997e	108.7	109.7	109.4	113.6	117.2
1998e	108.6	109.1	110.1	115.1	118.6
1999e	105.0	106.2	107.7	113.7	116.5
2000e	108.1	109.5	112.1	119.1	122.4

If fleet size is further adjusted to include total available carrying capacity of 120.8 million net tons it is apparent that there will be no shortage of vessel availability throughout the entire forecast period with the exception of a single case in the year 2000. This relationship is depicted in Figures 7-1 through 7-3.



Compiled from LCA Data

Figure 7-1. ESTIMATED TOTAL DRY BULK DEMAND.

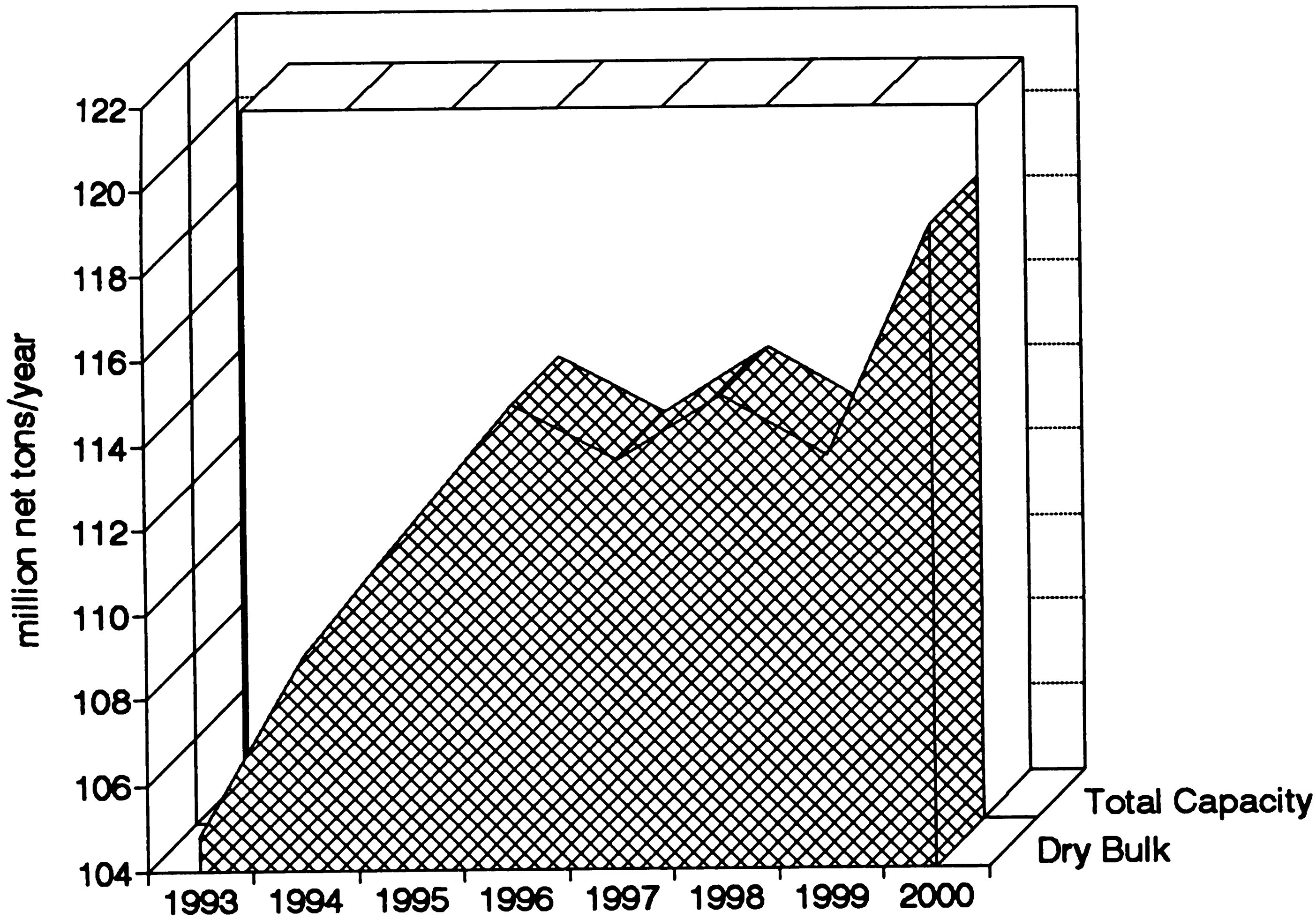


Figure 7-2. HIGH DRY BULK DEMAND VS. TOTAL DRY BULK CAPACITY.

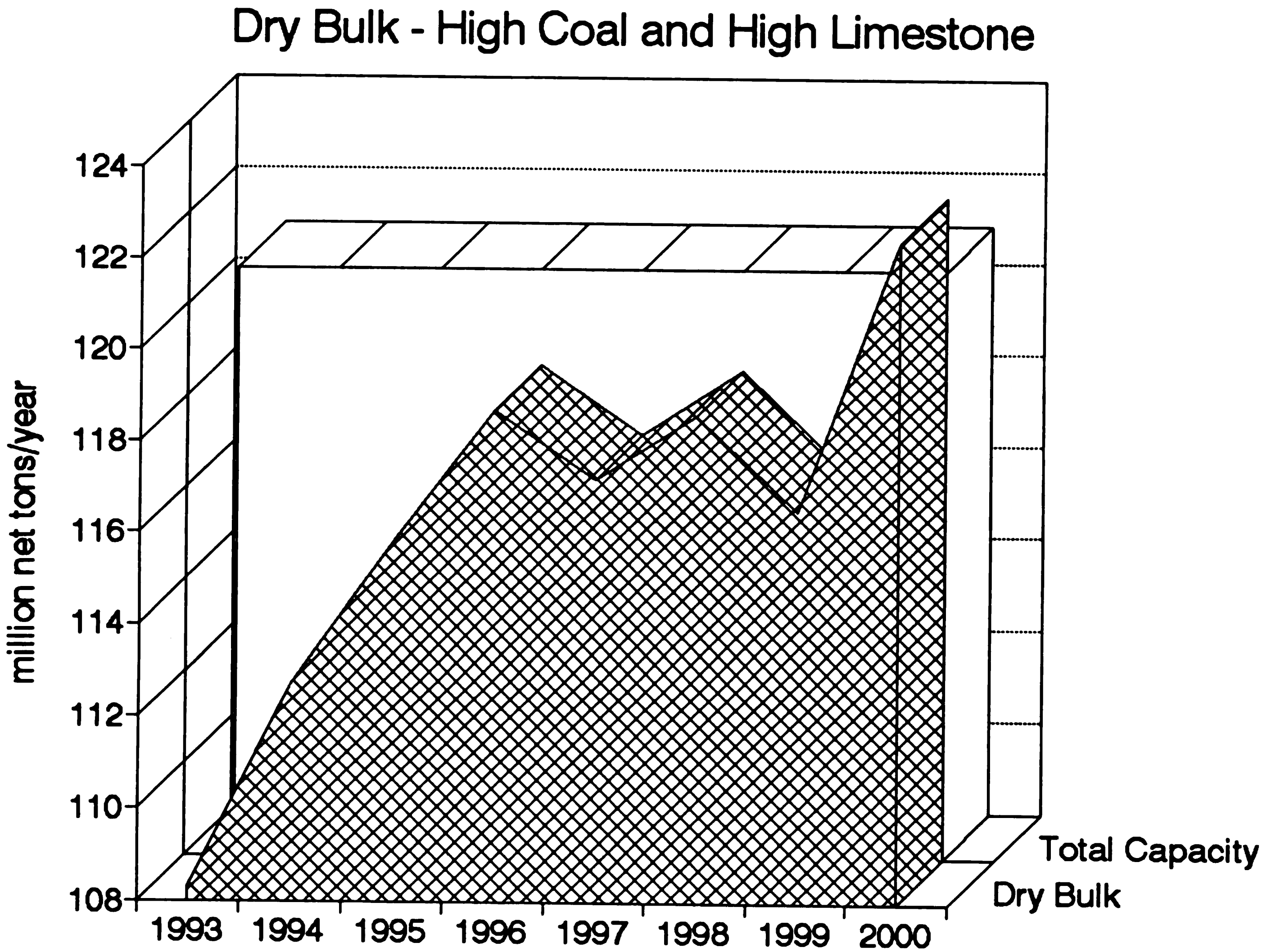


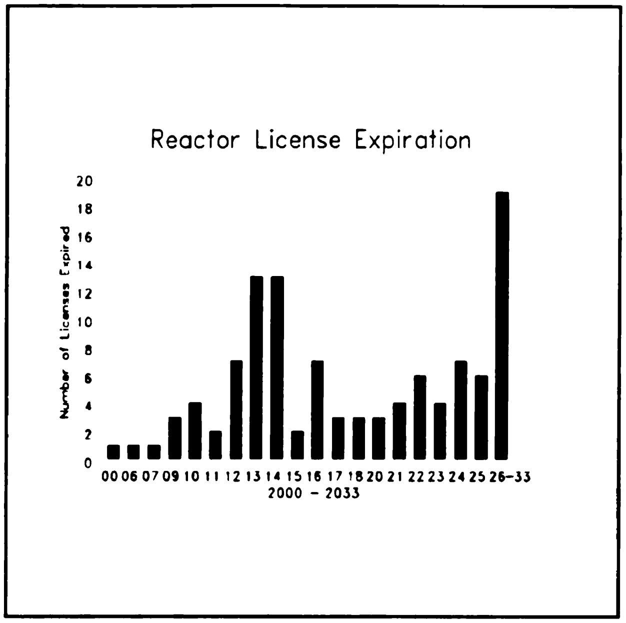
Figure 7-3. HIGHEST DRY BULK DEMAND vs. TOTAL DRY BULK CAPACITY.

II. NUCLEAR REACTOR LICENSING AND COAL CONSUMPTION.

By the year 2036 all of the 111 commercial nuclear power reactors in the U.S. are scheduled for relicensing. The coal transportation relationships in this study are based on the assumption that existing facilities in the Great Lakes States will be relicensed. The Nuclear Regulatory Commission however has not yet issued criteria for relicensing nor have they indicated for how long the new relicensing period will be. This creates a major uncertainty regarding future demand for waterborne coal.

In the states bordering the Great Lakes there are 39 nuclear units which generate over 32,000 MW of power. Of these, eleven are strategically located within the geographical proximity of the Lakes themselves and could receive coal by water if necessary.

As illustrated in Figure 7-3 however, the relicensing schedule
for all U.S. facilities indicates that only one license will expire during the entire forecast period of this study.



Source: NRC Information Digest, p. 48.

Figure 7-3. NUCLEAR REACTOR LICENSE EXPIRATION DATES.

The single nuclear power license that expires in the year 2000 is the 67 MW Big Rock reactor in Michigan (NRC, 1993). The next expiration in 2007 is the 755 MW Palisades reactor which is also in Michigan, followed by the 470 MW Ginna reactor in Rochester, NY, and the 605 MW 9 Mile Point reactor in Oswego, NY., both of which occur in the year 2009 (EIA, 1992, 1991b).

After the year 2010, if all or a portion of these 11 strategic units are not relicensed and they are converted to coal fired generators, waterborne demand for both Western and Appalachian coal will be greatly affected. It should be noted though that through the end of the forecast period, relicensing will not play an important role in coal consumption and vessel availability.

CHAPTER 8.

I. SUMMARY.

If this investigation were structured as a piece of classical scientific research with the formulation and proof of a hypothesis, the null hypothesis might read: "Increased dry bulk cargo through the 1990s will not exceed U.S. flag fleet shipping capacity." Through a series of forecasts, projections, and analytical narrative the researcher would set about to prove or disprove this statement, and would be 90 to 99% certain of his accuracy, assuming his model was without error.

Because of the complex applied nature of this research question, however, a yes or no conclusion is of less value than the richer shades of meaning that an equally analytical but insightfully more fertile qualitative study can provide. As for the question at hand, from a strictly analytical viewpoint, the null hypothesis is proved. There will be no significant Great Lakes vessel capacity shortfall through the year 2000. In fact it is only in the year 2000, under the very highest cargo growth scenario, that dry bulk demand actually exceeds shipping supply, and then only by a mere 1.6 million net tons (assuming the model holds).

From the viewpoint of rationality, however, what often looks good on paper does not actually work in the real world. While there seems to be sufficient excess capacity in the U.S. flag fleet throughout the 1990s, there may not actually be enough excess to provide a realistic and reasonable cushion. Foul weather, labor strikes, mechanical breakdowns, and so on, all interfere with the shipper's ability to maintain dispatch schedules and to provide for cost-effective cargo flows.

Excess capacity does exist, but primarily with the smaller vessels and it is precisely these vessels that are not much involved in Head-of-the Lakes trade because of economy of scale. It is simply not efficient for a smaller vessel to move in two and a half trips what a single Poe class vessel can move in one trip.

This analysis has in fact made clear that when U.S. flag fleet capacity is examined by individual class it is evident there is a growing shortage of Poe class vessels.

Table 4-6 shows that from May through December in 1992 and in 1993 Poe class vessel use was at 98% of capacity. While this is a commendably efficient operations rate, it is also an indication of just how narrow is the excess capacity margin and how very little room there is to accommodate expansion of the dry bulk trade. Thus it does appear that an additional 1000 footer or two may be required in the 90s, but from the numbers generated in this study it is not clear when.

In addressing this issue it would be very shortsighted to rely simply on graphic relationships and to ignore standard industry practice. In the shipping industry, as with any enterprise, capital investment in new ship construction depends on real or anticipated growth in business volume. As referenced in Chapter 4, LCA President George Ryan has indicated that 3 million tons of sustained excess cargo is the critical volume necessary for new thousand foot construction. With this in mind, cases A, B and C from Table 7-2 (low coal growth and low limestone growth) will conservatively require one new thousand foot vessel by early 1995 at the latest to meet dry bulk shipping demand, with a second vessel being needed in 1996 for case C. Likewise cases D and E (high coal and high limestone growth) will conservatively require additional 1000 foot capacity in 1994, 1995, 1998 and 2000.

This analysis shows that steadily rising limestone and coal volumes will more than make up for the expected sinking demand for iron ore in the late nineties. Lead time for new vessel construction is 2 to 3 years and there are currently no vessels under construction. If a new ship were to be constructed using existing specifications, the earliest delivery time will be toward the end of the 1995 season. The apparent capacity shortfall that will result indicates that industry has erred on the side of caution, opting to have too little capacity rather than too much. This inability to provide service could work to the advantage of the railroads by providing them with the opportunity to siphon off and retain increased coal haulage on existing lines while using the extra capital to lower rates overall and further increase market share.

Furthermore, given what will likely be the marginal ability of the U.S. fleet to meet cargo capacity demands, it is likely that the winter navigation season will see increased traffic throughout much of the 1990s as shippers struggle to fulfill transportation contracts pending new ship construction. A short term solution is to see if better use can be made of Poe class vessel capacity in the month of April when there is considerable surplus capacity, as well as in early January before significant ice-over conditions occur. By doing this, late March sailing can be avoided when winter ice is thickest and the potential for environmental damage is greatest.

II. LIMITATIONS.

The forecasts for the major dry bulk commodities examined in this study represent expectations of how demand may change given a certain set of circumstances and assumptions. They are of course not intended to be considered as unconditional and categorical predictions of future conditions, but rather represent best estimates based on extensive study of the literature and numerous contacts with industry and government experts. If conditions change, of course outcomes will change accordingly.

III. RECOMMENDATIONS FOR FURTHER STUDY.

a. Winter Navigation Issues.

While the portion on winter navigation certainly is not intended to imply a causal relationship between shipping and Great Lakes ecosystem deterioration, it can rightly be considered as a good overview of the salient issues surrounding the controversy. As such the background information developed in Chapter 3 might serve as a starting point for those interested in working toward a compromise between two very important competing concerns.

The benefits of extended season navigation are mainly to meet the needs of commerce and, according to the Corp of Engineers, in particular the needs of the integrated steel mills. At issue is the feared loss of competitive economic position in the world market if winter stockpiles exceed or fall below some undisclosed level. In preparing its environmental impact statements, the Corp chose not to address this very basic concern by noting that it was beyond its level of expertise. This matter should be more closely investigated. Perhaps by developing a strategic materials flow profile for each individual mine and mill, an improved coordination between the needs of commerce and the concerns of environmentalists could be realized.

b. Second Poe-Sized Lock.

The Lake Carriers' Association has long been a champion of the need for a second Poe lock and continues to request Congress to fully fund the project. A fast-track schedule for planning and construction has been urged since time to completion, if begun soon, would not be until early in the next decade. As the financial health of Great Lakes economy improves fuller utilization of Poe-class vessels will be required. Furthermore, economic growth could be significantly limited without additional locking capability sufficient to handle additional traffic.

The LCA contends that the needs of commerce demand a second lock, that federal funds should pay for it, and that no further environmental damage is to be expected as a result. The growth projections developed in this present study might be used to further evaluate the need for a second Poe lock and perhaps help to focus the debate concerning the environmental impact of such an undertaking.

c. Emissions Trading and Transmission Access.

Free market environmentalism in the form of emissions trading is a new development in environmental economics and holds much promise for emissions regulation. This too needs to be tracked to see how well the theory will work in practice and what the impact will be on emissions strategies as Phase II approaches.

Likewise, if the push for retail wheeling of electric power is successful, the implications will be far-reaching. While wholesale wheeling has been around for some time, retail wheeling is new and has the potential to greatly change the way electric utilities do business. It seems likely that monopoly utilities will eventually be required to provide transmission access to all buyers at fair prices. When this happens, distant utilities with lower delivered power costs will force local utilities to lower their costs, or else face a reduction in demand for locally generated power.

Emissions trading alone, or retail wheeling alone, will have an impact on the complex relationship that exists between the electric utility industry, the coal supply and transportation industries, and the regulatory community. The compounded impact of these two developments occuring together will likely result in the break-up of long established patterns of interaction in favor of new and hopefully more efficient relationships. Thus both of these developments need to be kept in focus through additional research and analytical policy impact studies.

e. Short-Term Future Studies - Rolling Forecasts.

In a few years it will be worthwhile to carry out an intermodal transportation analysis that compares costs per ton mile for an all rail transportation route versus a combined rail and vessel route from the Powder River Basin to a designated lower Lakes port. The dynamics of rail transportation are becoming much more cost competitive with the developing trend of unit trains that are composed of customer-owned, light weight aluminum coal cars. As mentioned, in order to account for new technologies, policy changes, and economic conditions it is prudent and reasonable to periodically reexamine all of the relationships highlighted in this study, perhaps every 3 to 5 years. Better to invest in a sort of rolling forecast rather than to become wed to a certain set of longterm outcomes whose unreliability may actually vary directly with their distance from the present.

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