PREPARED FOR:

MARITIME ADMINISTRATION,
U.S. DEPARTMENT OF TRANSPORTATION

IMPACT OF HIGH OIL PRICES ON FREIGHT TRANSPORTATION: MODAL SHIFT POTENTIAL IN FIVE CORRIDORS

TECHNICAL REPORT

OCTOBER 2008

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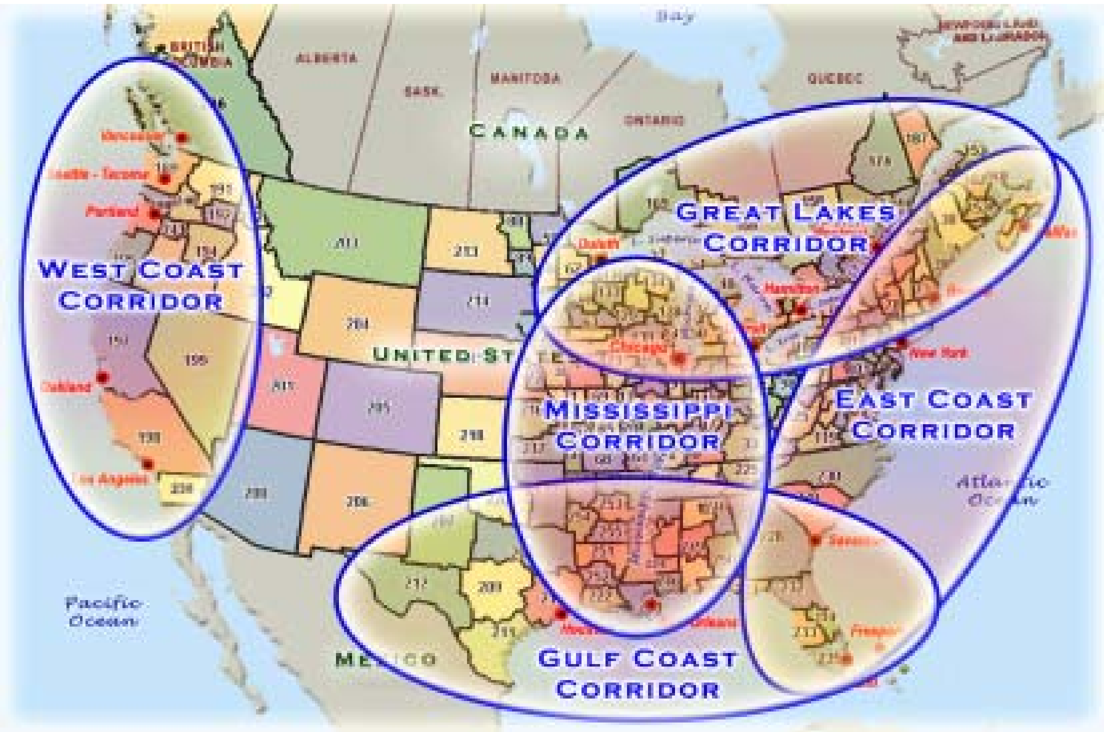
THE PURPOSE OF THE STUDY

In recent months the price of oil has risen sharply and with it, gasoline, diesel, and fuel oil prices. The impact of these oil price increases is very strong as it flows through the U.S. economy. Firstly, its impact on production costs results in a reduction on the overall demand for goods and services in the economy. Second, its impact on transport costs is changing distribution systems and the ability of existing logistics chains to serve world markets. This second impact affects not only the hinterland and distribution systems of major markets, but also the relative competitiveness of the modes that serve those markets.

In order to understand the impact of oil prices on markets and their logistic chains, the Maritime Administration (an agency of the U.S. Department of Transportation) asked Transportation Economics & Management Systems, Inc. (TEMS) to evaluate the impact of oil prices on U.S. domestic freight transportation. The study first forecasts the potential range of oil prices in the short and long term, and then assesses how such prices would impact transportation logistics chains and evaluate likely changes. The analysis considers both the national impact as well as the impact in five critical corridor markets, as shown in Exhibit 1. These five corridors include over 95 percent of the US population and an even higher share of its total production and consumption.

Exhibit 1: The Five Corridors Evaluated in the Analysis



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INTRODUCTION

2.1 THE OIL PRICE ISSUE

Over the last forty years, one of the most difficult transportation policy questions has been the issue of the price of oil and its associated impact on transportation systems[1]. Since the 1950's the North American economy and its transportation system have become increasingly dependent on oil both in terms of its production of goods and services, and their distribution from production centers to market consumption centers. Oil drives a large part of the costs of the production of agricultural, manufacturing, and service industries. Furthermore, as industries have globalized over the last thirty years the low price of oil has been critical in allowing logistics chains to become more and more elongated. As a result of economic globalization, more and more of the U.S. Gross Domestic Product (GDP) has become dependent on international trade and movements across the world.[2] It is estimated that whereas only five percent of U.S. GDP was generated from trade in 1950, the growth of international trade (See Exhibits 2 and 3) by the year 2000 resulted in twenty percent of GDP being generated by international trade, and that by 2050 it will be fifty percent.[3]

The transport systems that support this growth in "economic globalism" are very dependent on oil. Whether it's the ships that carry containers with consumer goods from Asia and Europe, or the oil tankers bringing fuel oil to the U.S., or bulk carriers moving coal, ores, and grain, marine shipping has been driven by economies of scale being generated by faster and larger ships, and steady if not falling oil prices. Equally, in terms of inland distribution whether by truck, rail, or inland water, steady or falling oil prices have allowed the growth of an efficient distribution system using existing infrastructure systems that had adequate capacity. Interstates were built and maintained by Federal and state government, railroads maintained by the private railroad companies, and port and inland water systems have been built and maintained by the Federal and state government, and the private sector.

In the global economy and both the internal and external transportation systems of the United States, significantly increased oil prices will have a very large impact on a number of demand and supply factors, including:

- The ability to maintain and grow the global economy
- The costs of both marine and inland shipping
- The competitive relationships and role of inland shipping services (i.e., modal share).

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[1] A.E. Metcalf and D. O'Sullivan. "Planning for Energy Conservation in Transportation: The Options," Irish Institute of Engineers. Dublin. March 1979.

[2] A.E. Metcalf, E. Kraft, L.Y. Bzhilyanskaya. "Ohio Intermodal Rail Freight Growth Strategy-Concept Study." TEMS, Inc. November 2006.

[3] Bureau of Economic Analysis. U.S. Department of Commerce.

Exhibit 2: U.S. Exports & Imports, 1950-2005 (Billions of $2005)

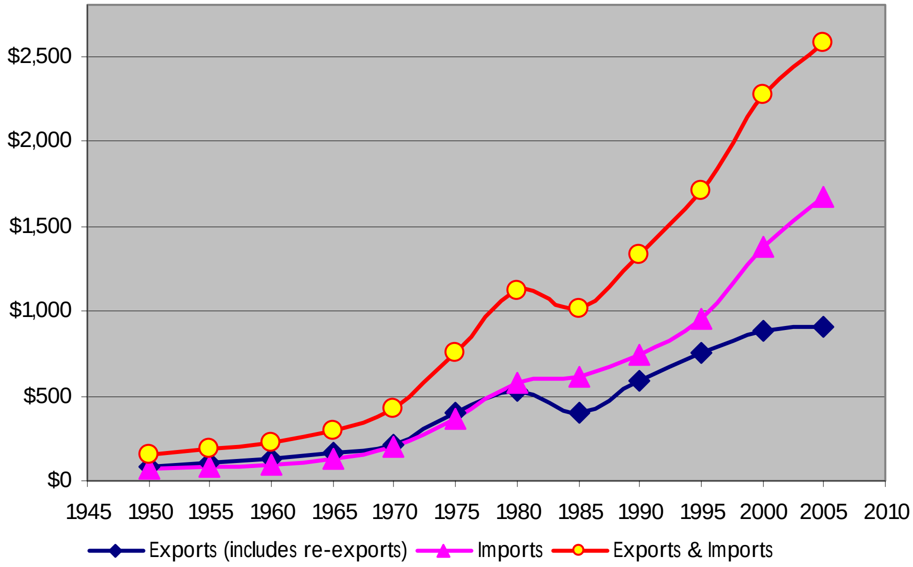
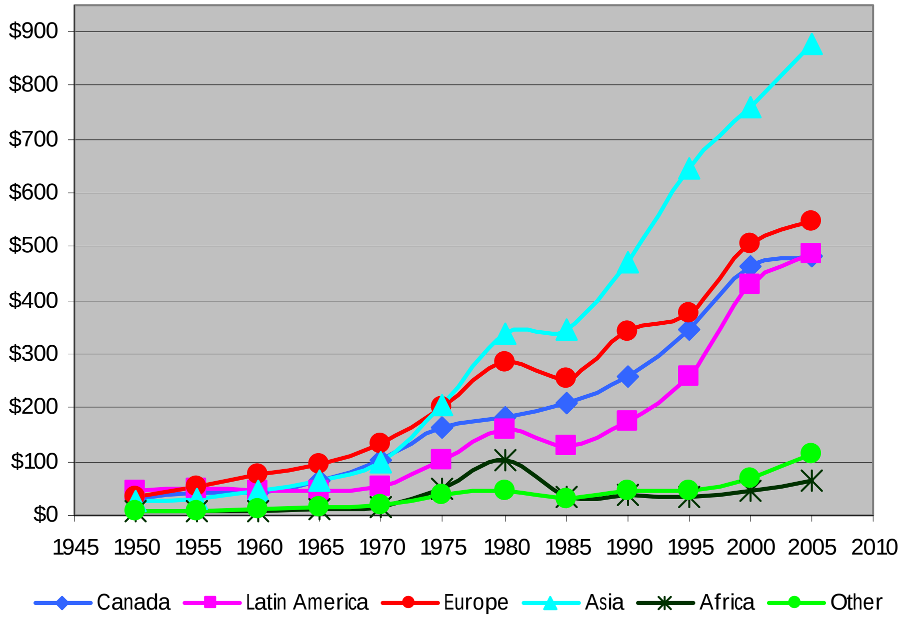


Exhibit 3: U.S. Exports & Imports by International Region, 1950-2005 (Billions of $2005)



2.2 THE ABILITY TO MAINTAIN AND GROW THE GLOBAL ECONOMY

In the short run, higher oil prices will undoubtedly have an impact on the rate of growth of the global economy, as oil has such a significant role as a factor of production in agriculture, basic raw materials, manufactured products, and service industries. For agriculture, oil impacts as much as 20-50 percent of total costs, for raw material industries 20-30 percent, for manufacturing industries 10-20 percent, and for service industries 5-10 percent.[4] However, while increased oil prices will slow the growth, and in the short term may limit or cut production, there are in many cases a wide range of substitutes for oil that could replace oil given time. For example, in the generation of power, the electricity supply can within the short or medium term switch from oil to natural gas, coal, nuclear, solar, and even wind alternatives. In addition, a range of conservation measures may be applied on the demand side. Changing to these new fuel sources will allow the production and consumption markets to expand after a short-term hiatus. As a result, oil will tend to become more focused into specific “products” such as, fertilizers for agriculture, or feed stock for plastics and chemicals as low cost substitutes will be harder to develop in the short and medium term (0-10 years) in these areas. In the longer term (10-15 years)[5] liquefied coal or cellulose-based alternatives (e.g., bioplastics) will likely be developed that can substitute for oil. Overall, therefore, while the prices of today may be moderated by substitution, the worldwide expanding demand for oil is likely to be a consistently upward pressure on oil prices, and result in oil prices stabilizing at far higher levels than were experienced in the 1990’s or before 2005. This will result in a short or even medium downturn in the U.S. and world economies shaving 1 or 2 percentage points per year off U.S. GDP.

2.3 THE COSTS OF MARINE AND INLAND SHIPPING

In the last five years the transport industry has experienced a five to eight fold increase in the price of fuel for marine and inland shipping (i.e., as a result of a price increase in crude oil from $20 to $140 per barrel). This causes a major “dislocation” for industry that may significantly impact the current distribution pattern of goods and services. In the year 2000 fuel represented only 20 percent of transport operating costs, recently at $140 per barrel it represents over 50 percent, and were the oil price to rise to $200 a barrel, it would be over 70 percent of operating cost. Transport prices have risen by nearly 100 percent between 2002 and 2008, and could increase by almost another 300 percent if oil prices increase to $200 per barrel. A one-dollar rise in world oil prices leads to a 1 percent rise in trade transport costs. In terms of the marine and inland transport movement of a 40-foot container from Shanghai to Columbus, Ohio, the total transport cost was $3,000 when oil prices were $20 per barrel in the year 2000. Today at $140 per barrel, the cost is $8,000, and should oil prices rise to $200 per barrel transport cost would rise to $15,000 per FEU (See Exhibit 4).

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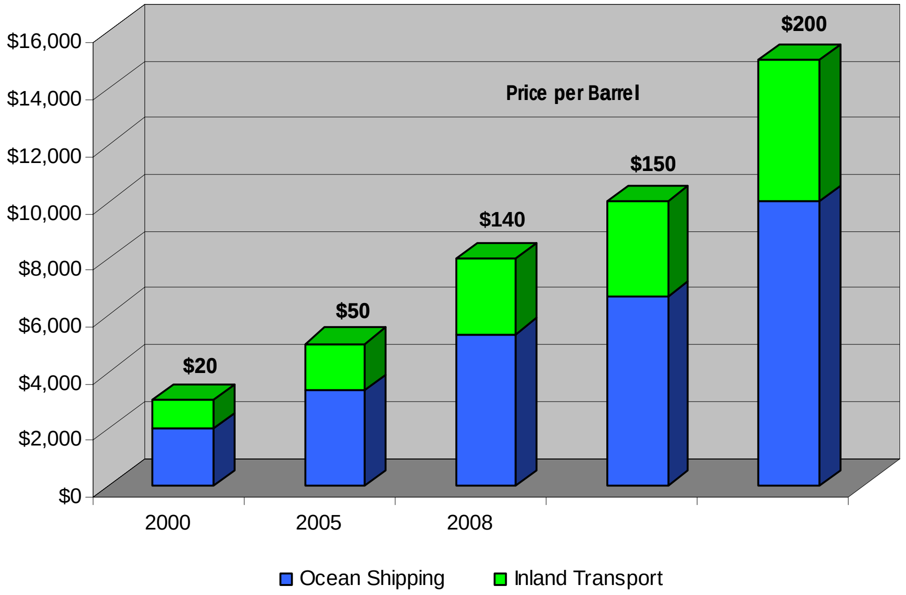
[4] R. Jimenez-Rodriquez. “The Industrial Impact of Oil Price Shocks: Evidence from the Industries of Six OECD Countries.” Documentos de Trabajo No. 0731. 2007; N. Velazquez. “Impact of Rising Energy Costs on Small Business.” Congress of the United States. House of Representatives. August 10, 2006.

[5] M. Der Hovanesian. “I Have Just One Word For You: Bioplastics.” Business Week. June 30, 2008; B. Elgin. “The Dirty Truth About Clean Coal.” Business Week. 30 June 2008; D. Montgomery. “Air Force Leads Push to Liquified Coal Fuel.” Seattle Times. March 30, 2008.

Exhibit 4: Cost of Transporting a Container (FEU) from Shanghai to Columbus, Ohio at Different Oil Prices ($2008)



The prices of food, consumer goods (e.g., electronics, furniture, and clothes), and capital goods items like cars and houses are all likely to suffer from continuing oil price shocks.[6] It is estimated that the realignment of prices will result in a significant set back in the growth of the world economy and both suppliers and consumers will face a change in "equilibrium" of the economy, with suppliers having to increase prices to pay for the increased production and transport costs, and consumers having to reduce demand as prices rise. A good example of the impact of increased oil prices on transportation is shown by the change in the supply and demand conditions for steel production. Chinese exports of steel to the U.S. are now falling on a year over year basis by more than 20 percent, while U.S. steel output is rising by 10 percent a year. While production costs in China and the U.S. are very similar at $600 per ton of rolled steel (due to exchange rate changes), the extra shipping cost faced by Chinese steel of $100 per ton is making it uncompetitive in U.S. markets (See Exhibit 5). The new equilibrium will result in a short to medium term change in the market. In effect, the elongated supply chain from China has been neutralized by higher oil prices. As the market had become reflective of transport conditions 10 to 20 years earlier in terms of volumes transported and supplied to the market,[7] the result should be a short-term shake out among producers, and a more competitive market as demand falls. Lower cost producers will gain market share at the expense of high cost producers. All producers will look for cheaper ways to supply the market, and consumers will look for competitively priced goods. Clearly pressure will be on the transport supply industry to find more cost-effective alternatives.

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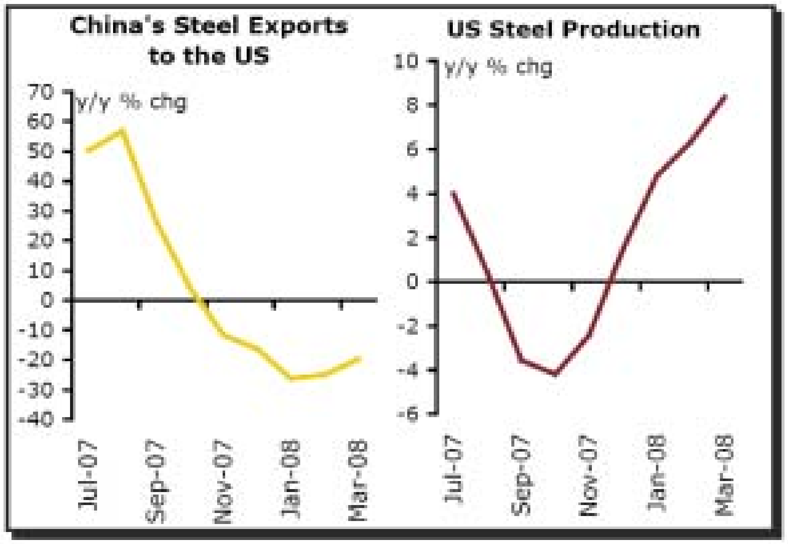
[6] R. Avent. "A World Less Flat." Guardian, UK. June 25, 2008.

[7] J. Rubin. "The New Inflation." CIBC World Markets. May 27, 2008.

Exhibit 5: China's Steel Exports to U.S. Fall, While U.S. Steel Production Rises



Source: US Census Bureau, CIBCWM

2.4 COMPETITIVE RELATIONSHIPS AND INLAND DISTRIBUTION SYSTEM

In the marine transport system, the higher costs of oil and its market impacts will put tremendous pressure on carriers to become more and more competitive, and to seek both operating savings and "economies of scale" to offset higher fuel prices. For example, in terms of operating savings, it is estimated that over the last 15 years the increase in speed of the world fleet from 20 to 29 knots has doubled fuel consumption per unit of freight. As such, it is not surprising that the increased cost of oil is now slowing the fleet. In terms of "economies of scale" this would suggest an even more intense drive to larger ships as a mechanism to offset higher oil prices per unit of freight. As a result, there may well be a new round of tanker, bulk, and container ship development as carriers seek to be more and more competitive. Equally, given the higher costs of the inland distribution system, shippers may well seek to maximize marine movements and minimize inland distribution costs. Inland distribution costs[8,9] are much higher per ton, teu, etc., than maritime costs. As a result, higher oil prices could:

- Increase the maritime trip length, which favors Atlantic and Gulf ports instead of West Coast ports for Asian traffic.
- Shift traffic from truck to rail and water for inland distribution.

In terms of inland distribution, the increase in oil prices has significantly impacted the relative advantage of the lower cost modes rail and water. The truck industry has been badly damaged, and in particular, many small owner-operators have been forced out of the market by increased oil prices. Already beset with labor shortages and longer travel times due to highway congestion, the industry is being forced to consolidate by higher oil prices, which will have a tendency to increase truck rates. This will occur despite the improvements in productivity that consolidation will produce. For example, an improved percentage of backhauls, which are so difficult for the smaller trucking firms to obtain, are more likely in a consolidated industry. Large firms with a wide range of "hubs" and "operating centers" across the country can far more easily find backhauls from one region to another, and consolidate traffic because of their broader network of routes.

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[8] Maritime Administration (USDOT)/Transport Canada, Great Lakes-St. Lawrence Seaway Study- New Cargoes/New Vessels Market Assessment Report, TEMS, Inc./RAND. January 2007.

[9] U.S. Ports Model: Route Choice Model, TEMS, Inc. 2008.

For rail, increasing oil prices are far less of a problem than for trucking because rail is far more fuel-efficient. The cost of fuel oil is a far smaller percentage of total rail operating costs and as such will result in far smaller percentage rate increases. However, freight rail faces a very significant set of capacity problems and so rail has only very limited ability to expand market share. As a result, the freight railroad is likely to price-up (including fuel surcharges), specialize in higher value goods, and reduce low value traffic. Key rail freight include coal and grain (for ethanol), which while being affected by the slow down in the world economy due to oil, are in themselves fuels that may be used to substitute for oil, and may therefore continue to see rising demand despite the reduced rate of world economic growth. However, another key rail service, intermodal traffic has clearly reflected the slow down in the economy. This is encouraging the railroads into collaboration with trucking industry and may result in more diversion from truck to rail, creating growth in some lanes while others shrink. For example, Kansas Southern saw intermodal revenues rise by 19 percent in the first quarter of 2007, as traffic switched from truck to rail.

For water, the market position is similar to that of rail as it can provide an alternative to truck because of water's lower operating costs. The major issue is that because the water mode is so much slower than truck or rail it has not been able to move into the higher value container or intermodal business, and has typically only substituted for truck or rail in bulk and neobulk markets. However, as both truck and rail have capacity problems while water has considerable capacity, the opportunity may now exist for water to move up market from bulk traffic, first into neobulks (steel coil) and then into containerized freight, particularly where market conditions provide additional advantage for water (e.g., shorter water distance, easier port transfers, etc.).

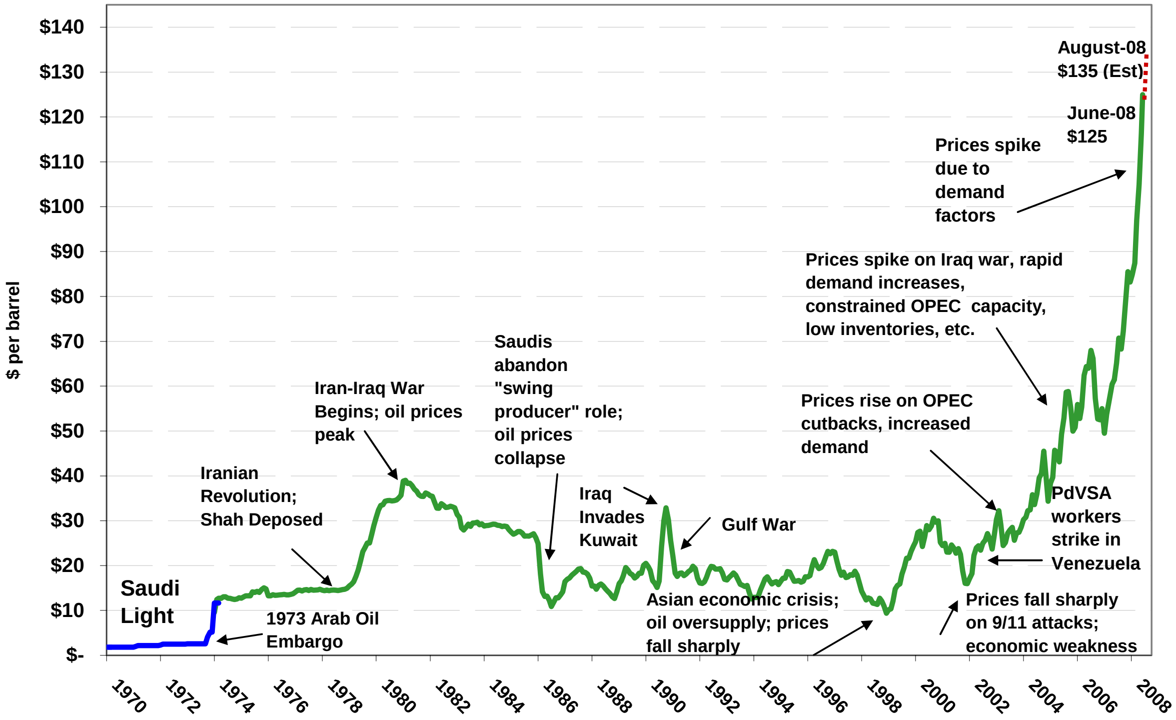
3

OIL PRICES TODAY AND IN THE FUTURE

3.1 THE HISTORY OF OIL PRICES

Since 1970 and prior to 2004 the world has suffered a number of oil price shocks largely due to the actions of OPEC, and Middle East wars (See Exhibit 6). However, the recent oil crisis has resulted in the nominal price of oil far exceeding any previous crisis at $140 per barrel. In nominal terms, the refiner acquisition cost of oil (which is typically 95 percent of domestic market price) did not exceed $40 per barrel, prior to 2006 and major price spikes were largely due to Middle East wars, such as the Arab oil embargo (1973), Iran/Iraq War (1982), and Persian Gulf War (1992). That situation changed after the year 2000 when non-supply issues like the growth in world oil demand (2003 to 2007) began to impact oil prices. From a low of $10 per barrel in 1999, oil prices rose quickly in nominal terms to nearly $70 per barrel in 2006 and to $140 per barrel in 2008.

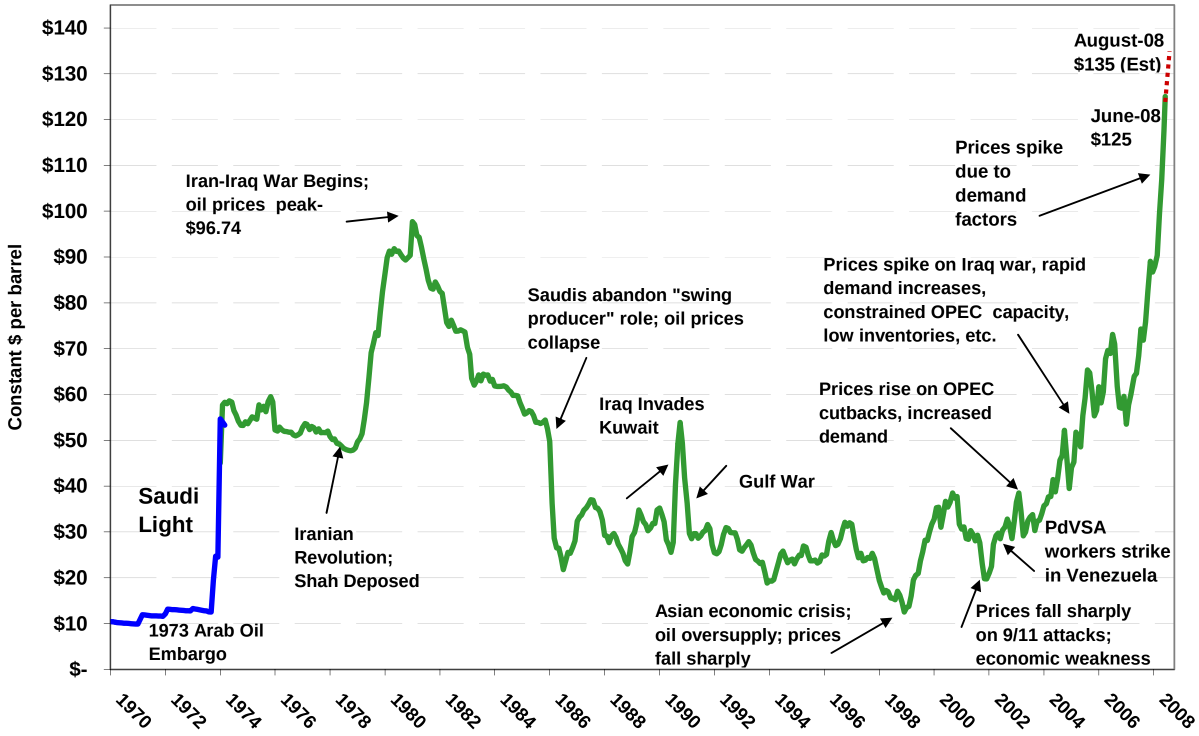
Exhibit 6: Major Events and Nominal World Oil Prices, 1970-2008: Imported Refiner Acquisition Cost



Source: EIA, BLS and TEMS

Even in real terms (See Exhibit 7), oil prices (adjusted for inflation) remained within historic norms up to 2006, when the oil price per barrel was at $70. The price was lower than that in the 1982 Iran/Iraq war when the oil price peak at over $90 per barrel in 2006 dollars. However, after 2006 it is clear that there is a major change in the market with the average 2008 price rising dramatically to $125 in 2006 dollars, and peaking at over $140 per barrel in 2008 dollars.

Exhibit 7: Major Events and Real World Oil Prices, 1970-2008: Imported Refiner Acquisition Cost (Prices adjusted by CPI using June 2008 as a base)



Source: EIA, BLS and TEMS

According to the International Energy Agency (IEA), the recent rise in oil prices reflects the impact of global demand factors. For the first time world demand is considered to have become a significant influence on oil prices and heralded a new oil price equilibrium. For example, Mr. Rick Wagoner CEO of General Motors described the new oil prices as a major dislocation in the world economy to which his firm would need to adjust.[10] It was not considered a temporary impact that, in the case of previous "war driven" oil crises, would slowly subside as peace was restored to the Middle East. Rather, it represented a major permanent structural economic shift that would need to be responded to on a permanent basis, representing not a temporary shortage of supply but long-term growth in world demand that existing world supply could not meet.

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[10] H. Schneider. "GM Closing 4 Truck and SUV Plants in North America." washingtonpost.com. June 3, 2008

3.2 THE FUTURE RANGE OF OIL PRICES

From the review of discussion and historic data on oil prices, it is clear that there is much uncertainty about how oil prices may change in the future. To evaluate how the potential range of oil prices might affect the transport industry, three potential scenarios[11] were developed. These include a low (optimistic) case, high (pessimistic) case, and a central case.

In order to prepare these scenarios the following procedures were used. First, historic data from years 2000 to 2007[12] were derived from the Energy Information Administration (EIA database). In addition, forecasts from the EIA Short Term Energy Outlook (2008-2009)[13] were used that reflected recent price increases for the first six months of 2008. This established new forecasts for years 2008 and 2009. Second, in order to develop long-term forecasts, the growth rates developed by the EIA for long term central, high, and low case scenarios were used.[14] The EIA average annual growth rates were linked directly to the July 2008 short term values, and forecasts were generated to 2020 for the central, high, and low case scenarios. The forecasts are shown in Exhibits 8 and 9 in both nominal and constant (2008) dollars. To develop the nominal dollar estimate for the prices of oil, the constant 2008 dollar values were inflated by an inflation rate of 3 percent per year.

Optimistic Scenario (Low Case): Under the optimistic view or low price scenario, new oil supplies and substitutes are gradually brought on line (i.e., over 2-3 years) and then oil prices fall to a new higher equilibrium level of $60-80 per barrel. This reflects the fact that supply conditions improve and that an increase in supply will return the economy to a moderate or high growth strategy. While conditions will not be as advantageous as they were in the 1990's, increased oil supplies and improved energy use productivity result in a new equilibrium level for the economy that will operate very efficiently with oil costs only double or triple what they were in the 1990's. This scenario is similar to what happened after the Iran-Iraq war when oil prices peaked at $97 compared to the $140 recently experienced. The difference with that situation is that oil returned to $20 - $30 per barrel after five years of a steady fall, instead of halting at a higher level of $60 - $80 per barrel forecast under this scenario. This scenario assumes that OPEC would expand output so that it's nearly keeping pace with the expanding demand in China and India so that while world demand is high, so is supply. As a result, the ability to stabilize oil prices even at a new higher equilibrium price floor will lead to renewed growth in the economy and a gradual rise over 3 to 5 years in GDP growth to the 1990's levels of 3 to 4 percent per year.

Pessimistic Scenario (High Case): Under the pessimistic or high price scenario, the expansion of world demand is so strong that the new equilibrium level will be consistently rising to over $200 per barrel, and that this change is likely to be permanent, and specifically, due to the growth of Asian and Latin American markets. In this scenario, it is envisaged that despite OPECs best efforts to expand production, the use of supply substitutes, and efficient energy use, it is still not possible to keep world oil production up with expanding world demand for oil. Rising long-term oil prices dampens the U.S. economy's ability to grow so that growth rates moderate to 1 to 2 percent per year as increasing oil prices almost completely absorbs much of the productivity gains and growth of the economy. While living standards rise, such slow growth will reduce the dynamism of the economy and its ability to rebuild itself every ten to twenty years.

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[11] Prepared by TEMS using EIA historic data and projections.

[12] The historic data for 2000-2007 is taken from Energy Information Administration (EIA) website. (http://tonto.eia.doe.gov/dnav/pet/pet_pri_rac2_dcu_nus_m.htm).

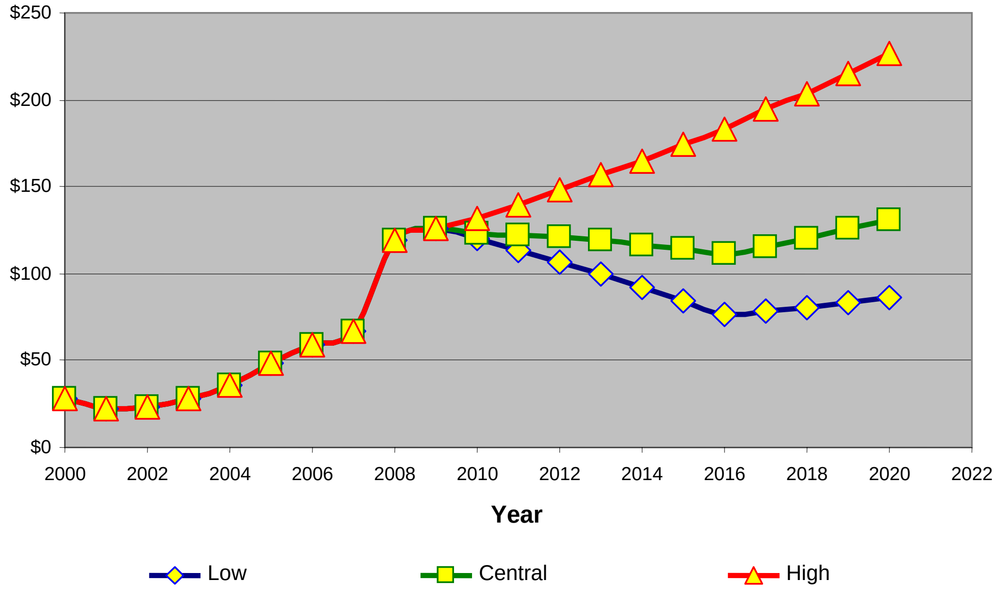
[13] Data for 2008-2009 are obtained from EIA Short Term Energy Outlook, July 8, 2008, (http://www.eia.doe.gov/steo).

[14] Long-term forecast for years 2010-2020 was prepared by using growth rates assumed by EIA in accordance with three scenarios - low, reference and high. (See: Annual Energy Outlook 2008, June 2008 Table 12, http://www.eia.doe.gov/oiaf/aeo/index.html). EIA growth rates were applied to the 2009 numbers obtained in step 3. Annual inflation rate of 3.0% was assumed in order to transfer data into nominal prices.

In the worst case, the U.S. may suffer from the "European disease" of a "mature economy," or the "Japanese disease" of stagflation.

Central Scenario (Middle Case): As a result, we have two very different perspectives on oil prices as shown in Exhibit 8. A third, central scenario would be a stable or slightly falling set of oil prices based on the idea that increasing world demand will strain existing oil supplies, but that new substitutes would gradually become available (e.g., ethanol based on sugar cane/biomass), and new oil finds will be brought on line such as the recently U.S. Geological Survey announced Bakken oil finds in North Dakota, Montana, and southeastern Saskatchewan.[15] This suggests an intermediate course that would fall between the optimistic and pessimistic cases. However, this scenario will see long term oil prices at least quadruple in nominal terms what they were in the 1990's. In this scenario, the pace of the economy quickens after two or three years of very low growth reflecting the current slowdown. Increased growth results from increased oil production, substitute fuels, and energy use productivity, which gradually outpace growth in world demand for oil. This leads to stable or slowly falling oil prices at $100 to $120 a barrel by 2016 in nominal prices, but remaining under $100 per barrel in 2008 prices. After six to ten years of 2-3 percent GDP growth, the new equilibrium oil price of $90-$100 enables U.S. economy to increase 3-4 percent GDP growth per year. This middle-case equilibrium price for oil reflects the balance between OPEC and the world oil production capability, and the expansion of world demand. It assumes major gains in energy supply, the development of substitute fuels, and improved energy use productivity (e.g., higher fuel-efficiency standards for automobiles), not just in the U.S., North America, and Europe but in Asia as well.

Exhibit 8: Crude Oil Nominal Prices - Annual Averages (Imported Refiner Acquisition Cost per Barrel)



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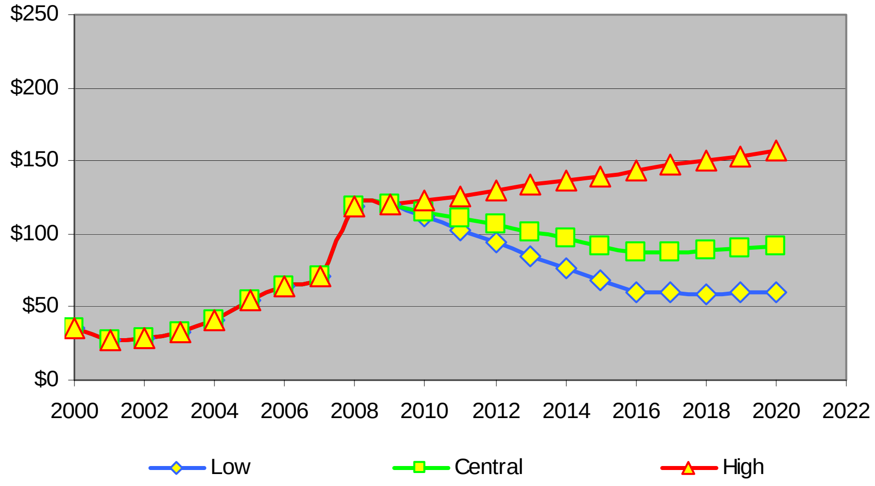
[15] U.S. Department of the Interior. U.S. Geological Survey. April 10, 2008. www.usgc.gov. It is estimated that from this 3.6-4.2 billion barrel oil field (which represents an increase of 20 percent in current U.S. reserves), oil can be produced at $16-$20 per barrel and be completely marketed at prices of $40-$80 per barrel.

Exhibit 9: Crude Oil Constant Prices - Annual Averages (Imported Refiner Acquisition Cost per Barrel)



4

POTENTIAL IMPACT OF OIL PRICE SCENARIOS

4.1 OIL PRICE SCENARIOS

The analysis of oil price scenarios shows clearly that the operating costs of transportation systems that support U.S. ground transportation have fundamentally changed. At a minimum, U.S. transportation systems face a doubling of fuel costs compared with the equilibrium conditions of the late 1990's, and in the worst case a six-fold to eight increase by 2020. The most likely central scenario would be a quadrupling of prices by 2020.

Under any of these conditions, the impact on transportation is very significant with quite radical responses in logistics chains and intermodal competition to be expected. All oil price scenarios result in significant changes in U.S. logistics and the role of ports, highway, rail, and water infrastructure in meeting national transportation requirements. In consequence, it is important to understand specifically how oil prices will impact:

- National transportation trends and requirements
- Corridor specific changes

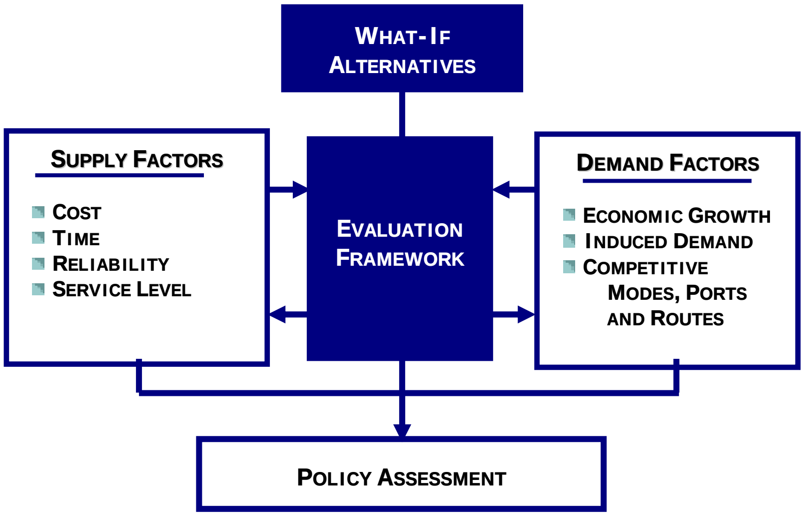
4.2 EVALUATION PROCESS

A micro-economic evaluation framework provided a basis for assessing the "elasticities" associated with providing different levels of service in the different corridors. To define elasticities, a supply and demand analysis is required that shows the equilibrium response of demand to any given set of supply conditions. It is critical to measure elasticities at equilibrium since elasticities can change dramatically for quite small changes in the levels of service provided by any mode. For example, service frequency elasticities change dramatically as water service increases from one vessel call per week to eight calls per week (-0.95 to –0.1). As well, different elasticities apply to either increasing or decreasing services or costs. As a result, the final form of the structure depended on final corridor and route definitions, but the evaluation framework should provide a basis for comparing alternative logistic structures and the ability to provide a competitive service in each corridor. To meet this requirement, both the supply side and demand side factors were evaluated within a "what-if" framework.

The what-if framework contains three major components:

- Economic scenarios and transportation strategies – what-if alternatives
- Demand model factors and systems
- Supply model factors and systems

Exhibit 10: Evaluation Frameworks



The structure shown in Exhibit 10 allows the character of demand for the transportation system to be tested under a range of different economic or transportation price (time, cost, etc.) alternatives. As a result, the model can be used to perform sensitivity tests of oil price potentials. This is done by developing modal transportation networks for each region that include higher oil prices forecast under the optimistic, central, and pessimistic case oil price scenarios described above.

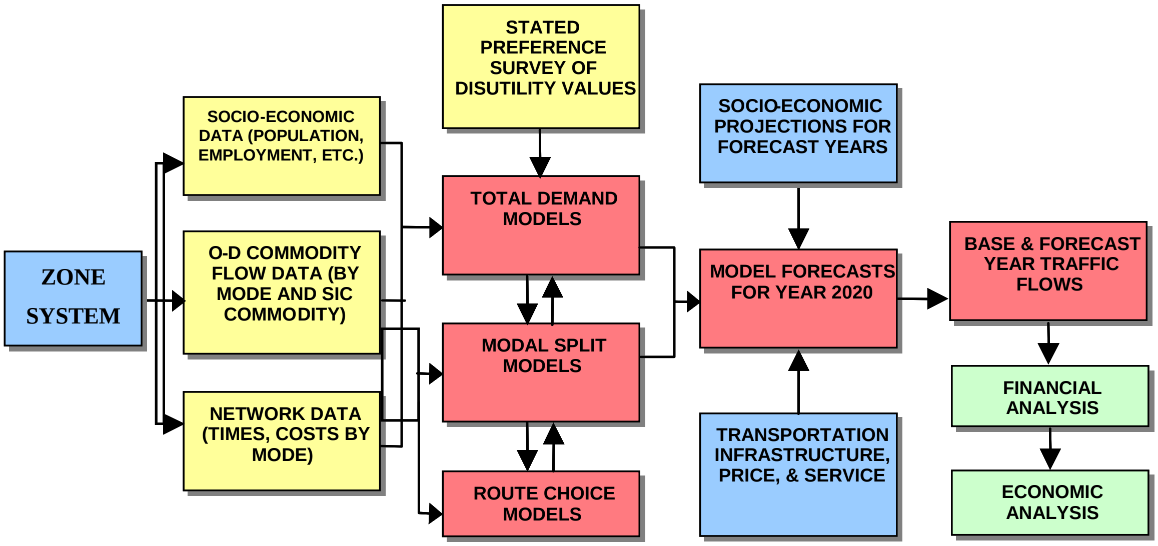
For each of the five corridors defined in Exhibit 1, demand and supply for freight shipments was set up in TEMS' GOODS™ model by defining on the supply side the required input Truck, Rail and Maritime networks, with costing coefficients appropriate to the scenarios being tested; and by loading on the demand side an origin-destination traffic database that was primarily derived from USDOT Freight Analysis Framework (FAF) data. The traffic database, however, was augmented with Bureau of Transportation Statistics data on cross-border flows and with Transport Canada data for Canadian domestic flows in the GLSLS (Central Canada) region, and other TEMS statistics. The GOODS™ model was then run for each corridor and forecast scenario to develop Base Line (2005) and fuel price sensitivity scenarios.

The basic calibration of the model is designed to identify the potential for waterborne transportation capture of containerized traffic, which normally requires a truck pickup and delivery at each end of such moves. However, there may be additional traffic potential for development of water feeder services to specific ports. This type of analysis requires more port-specific data than is generally available in the FAF data, which takes an overall metropolitan area view. However, as will be discussed later, it may be possible to identify a potential for development of additional feeder services, particularly on the East and West Coast, through a follow-up analysis of port specific data.

4.3 ANALYSIS METHOD

For each corridor, an analysis of the potential oil price impact was accomplished using the GOODS™ demand and supply model (See Exhibit 11). This model was originally developed for the Great Lakes and St. Lawrence Seaway Study carried out by the Maritime Administration (USDOT) and Transport Canada for the New Cargoes/New Vessels Market Assessment as part of the Great Lakes – St. Lawrence Seaway Study. The model was subsequently used for the Panama Canal Route Choice study, as well as for regional studies (e.g., Northeast Freight Study for USDOT's Federal Railroad Administration). The GOODS™ model sets up a supply and demand analysis for freight transportation in each corridor being examined.

Exhibit 11: GOODS™ Demand Model



4.4 SUPPLY SIDE ISSUES

The GOODS™ model uses a generalized cost (GC) framework for assessing the factors that are most directly relevant to shippers' and carriers' decisions for routing freight. A GC metric incorporates all of the critical factors that motivate shippers and carriers to use a particular route, mode and shipment type. This GC framework focuses on four main factors: *Transit Time, Shipping Cost, Frequency* and *Reliability* to reflect shippers' choice behavior. The generalized cost of shipping is typically defined in shipping time (i.e., hours) rather than dollars. Costs are converted to time by applying appropriate conversion factors, as shown below. These conversion factors, VOT_{mp}, VOF_{mp}, and VOR_{mp} are based on the results of stated preference surveys, showing how shippers value each of these components of generalized cost (GC). The generalized cost of shipping between zones i and j for route m and commodity p is calculated as follows:

$$GC_{ijmp} = TT_{ijm} + \frac{TC_{ijmp}}{VOT_{mp}} + \frac{VOF_{mp}\,OH}{VOT_{mp}\,F_{ijm}\,C_{ijm}} + \frac{VOR_{mp}\,\exp(-OTP_{ijm})}{VOT_{mp}}$$

Where:

TT_{ijm} = Shipping Time (in hours) between zones i and j for route m
TC_{ijmp} = Shipping Cost ($) between zones i and j for route m and commodity type p
VOT_{mp} = Value of Time ($/hr) for route m and commodity type p
VOF_{mp} = Value of Frequency ($/hr) for route m and commodity type p
VOR_{mp} = Value of Reliability (%/hr) for route m and commodity type p
F_{ijm} = Frequency in departures per week between zones i and j for route m
OTP_{ijm} = On-time performance (%) for shipping between zones i and j for route m
OH = Operating hours per week

The first term in generalized cost function is the shipping time.

The second term converts the cost of shipping into time units.

The third term in the generalized cost equation converts the frequency attribute into time units. Operating hours divided by frequency is a measure of the headway or time between departures (e.g., once or twice weekly). Tradeoffs are made in the stated preference surveys resulting in the value of frequencies on this measure. The third term represents the impact of perceived frequency valuations on generalized cost.

The fourth term of the generalized cost function is a measure of the value placed on reliability of the route. The negative exponential form of the reliability term implies that improvements from low levels of reliability have higher impacts than similar improvements from higher levels of reliability.

Generalized costs are developed for each origin destination pair, based on the aggregate time, cost, frequency, and reliability characteristics of all the links that make up a route. The following describes each of the key inputs that are captured by the GC formulation.

Price

Line Haul: A key feature of any supply chain is price. Typically, water transportation has been able to offer the lowest line-haul price. Although price dominates bulk transportation, it is far less important in the movement of container traffic where transit time and a wide range of other service variables play a major role.

In the case of bulk traffic, given the volumes involved, shipper concerns focus on the lowest rate per ton. In the case of container traffic, by comparison, the main focus is on transit times and the ability to reach certain markets by a given deadline. Faster transit times allow a higher price to be charged. Clearly, faster transit times that are competitive with rail and truck can attract a price similar to that of rail and truck and dramatically increase revenues per ton-mile.

Since water options generally offer longer transit times than rail or truck, the ability to offer lower prices is critical to their success. This means that from an operating cost perspective, the water mode must be lower-cost than rail (including the cost of port or terminal handling) wherever the rail option is present, as it is for most proposed short-sea shipping lanes. As a result, it will be important for vessel operators to maximize economies of scale by using vessels that are both large and fast enough to be able to offer a competitive service in the marketplace.

In this study, fuel is an important component of operating cost and so the impact of rising fuel costs on each mode was evaluated for each of the three oil price scenarios.

Access/Egress/Terminal Costs and Time: The experience of both rail and water transportation providers is that access, egress, and port/terminal dwell time along with drayage are very expensive components of both shipment cost and time, and can rapidly reduce the viability of a service. For example, the reason for development of the Alameda Corridor in California was the need to reduce dwell time, access/egress, and drayage times for the ports of Los Angeles and Long Beach. The congestion and delays associated with getting from both ports across Los Angeles was such that shippers were willing to pay as much as $17 per box for improved service.[16]

The costs of access/egress and terminal time were modeled by including "centroid connector" links in the network definition. These links connect the traffic zone origins to the ports and include a cost for both local trucking and port charges. Such access costs can be significant, especially for a short-haul service, and comprise a large percentage of the overall shipping cost.

The impact of short-haul trucking or drayage cost is not often understood, but it forms a key component in establishing the viability of intermodal rail as well water services. The problem is that loaded drayage moves are often not balanced so the backhaul must return empty. Up to six trucking moves can be required to get one loaded trailer to and from its destination, as follows:

- Truck from Depot to Port to pick up loaded container (bob-tailing)
- Port to Customer (loaded)
- Customer back to Depot (bob-tailing)
- Depot to Customer to pick up empty container (bob-tailing)
- Customer to Port (empty)
- Port back to Depot (bob-tailing)

Under these circumstances it is not unusual for drayage to cost anywhere from three up to six times the normal over-the-road trucking rate. This factor plus the port handing cost impose a minimum distance threshold, which in rail is thought to be 700-1,000 miles before the efficiency of the line-haul offsets the added cost for the drayage and port handling charges. For domestic intermodal services, another effect of high-cost truck drayage is to generally limit their effective service areas to immediate port hinterlands, usually in the range 30-50 miles around a port, because trucking costs are just too high for collecting traffic from beyond that range.

Transit Time

In a just-in-time economy, transit time has become the prime factor in shippers' decisions for container traffic. Improved transit time, therefore, has a strong relationship with the ability of the water mode to attract container traffic. This can happen in several ways: water transit time can be improved relative to other modes because of the improved operation of the ports and waterway system; by the use of new and faster vessels; or as a result of increased time and cost for other modes as due to congestion, capacity delays, and higher fuel prices. In each case, the relative difference between water transit time and its competitor's transit time must be significantly reduced for water intermodal service to be an effective option. For example, nowadays it takes about ten days for a ship to go from one end of the Great Lakes and St. Lawrence Seaway (GLSLS) system to the other. Critical bottlenecks include the Montreal-Lake

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[16] "Expanded Preliminary Model – Alameda Corridor". Transportation Economics & Management Systems, Inc. March 1993.

Ontario section, which has a 22- to 24-hour average transit time, and the Welland Canal with an 11-hour transit time. For bulk freight such as grain, iron ore, coal, and steel, these times are both reasonable and competitive given the volume of cargo involved. However, for container or palletized products – the typical way to move manufactured products – these time scales are generally unacceptable. Since the gap between water service for bulk freight and its competitors is currently three to four days of transit time; water service for containerized freight would probably need to be improved to within one or two days, at the most, to become an effective shipping option. What this means is that fast ships operating in the 18-22 knots speed-range will likely be required to compete with surface transportation in short-sea lanes. Technologically, sailing speeds in this range are not a problem for modern vessels.

Frequency of Service

The frequency of service is often a critical factor in a shipper's decision to use a particular transportation option. On Europe's Rhine/Danube River System, container traffic barges are scheduled to ensure that required frequencies are being met and that their reliability is improved. It is likely that frequency will be a critical factor for any short-sea shipping service where a minimum daily service level will be essential to attracting shippers and new cargoes. In contrast, weekly service is considered to be the norm for international shipping lanes.

Reliability

The new economy of the 21st century is entirely dependent upon reliable transportation service to support the just-in-time manufacturing and processing of modern industry. Improving reliability significantly improves the ability of any short-sea shipping service to attract container traffic. Reliability needs, therefore, to be built into the supply model.

Other Factors

Several other factors are not explicitly included in the Generalized Cost equation but are reflected in the "modal bias" constant factors that result from the calibration regressions.

Seasonality: A key issue for water transportation system is seasonality. This concern applies mainly to the GLSLS system where, over the last quarter century, its St. Lawrence Seaway component has typically opened in late March and closed in late December, a period of 274 days, or more than 9 months. While the months of January to March are typically some of the slowest for manufacturing and, in particular, the retail industry, the inability to offer any service at this time has been perceived as a major limitation.

The impact of closing the GLSLS System for three months is that shippers and carriers will look for other alternatives. Once they find those alternatives, build relationships, negotiate contracts, and develop a dependable logistics chain it is difficult to see why they would return to the GLSLS. To evaluate the impact of seasonality, specific shipper and carrier input is required that shows the "disruptiveness" of the seasonality issue, how it affects costs and the penalty associated with forcing shippers to use alternative rail and truck options. Shippers and carriers are looking for seamless logistic systems negotiated for a given business cycle. One possible alternative is for the GLSLS to develop partnership arrangements to mitigate this issue, as was proposed in TEMS' earlier New Cargoes/New Vessels Market Assessment.

Security: Before containerization, pilferage from all forms of transportation was a problem. As a result of containerization, moving goods became more secure and the level of pilferage diminished. Although the use of containers has enhanced shipment security, the level of security between different modes of transportation may not be the same, which can be a significant shipping issue. In general, shippers regard water transportation as a safer mode than rail and truck, and this perception could be an advantage in the movement of some specific kinds of freight, such as hazardous materials or waste.

Shipment Characteristics: Cargoes have special characteristics that make them more or less subject to transportation restrictions on certain modes. For example, hazardous materials or cargo requiring refrigeration both often have special handling cost implications and modal restrictions. Hazardous materials might be banned from critical bridges and tunnels, and waterborne transport is also generally superior to other modes in terms of its ability to handle very large or wide "dimensional" loads that may simply be too large or heavy to fit through existing highway or rail bridges or tunnels.

Capacity: An increasingly important factor in shipping decisions in the future will be system capacity. This factor generally reflects indirectly through the transit time and reliability factors associated with the service. It is anticipated that supply side limitations including labor (trucking industry) and infrastructure will make existing distribution systems less cost effective and physically limited in what they can carry. As a result, capacity issues need to be considered for their impact on transit times and reliability, which are expected to worsen in the future for highway transportation. However, the forecasts produced for this assessment assume base-year reliability and parameterize fuel cost only, which makes them conservative with respect to future forecast years.

Conclusion: The supply side model needs to be able to faithfully replicate these factors in freight shipping decision-making and to show the impact of changing any one of the factors on the supply chain and overall modal efficiency.

4.5 DEMAND SIDE ISSUES

On the demand side, a number of market issues need to be assessed in the analysis. These include –

Changes in Market Size Due to Economic Growth

Over the next twenty to thirty years, if current trends continue, the freight volumes will increase by at least 70 to 100 percent. Recent Statistics Canada, U.S. Bureau of Commerce, and OECD data show trade volumes increasing rapidly from the early 1980's along with the increasing integration of the world economy. For example, U.S. exports increased 63 percent in the ten years from 1992-2002, while U.S. imports grew 138 percent over the same time period, according to the U.S. Bureau of Economic Analysis.[17] The existing infrastructure will find this difficult to handle due to capacity limitations and, once existing modes reach full capacity, cargo will seek new opportunities to reach markets. At this point, short sea shipping will become more competitive and more attractive for container traffic. Assessing the impacts of higher oil prices on total demand requires consideration of how macroeconomic factors will impact supply chains. Initial indications have suggested that imports may decline, but both domestic production and exports may go up as a result not only of oil prices, but also currency shifts. This suggests that imports may level off as production shifts back to the United States. But as a result of this same shift, the domestic freight market may be expected to continue to grow rapidly, and it appears likely that a more competitive short-sea shipping mode due to its greater fuel efficiency could capture at least some of this growth.

Because of the current uncertainty surrounding economic and traffic growth forecasts, however, this report based its projections on the historical Freight Analysis Framework (FAF) traffic levels and will focus primarily on identifying the prospects for market share shift between direct trucking and rail and water intermodal services. The FAF database itself relies heavily on the Commodity Flow Survey (CFS) data but was selectively enhanced using other data sources prior to public release. In addition the base year data was augmented with Canadian and cross-border data for the GLSLS New Cargoes/New Vessels study, so the database reflects the best available source for assessing the traffic that might potentially be available to a new water shipping system.

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[17] U.S. Bureau of Economic Analysis of Current Business. April 2003.

Impact of Market Accessibility on Total Demand

As existing freight options reach capacity, new routes will open. If these new routes prove not to be as competitive as existing routes, this will reduce the size of the overall market. Significant distributional impacts might follow. Conversely, once the minimum volume threshold required to support short-sea shipping services has been attained, shippers will have additional competitive options for transporting their goods. While demand for transportation services is largely derived from the needs of the agricultural, manufacturing, and service industries, a less competitive transportation market will reduce the total demand for shipping freight across all modes of transportation while a more competitive transportation market makes the overall market larger. This is due to the impact the competition has on the costs of transportation and the overall pricing of products. The demand model in conjunction with the supply model must be capable of determining the appropriate level of demand at equilibrium (i.e., the balance of market price and supply costs).

Level of Modal and Route Competition

The competition between different modes of transportation and routes was assessed by a comparison of their relative performance as measured by transit time, price, frequency, etc. Changes in the relative performance of a mode or route will make it more or less competitive. The size of a given mode's market share is proportional to its relative competitiveness as measured by its performance compared to other modes. In evaluating route options, the study has considered the potential changes in trade with Asia, the increasing role of south and west Asia, and the potential for Asian traffic to the Midwest and central Canada to divert to Atlantic routes via the Suez Canal.

Capacity Constraints and Traffic Shifts

The impact of mode, route, or port capacity constraints on ports, railroad, and trucks can cause a fundamental shift in the competitive advantage of the modes. If the relative performance of today's port and inland transportation distribution system worsens due to increased fuel prices or capacity constraints, short sea shipping could become an overflow option for the truck and rail services.

Conclusion: Analysis of the demand side factors was undertaken using a model that provided a mechanism for evaluating the full supply chain of each mode and set of modal service options. This showed the relevance of each component of the supply chain to a shipper or carrier's decision-making process, which was assessed in an earlier study with stated preference surveys that allow the strengths and weaknesses of each service/supply chain option to be evaluated. The demand-side analysis showed not only how competitive the existing shipping services are, but also how they need to change in order to attract new cargo. In this way, the thresholds that water services need to reach to achieve their potential market shares have been identified and the actual potential of achieving the threshold defined.

5

THE IMPACT OF OIL PRICES ON TRANSPORTATION COSTS

5.1 OVERVIEW

In general, transportation systems will adjust to fuel price changes by passing through the added costs to their customers. In an environment of contract rates, fuel surcharges that allow for short-term rate adjustments have been implemented by a number of carriers. However, it must be noted that firms are only able to price "according to what the market will bear." This means, for example, that in a competitive environment such as that for transcontinental double-stack intermodal service, railroads will consider rates based on what *ocean* carriers charge for an all-water movement to the East Coast, rather than based solely on their own cost. In these cases, transportation systems may not be able to pass on the full cost of the fuel increases, and so must seek efficiency gains to remain viable. As a result, a fuel price increase may result in a wide range of impacts depending on just how much of the increase can be passed on to consumers.

The key results of the analysis show that:

- Large fast vessels, such as the 22-knot, 342-FEU (GLSLS-max) RORO's considered by the earlier New Cargoes/New Vessels (NC/NV) Market Assessment, can maintain competitive parity with rail intermodal service and present a strong opportunity for diversion of truck traffic, through the development of appropriately structured, water intermodal services.
- Small and/or slow vessels, such as the 90-FEU European "Coaster" design considered by the earlier NC/NV study, are not rail-competitive. These vessels could divert some truck traffic or serve as short-distance feeders, but overall, such vessels were not competitive to rail before the fuel price increases, and become even less so after the increases.
- On shallow inland waters, COB is the most energy-efficient mode. As such, it may see the development of some container traffic as the differential between COB costs and those of other modes, continues to widen.

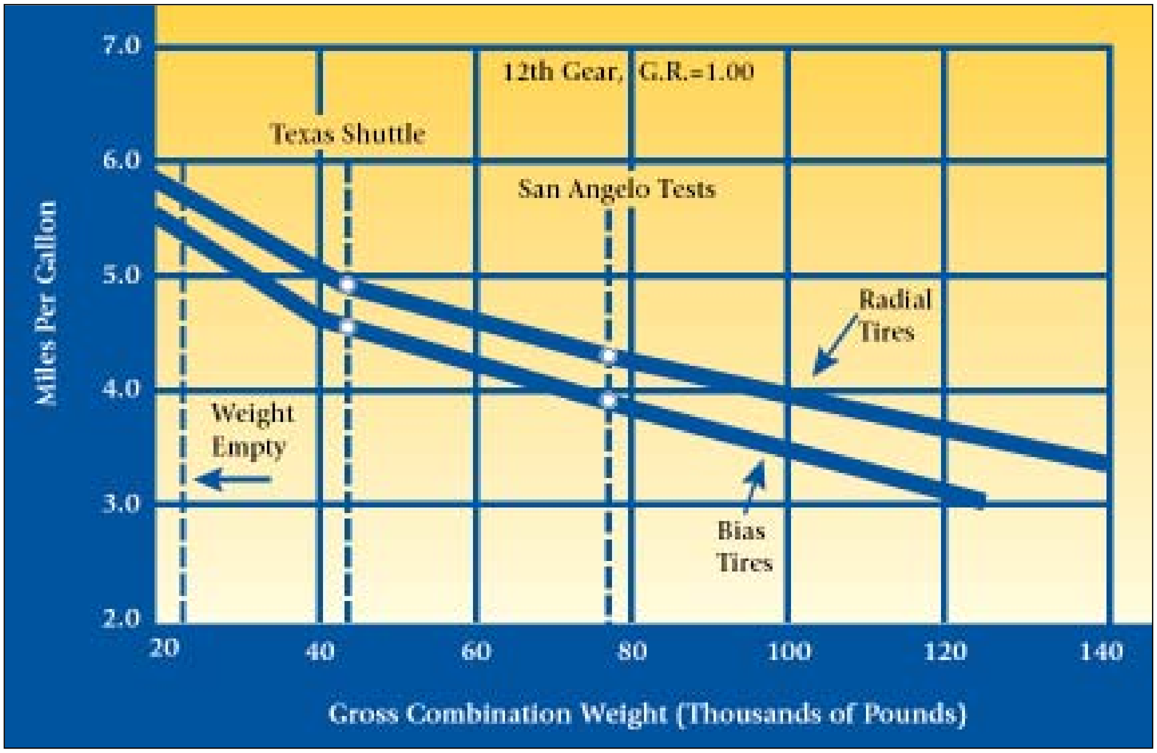
Because the main focus of this study is on the development of coastal short-sea shipping, in general the vessel technology assumptions and costing approach employed here are consistent with that of the earlier GLSLS NC/NV study. This discussion focuses on the cost impacts of fuel cost increases for the various types of technologies that would be appropriate for deployment on short-haul Intermodal lanes. However, the comparative economics of larger ships that are used in the main international trade lanes will also be discussed as it impacts the market for movement of goods within the U.S.

This chapter is organized as follows: first, there is a discussion of the impact of fuel price increases on the efficiency of each individual transport mode: truck, rail, and water; then these results are integrated together in a Competitive analysis section that identifies the impacts across the modes.

5.2 TRUCKING EFFICIENCY

The trucking sector is highly sensitive to fuel price increases. Truck fuel consumption is highly sensitive to vehicle weight, as shown in Exhibit 12. An empty truck can get 6 miles per gallon, but fuel efficiency declines to 3 miles per gallon for a fully loaded truck.

Exhibit 12: Miles per Gallon vs. Truck Gross Weight*



* Source: http://www.goodyear.com/truck/pdf/radialretserv/Retread_S9_V.pdf

In 2005, average diesel fuel prices were $2.40 per gallon; so with a fully-loaded truck getting about 3 miles per gallon, fuel already comprised 80¢ per mile or 46 percent of the trucker's overall operating cost. There is a direct relationship between oil cost per barrel and the cost of diesel fuel, and this allows the trucking cost per mile to be estimated as a function of fuel price. In Exhibit 13, it can be seen that trucking costs rise less rapidly than do fuel costs because capital and labor costs are added to the fuel cost to provide the total Truck costs. This holds true if capital and labor costs remain constant, but in recent years these costs have been rising as well, making trucking cost rise even faster than just the fuel price impact.

Exhibit 13: Line Haul Trucking Costs as a function of Fuel Price

Scenario	$/Barrel	Diesel/Gal	Truck Cost/Mile	Fuel % of 2005 base	Truck % of 2005 base
2002 Historic	$28.85	$1.37	$1.41	53%	80%
2005 Base	$54.79	$2.40	$1.75	100%	100%
2020 Optimistic	$59.61	$2.61	$1.82	109%	104%
2020 Central	$91.03	$3.99	$2.28	166%	130%
2020 Pessimistic	$157.18	$6.88	$3.24	287%	185%

Local pickup and delivery, called “drayage,” is more expensive than normal over-the-road trucking because drayage typically requires many empty miles, as well as non-productive time that a truck must spend at the port, intermodal terminal, and the shipper’s and consignee’s loading docks in the process of picking up and delivering both empties and loads. Typically drayage moves are priced on the basis of 100-percent empty return since it takes at least two round trips to complete the movement of one load. In the typical example used as the basis for Exhibit 14, 72 empty or bob-tailing miles were required to support a one-way loaded movement of 30-miles. Because of this, while over-the-road trucking cost $1.75 per mile in the 2005 base, comparable rates where drayage is involved were quoted in the range of $5 to $10 per mile.

Taking the large number of empty miles into account, as shown in Exhibit 14, drayage costs do not rise as quickly (on a percentage basis) as those for over-the-road trucking. In the 2020 Pessimistic (high oil price) scenario, it can be seen that drayage costs rise only by 66 percent, whereas over-the-road trucking costs rise by 85 percent as fuel costs go up to the anticipated level of $6.88 per gallon. Nonetheless, the cost of a typical movement involving drayage increased significantly in absolute terms. Cost increases of this magnitude, whether for over-the-road trucking or for drayage, put significant pressure on the owner-operator, causing further consolidation of the trucking industry since larger firms are better able to minimize empty movements.

Exhibit 14: Drayage Costs as a function of Fuel Price

Scenario	Loaded Cost/Mi	Empty Cost/Mi	Average Cost/Mi	Total Cost for a 30 Mile Loaded Move	Drayage Per Loaded Mile	% of 2005 base
2002 Historic	$1.41	$1.18	$1.25	$127.28	$4.24	85%
2005 Base	$1.75	$1.35	$1.47	$150.00	$5.00	100%
2020 Optimistic	$1.82	$1.39	$1.51	$154.65	$5.15	103%
2020 Central	$2.28	$1.61	$1.81	$184.96	$6.17	123%
2020 Pessimistic	$3.24	$2.10	$2.43	$248.77	$8.29	166%

5.3 RAIL LINE-HAUL EFFICIENCY

In terms of the direct operating cost that it takes to move a train from point A to point B, rail line-haul costs also show a large sensitivity to fuel, as shown in Exhibit 15.

Exhibit 15: Rail Line-Haul Costs as a function of Fuel Price

Scenario	$/Barrel	Fuel % of 2005 base	Rail Cost per FEU-Mile	Rail % of 2005 base
2002 Historic	$28.85	53%	$0.30	84%
2005 Base	$54.79	100%	$0.36	100%
2020 Optimistic	$59.61	109%	$0.37	103%
2020 Central	$91.03	166%	$0.45	123%
2020 Pessimistic	$157.18	287%	$0.60	164%

In the 2020 Pessimistic scenario, it can be seen that rail costs rise by 64 percent, which is comparable with the trucking cost increase. But in monetary terms the rail cost increase is much less since overall rail costs start from a lower base:

- While rail costs rise by 64 percent, this represents only a 24¢ per FEU-mile increase (from Exhibit 15).
- Trucking costs rise by 85 percent, but this represents a $1.49 increase per FEU-mile (from Exhibit 13).

So in absolute terms, overall rail costs are affected much less by the fuel price increase, reflecting the relative energy efficiency of rail over trucking. In addition, rail costs include a substantial component of terminal operating cost, which are largely fixed; and therefore these costs comprise a greater share of total cost for short hauls, and a lesser share for long hauls. Finally, since railroads have to pay for their own capacity expansion, they need to charge more than just their cost in order to have anything left over for funding capital projects, or return on investment.

As a rule, railroads must price competitively to other modes of transportation and thus, their price increases may be more reflective of other modes' costs than of their own. "As roadway congestion and high fuel prices continue to drive shippers to the railroads, CSX expects its rates to rise 5 percent to 6 percent this year, with only a small portion of that stemming from fuel surcharges meant to offset rising diesel prices.[18]" Accordingly, the assertion in Exhibit 4 that inland distribution costs are likely to rise along with maritime costs is a reasonable one, since for import/export traffic (particularly transcontinental double-stack traffic to the East coast); maritime costs establish the competitive environment within which the railroads must set their own prices for intermodal service.

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[18] "CSX Powers Up", *Railway Age* magazine, May 2008, page 28.

5.4 MARITIME LINE-HAUL EFFICIENCY

Maritime costs are strongly affected by fuel cost, since vessels move comparatively large volumes and are so efficient in terms of crew and capital utilization that fuel still comprises a high percentage of their total operating cost. Vessel operators have a great opportunity to save fuel by slowing down, but slowing down will be difficult for short-sea shipping lanes since they have to compete with surface transportation. Because of the time-sensitive nature of the kinds of loads that would be diverted from trucking, these services will need to maintain or even improve their speed, even at the cost of some fuel.

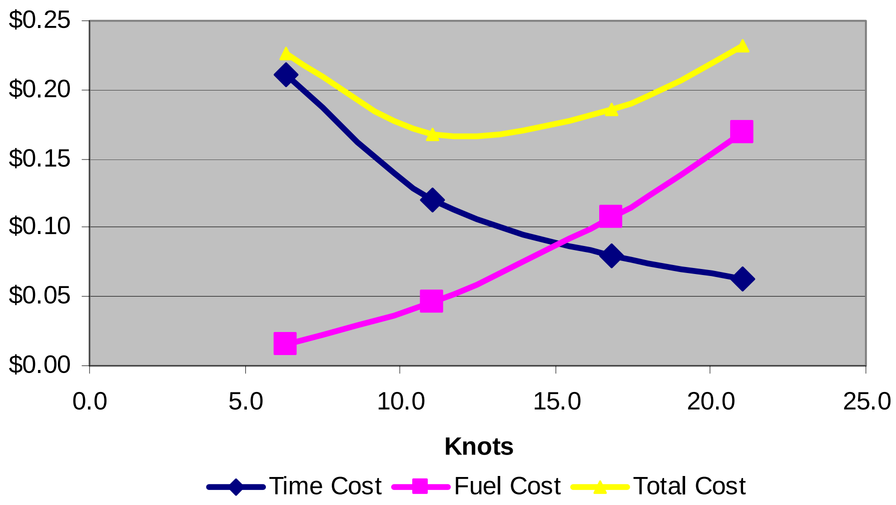
This section presents cost curves, as a function of vessel speed, for two different kinds of ships:

- A 342-FEU GLSLS-max RORO that was developed by the earlier GLSLS NC/NV study.
- A smaller 90-FEU "Coaster" vessel was also considered by the NC/NV study.

Additionally, the impact of fuel prices on Container-on-Barge (COB) costs will also be developed.

Exhibit 16 reproduces the vessel speed versus cost function for the GLSLS-max RORO ship that was developed by the NC/NV study at a time when oil prices were about $55 per barrel. This study found that a GLSLS-max RORO ship would have a line-haul operating cost of just 23¢ per FEU-mile at 22-knots, as compared to rail's cost of 36¢ per FEU-mile. As shown in Exhibit 16, although the minimum operating cost for this vessel occurred at about a 12-knots speed, the vessel was still assumed to operate at the higher speed. This strategy found a "sweet spot" by producing a *cost* and *transit time* combination that could be rail-competitive.

Exhibit 16: GLSLS-max RO-RO Costs, original NC/NV Study, $55 per barrel



Exhibits 17-20 show four other oil price scenarios that are also of interest in this study. Exhibit 17 shows the conditions in 2002 when oil prices were much lower, at less than $30 per barrel, the price of oil during the 1990's. Exhibits 18-20 show the vessel operating cost curves for the three forecast scenarios where oil prices are $60, $90 and $160 per barrel, respectively. Note that all three forecast scenarios are for oil prices that are much higher than they were during the equilibrium market conditions of the late 1990's and early 2000's.

Exhibit 17: GLSLS-max RORO Costs, Historic 2002 Market Equilibrium, $30 per barrel

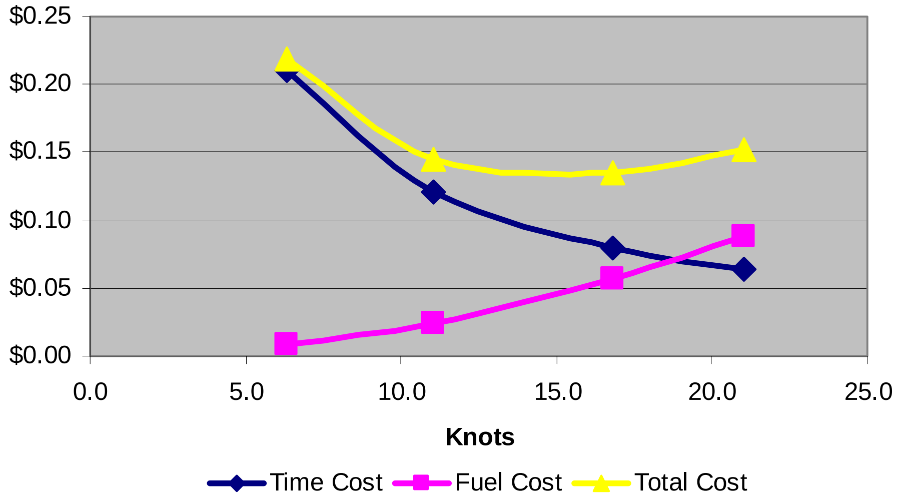


Exhibit 18: GLSLS-max RORO Costs, Optimistic Forecast Scenario, $60 per barrel

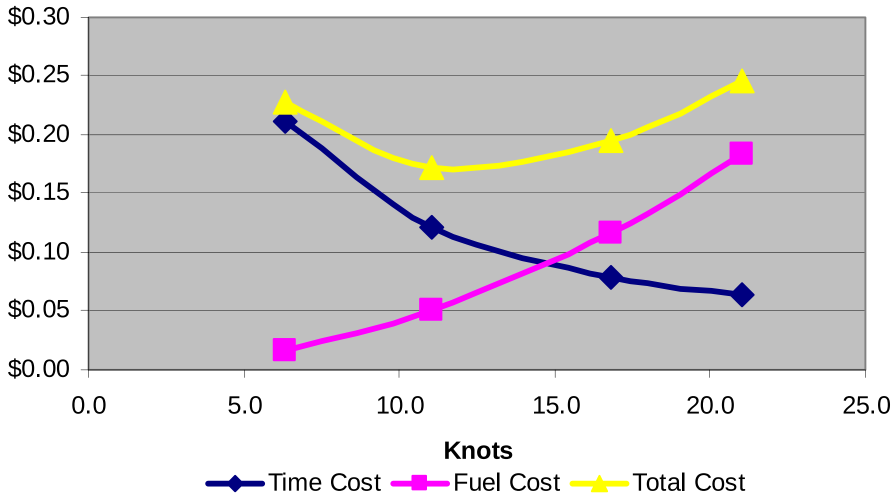


Exhibit 19: GLSLS-max RORO Costs, Central Forecast Scenario, $90 per barrel

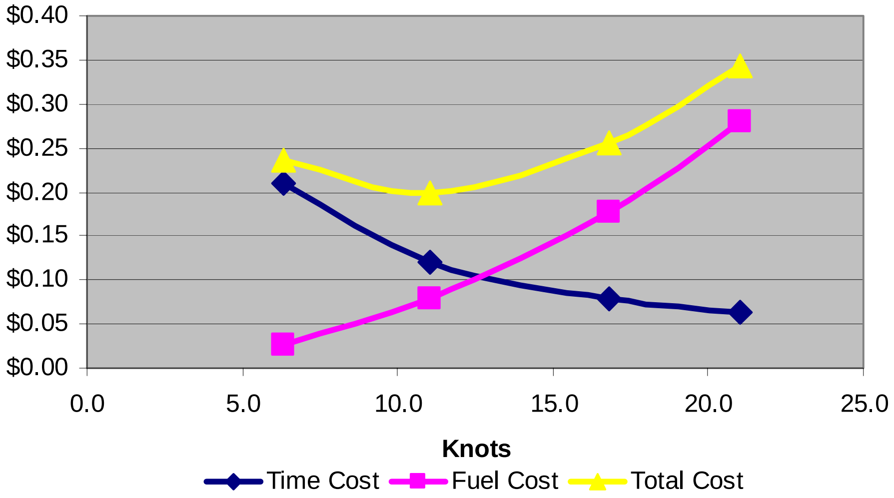
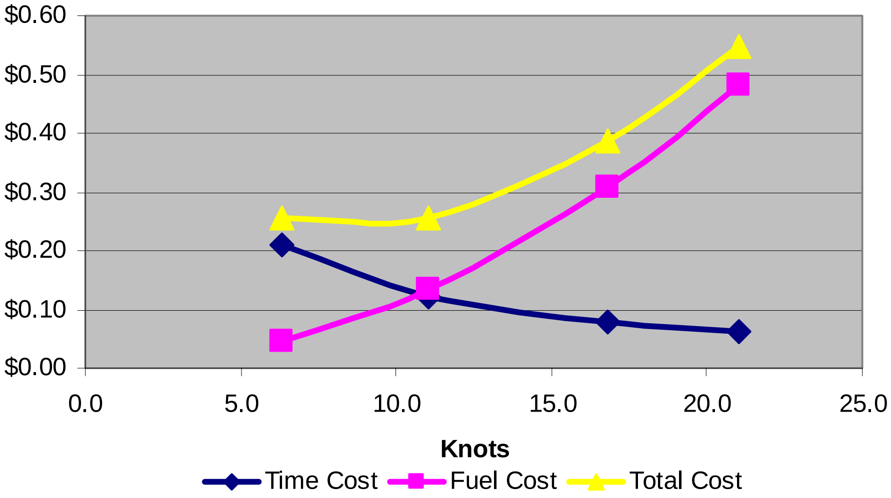


Exhibit 20: GLSLS-max RORO Costs, Pessimistic Forecast Scenario, $160 per barrel



The results of Exhibits 16-20 are summarized in Exhibit 21, which presents the resulting maritime cost projections for a 22-knots GLSLS-max RORO vessel under each of the forecast scenarios. As has been mentioned previously, the cost-optimizing speed declines as fuel prices go up, but this is of little relevance to a vessel service that has to compete with surface transportation modes for time-sensitive traffic. All the costs in Exhibit 21 are based on the full speed 22-knot service that is quite a bit faster than the cost minimizing point.

Exhibit 21: GLSLS-max RORO Costs Summary

Scenario	$/Barrel	Fuel % of 2005 base	RORO Cost per FEU-Mile	Ship % of 2005 base
2002 Historic	$28.85	53%	$0.15	66%
2005 Base	$54.79	100%	$0.23	100%
2020 Optimistic	$59.61	109%	$0.25	106%
2020 Central	$91.03	166%	$0.34	148%
2020 Pessimistic	$157.18	287%	$0.55	236%

In terms of the economics of a smaller ship, Exhibits 22-26 show the speed performance curves for the 90-FEU "Coaster" RORO vessel that was evaluated by the earlier NC/NV study. Exhibit 27 summarizes those results, which show that the GLSLS-max vessel offers considerable economies of scale over the smaller ship.

Exhibit 22: "Coaster" RORO Costs, original NC/NV Study, $55 per barrel

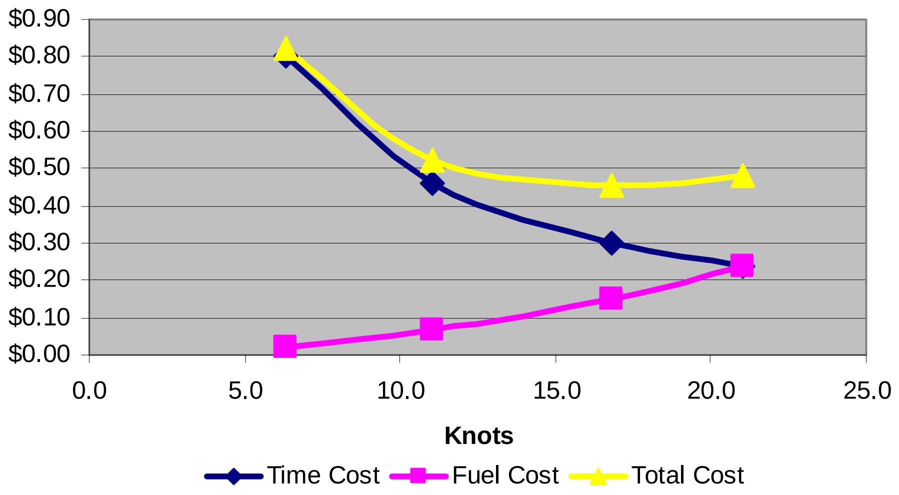


Exhibit 23: "Coaster" RORO Costs, Historic 2002 Market Equilibrium, $30 per barrel

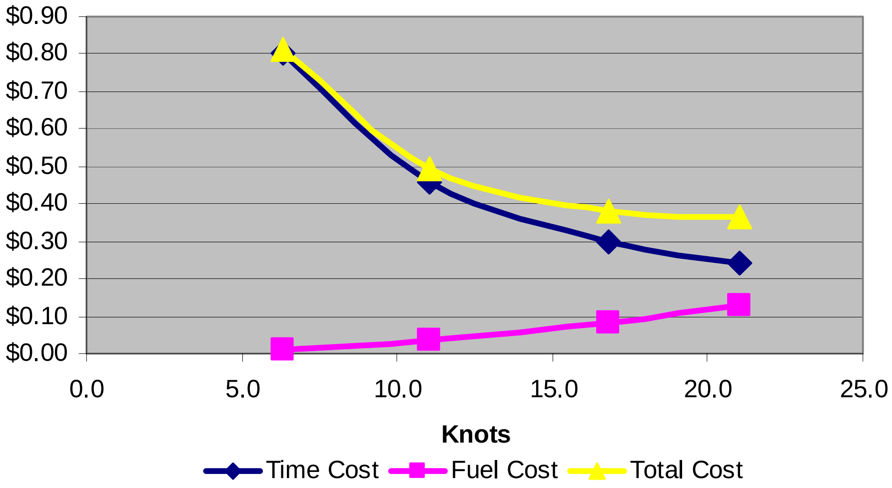


Exhibit 24: "Coaster" RORO Costs, Optimistic Forecast Scenario, $60 per barrel

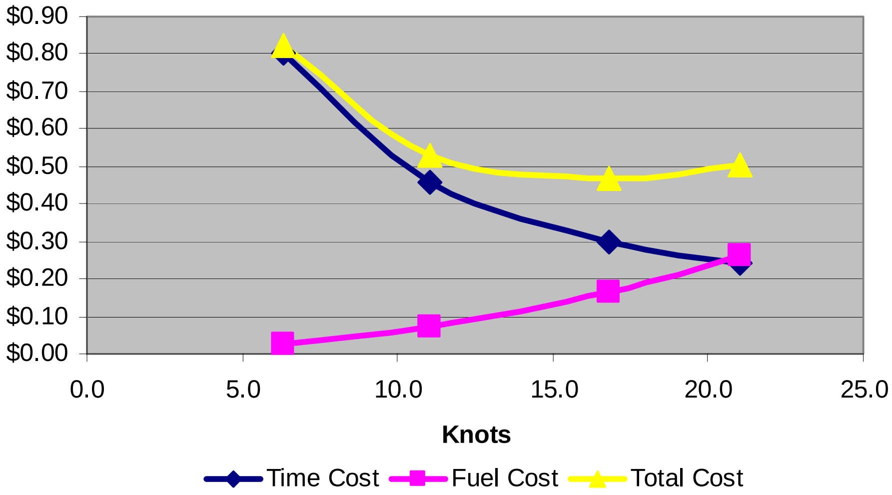


Exhibit 25: "Coaster" RORO Costs, Central Forecast Scenario, $90 per barrel

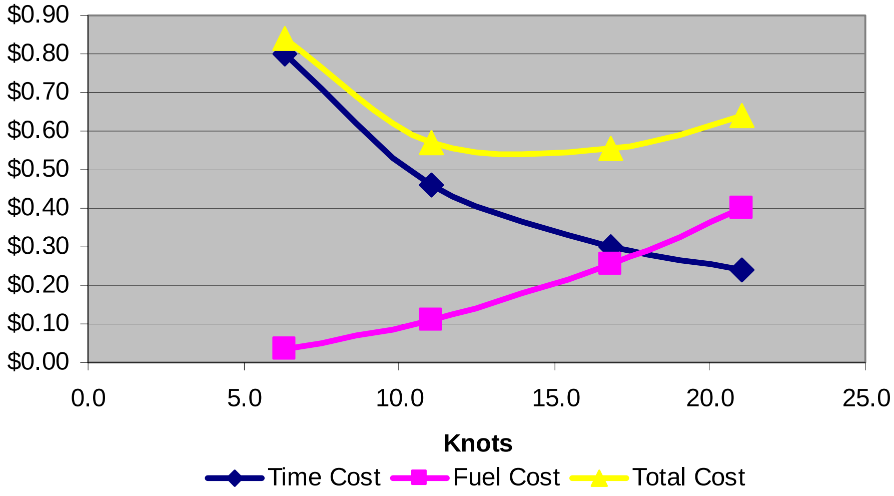


Exhibit 26: "Coaster" RORO Costs, Pessimistic Forecast Scenario, $160 per barrel

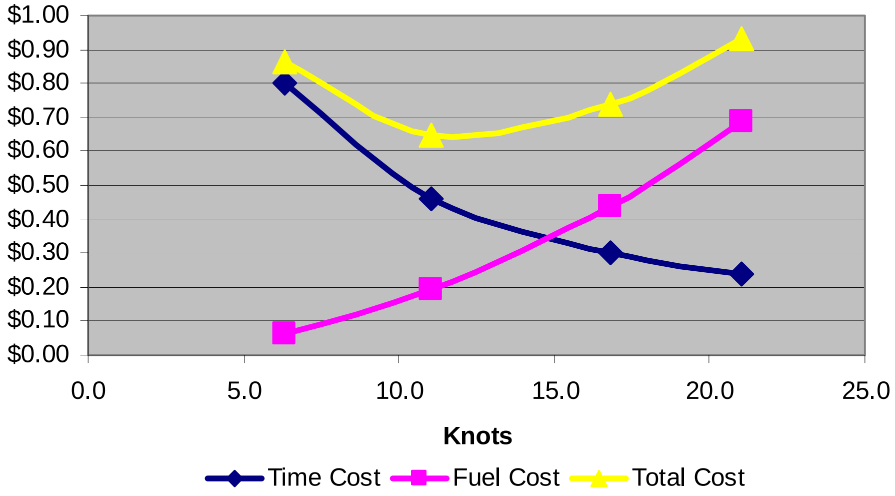


Exhibit 27: "Coaster" RORO, Summary of Vessel Costs

Scenario	$/Barrel	Fuel % of 2005 base	RORO Cost per FEU-Mile	Ship % of 2005 base
2002 Historic	$28.85	53%	$0.37	76%
2005 Base	$54.79	100%	$0.48	100%
2020 Optimistic	$59.61	109%	$0.50	104%
2020 Central	$91.03	166%	$0.64	133%
2020 Pessimistic	$157.18	287%	$0.93	193%

It can be seen in Exhibit 27 that the Coaster RORO costs per FEU are all substantially higher, almost double, those of the larger GLSLS max ship at all levels of fuel price. This differential reflects the improved capital, operating, and energy efficiency of the larger ship, which in turn becomes a key factor in the ability of maritime technology to successfully compete with rail and truck for market share.

Finally, Container on Barge (COB) service, which is one of the few options available for the Mississippi River, is the most energy efficient transportation mode being evaluated. COB shows a surprising insensitivity to rising energy prices. According to MARAD[19], COB can move a ton of freight 514 miles on one gallon of fuel; while rail moves it 202 miles and trucks move only 59 miles. This shows up in the costing models as well, where fuel comprised only 18 percent of COB line-haul cost in Base Year 2005, while it represented 35 percent of rail cost and 46 percent of trucking cost.

Accordingly as fuel prices go up, COB costs rise only a small amount in comparison to the costs of other modes. COB costs rise from 21¢ per FEU-mile in the 2005 Base up to only 28¢ per FEU-mile in the 2020 Pessimistic oil-price scenario. This opens up a huge differential in the cost comparison between COB and that of other modes. In the past the price differential has not been quite enough for shippers to justify the added time that COB service would take. In the future, the differential may be much larger if energy prices continue to rise, making COB service much more competitive.

RORO is suggested for both ship and COB options, because RORO vessels can be loaded and unloaded much more quickly and at a lower cost than crane-loaded vessels. This makes RORO appropriate for short-distance shipping lanes where high port charges could easily overwhelm any advantage that water may have in line-haul efficiency. RORO makes for a more cost effective movement overall because even though its line haul cost has gone up by a little, this added transportation cost is more than offset by the much larger savings in port handling charges.

5.5 MODAL PERFORMANCE COMPARISON

The impact of higher oil prices on U.S. transportation costs is dramatic. Exhibit 28 shows how inland shipping costs change under the low, central, and high oil price scenarios by 2020.[20] In the Central Case scenario with oil prices at over $90 per barrel in 2020:

- Truck costs increase from $1.41 per FEU-mile to $2.28 per FEU-mile, an increase of over $0.87 per FEU-mile.

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[19] See: http://www.irpt.net/irpt.nsf/LinksView/EnvironmentalAdvantages?Opendocument.

[20] The order of modes in the legend goes from most expensive to least expensive mode, respectively.

- Rail line-haul costs rise from $0.30 per FEU-mile to $0.45, an increase of $0.15.
- For COB, the increase from $0.19 per FEU-mile to $0.23 per FEU-mile is only $0.04.

Exhibit 28: Comparison by Mode of Fuel Prices and Line-Haul Costs ($2008)

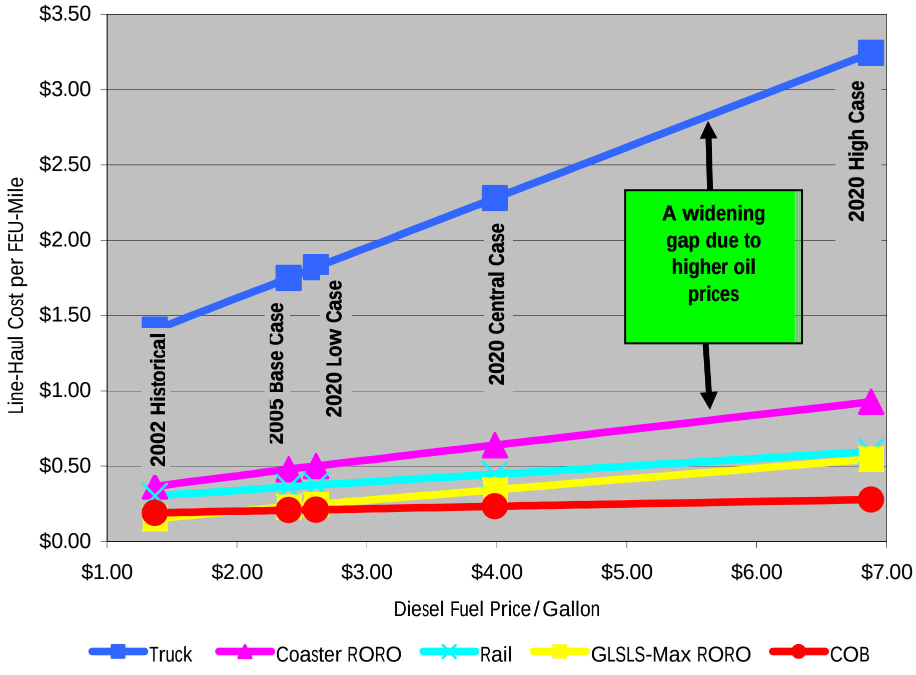
	Fuel Prices		Line-Haul Costs per Container (FEU) Mile				
Scenario	Crude Oil per Barrel	Diesel per Gallon	Truck	Rail IMX*	GLSLS-Max RORO**	Coaster RORO	COB
2002 Historical	$28.85	$1.37	$1.41	$0.30	$0.15	$0.37	$0.19
2005 Base Case	$54.79	$2.40	$1.75	$0.36	$0.23	$0.48	$0.21
2020 Low Case	$59.61	$2.61	$1.82	$0.37	$0.25	$0.50	$0.21
2020 Central Case	$91.03	$3.99	$2.28	$0.45	$0.34	$0.64	$0.23
2020 High Case	$157.18	$6.88	$3.24	$0.60	$0.55	$0.93	$0.28

* Rail IMX is rail intermodal traffic.

** GLSLS-max ships are vessels built to the maximum physical constraints of the St. Lawrence Seaway and other lock restrictions in the Great Lakes.

Exhibit 29 shows the impact of increases in diesel fuel prices on line-haul costs. The fuel-efficient rail and water modes, especially COB, are far less affected by fuel price increases than trucking. The gap between line-haul costs for truck versus rail and water widens as fuel prices increase, such that shippers will be able to realize significant savings by diverting to rail and water.

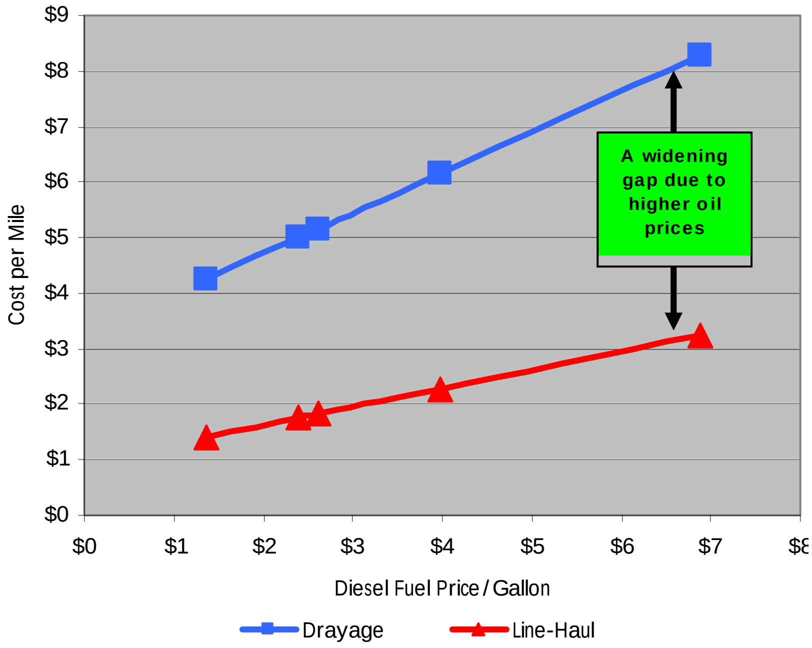
Exhibit 29: Comparison by Mode of the Impact of Diesel Fuel Prices on Line-Haul Costs ($2008)



As a result, the energy-efficient rail and water modes, especially COB are far less affected by fuel price increases than trucking. As a result, shippers can make real savings by diverting freight to rail and water as oil prices rise.

However, an important issue for rail and water modes is the cost of drayage (i.e., the movement from the terminal or port by truck to the final consignee), and like other trucking costs, drayage costs rise significantly with the price of oil. Drayage charges are very high as there is frequently no back haul and trips involve extra time for pickups and delivery, both at ports and at the customer's loading dock. Fortunately, drayage distances are usually short, limiting the impact on the overall economics. Drayage costs rise from historical $4.24 per mile to $6.17 per mile in the 2020 Central Case. This will encourage firms that make use of intermodal services to locate even closer to ports and rail terminals to minimize the drayage costs. Exhibit 30 illustrates the results presented in Exhibit 14 earlier in this chapter.

Exhibit 30: Impact of Fuel Prices on Drayage and Line-Haul Trucking Costs per Mile ($2008)



However, Exhibit 31 shows that even with typical drayage costs included, rail and water costs remain much lower than truck as energy prices rise. Since the drayage and port costs remain relatively fixed, and the costs for water and rail are lower per mile, the advantage of rail and water shipping increases over longer distances. Nonetheless, under the central case of a diesel fuel price of $3.99 per gallon, water shipping using RORO vessels or barges can be cost-competitive to trucking for distances as short as 250 miles. Rail still costs more than trucking at 250 miles because of the high terminal costs for lifting double-stack containers onto railcars. Specialized short-haul rail Intermodal technologies, such as Canadian Pacific's Expressway concept that uses RORO rather than Lift-On/Lift-Off (LOLO) railcar loading, are not in widespread use in the rail industry today.[21]

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[21] See: http://findarticles.com/p/articles/mi_m1215/is_1_204/ai_97447670.

Exhibit 31: 2020 Central Case Scenario - Comparison of Water, Rail and Trucking Total Cost per Mile for Line-Haul and Drayage ($2008)

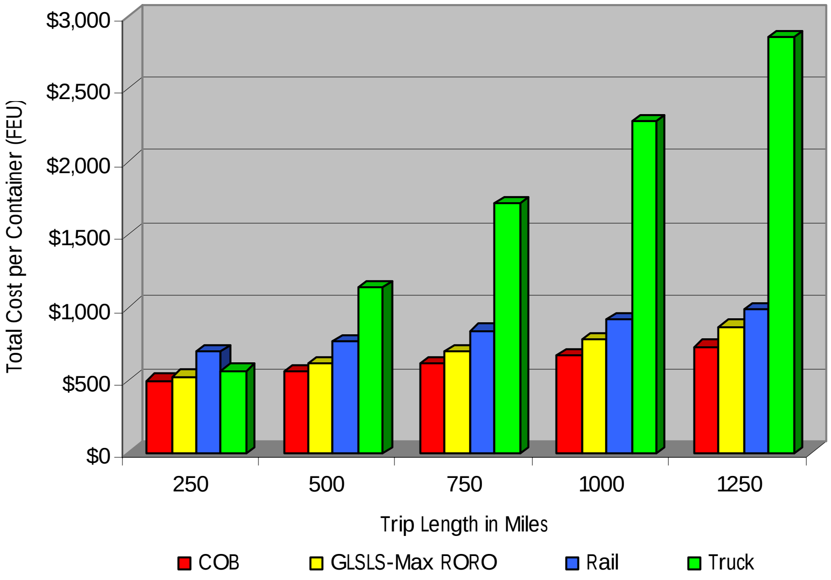
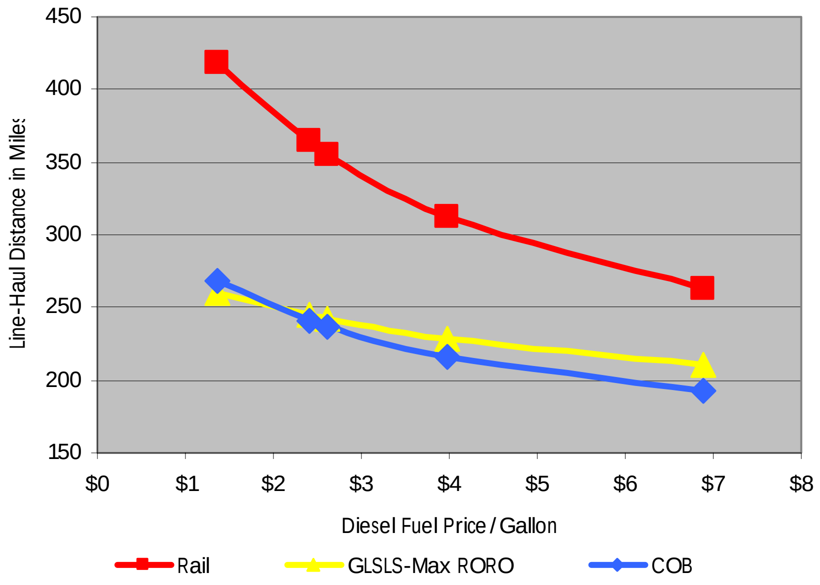


Exhibit 32 shows the minimum breakeven length of haul needed to support the viability of intermodal shipping by the water and rail modes. Although the calculated breakeven for rail is only 400 miles, typically railroads require at least 700 to 1,000 miles in order to generate a sufficient profit margin. Railroads need this profit margin because they must finance their infrastructure privately and pay their own costs for capacity expansion. Under these circumstances, railroad operators do not believe that short-haul traffic generates enough profit to justify the required infrastructure investments. Furthermore, for the last 10 years U.S. railroads have faced capacity problems and are limited in terms of how much additional traffic they can carry, particularly in East-West corridors.

In contrast, vessels would use existing waterways, which have considerable capacity. For example, the St. Lawrence Seaway is only operating at around 50 percent capacity. Therefore, water can compete for short-haul intermodal truck traffic at distances which rail does not have the capacity to handle. This means also that water will complement or augment existing rail capacity rather than competing directly with rail. In the current market, water will tend to take intermodal traffic which rail is not able to handle. This is especially true for the lower-cost water shipping options such as COB.

In terms of the different types of water vessels, one of the most important results of the analysis is the relative strength of the COB option. As energy prices rise, COB becomes more and more cost-competitive with truck and rail. Although COB is slower than rail, costs are much less affected by fuel prices than either RORO ship or rail alternative, reflecting cost increases that are only one third of those of the RORO vessels.

Exhibit 32: Line-Haul Breakeven Distance by Mode ($2008)



As a result, it is clear that the water and rail modes are least affected by rising energy prices. However, trucking costs rise significantly with energy prices. Large 22-knot inland or coastal RORO vessels can compete with rail and truck on a transit time basis and will maintain their cost competitiveness as energy prices rise.

COB service is remarkably insensitive to fuel price as a result of its dramatic energy efficiency, but it is much slower than either rail or trucking. Accordingly, COB may develop a niche market in price-sensitive commodities that can afford to take a few extra days of transit time. Up to this point, the cost differential between COB and other modes has not been quite enough to entice the development of commercially feasible COB services, but it is quite possible that such services can easily be developed in the future if the cost differential widens. The COB option may then very well become attractive to shippers who need a lower-cost alternative, as they become increasingly frustrated with the very high costs that will be associated with all the other modes as fuel prices rise.

The effect of these changing energy prices on the overall market share are addressed by the freight forecasts that are presented in the next Chapter.

6

MODAL SHIFT POTENTIAL IN THE FIVE CORRIDORS

6.1 OVERVIEW

This study estimates modal share shifts that are likely to result from the Optimistic, Central, and Pessimistic oil price scenarios. 2005 is used as a base line since that is the time period used in the earlier GLSLS NC/NV study. Using the same Base Year helps maintain consistency and comparability between the studies. Although the market equilibrium scenarios are defined with respect to potential oil prices in 2020, all freight numbers referenced are with respect to 2005 base year flows. A total market forecast of future year flows was not prepared.

The sensitivity analysis has been developed to show the effect of the historically lower oil prices that were in effect during the most recent market equilibrium conditions of the late 1990's and early 2000's, as well as a range of higher price scenarios that are possible for the future. Oil prices started rising steadily after 2002 and have not really attained a stable equilibrium since then. This report will assess the likely impact on transportation costs of three possible equilibrium scenarios that were defined in Chapter 3 as compared both to these earlier equilibrium market conditions as well as the interim non-equilibrium costs that were in effect during 2005.

6.2 BASE-LINE CONDITIONS

This study broadly evaluates the market prospects for introducing maritime shipping services along each of the five corridors that were defined in Chapter 4. As shown in Exhibits 33-37, these corridors are:

- East Coast Corridor - Boston to Miami
- West Coast Corridor - Seattle to Los Angeles
- Gulf Coast Corridor - Houston to Miami
- Mississippi River Corridor - New Orleans to Twin Cities
- Great Lakes and St. Lawrence Seaway Corridor - Duluth to Halifax

Exhibit 33: East Coast Corridor

Exhibit 34: West Coast Corridor

Exhibit 35: Gulf Coast Corridor

Exhibit 36: Mississippi River Corridor

Exhibit 37: Great Lakes and St. Lawrence Seaway Corridor

The corridors were defined to be long enough to capture both short and long-haul traffic potential, yet short enough so that the distinct characteristics of each region can be captured and identified. For the most part, the degree of interaction between the corridors is expected to be minimal, although there is some potential for long haul traffic to connect around Florida between the East and Gulf coast regions, which was not included here because separate models were developed for each corridor.

To assess national trends, an analysis compared the response of traffic to higher fuel prices and estimated the impact on relative modal competitiveness and potential changes in modal shares. To fully assess the policy issues, a range of potential oil price scenarios that reflect the potential range of oil price changes were developed for each corridor.

The existing transportation market in each of the five corridors are described in the following sections, including a description of the prospects for introducing short-sea or maritime service based on Base Year 2005 traffic conditions. This placed all the corridor analyses on a consistent basis with respect to the earlier GLSLS NC/NV study. After this, a series of fuel price sensitivities were run to describe how the market conditions in each of the five corridors will change as a result of fuel price assumptions. These results are presented in the next subsection under “Fuel Price Sensitivities.”

6.2.1 GREAT LAKES AND ST. LAWRENCE SEAWAY SYSTEM

The Great Lakes and St. Lawrence Seaway system incorporates major areas of the Midwestern United States and Eastern Canada. The GLSLS system extends from the vicinity of Halifax in eastern Canada, through Montreal and Toronto, Buffalo, Cleveland, Toledo, and Detroit, to Chicago and Duluth on the west end. The GLSLS NC/NV study extensively evaluated this corridor’s market potential and best-fit technology. This corridor is well served by truck and competitive intermodal rail service in Canada, but rail cross-border services are extremely weak, where those that are available are primarily focused on long-haul traffic. The NC/NV study found that a RORO service using 342-FEU GLSLS-max RORO ships could offer rail and truck-competitive service, and would have an advantage for developing cross-border lanes that are today poorly served by rail. Proposed services would cater to both domestic and cross-border shipping, as well as handling import/export traffic received at the ports of Montreal and Halifax.

The NC/NV study evaluated the market potential for COB at about 20 percent that of the RORO vessel service, because at 2005 oil price levels, the costs per FEU of COB and RORO services were about the same although COB transport takes twice as long.

6.2.2 U.S. EAST COAST

The U.S. East Coast lanes encompass the area from Maine to Florida including the heavily built-up Northeast Corridor area from Norfolk, VA through Richmond, Washington, Baltimore and Philadelphia to Boston, MA. North of Boston or south of Richmond, population densities are much lower. On the south, the corridor extends past the southeastern ports of Charleston and Savannah as far as Miami, Florida. On the north, the Hudson River at New York City forms a natural barrier to rail freight to New England, the southernmost rail bridge crossing of the Hudson being in the vicinity of Albany, NY. There is some competition from Halifax, which offers a feeder vessel service to the northern New England states; but this geographic barrier should enhance the potential for development of short sea shipping services from New York and the south to New England, which historically has been a very maritime-oriented region.

6.2.3 U.S. GULF COAST

The U.S. Gulf Coast is a lightly populated, but heavily industrialized region of the United States with not just petrochemical, but also extensive grain and coal, movements coming out of the Mississippi River delta. Houston anchors the region with a major port, while New Orleans also plays a major role in Caribbean trade and bulk cargoes. This region includes Miami and Tampa, FL and on the west end, and vessel services could actually extend south to Mexico and South American ports; although only domestic traffic potential was evaluated for this study. The corridor's industrial base supports a strong intracoastal shipping business, which could only be enhanced by the addition of maritime services for containers or trailers.

6.2.4 MISSISSIPPI RIVER SYSTEM

The Mississippi River system extends as far north as Minneapolis, MN, east to Pittsburgh, PA and as far west as Kansas City; with major port cities at St. Louis and Memphis. Feeding the port of New Orleans, the river system has historically played a strong role in the shipment of bulk products – grain, oil, coal, and stone – but it has had difficulty gaining a foothold in the movement of containerized traffic because of its slow transit times. During the previous era of low energy prices, the cost differential between COB, rail, or even trucking was not large enough to spur the development of COB services.

However, at higher energy prices, the relative energy efficiency of COB opens up a large cost differential that is capable of attracting some traffic to the mode. In addition, some new kinds of containerized traffic are developing – such as export grain in containers – which are known to be amenable to COB movement, since they already move by COB in the Pacific Northwest.

As a result of the convergence of these trends we see a vital role for the continuation of current energy-efficient bulk shipping on the river system, as well as an improved potential for the development of COB services as a result of rising energy prices.

6.2.5 U.S. WEST COAST

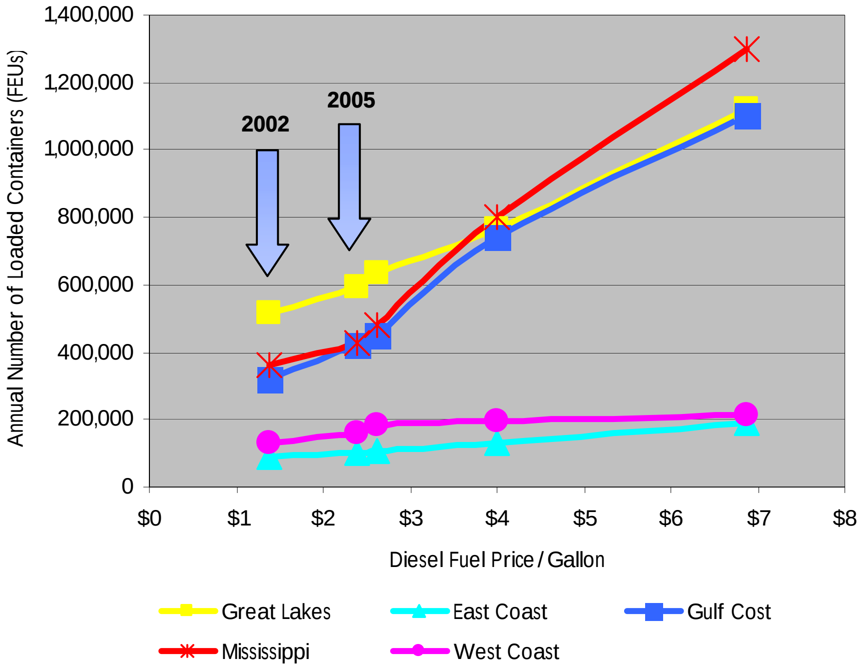
U.S. West Coast ports have historically been focused or oriented towards the development of east-west Asian container business; similarly, the rail intermodal system has been much more oriented to shipping towards the interior of the country (east-west) rather than along domestic north south lanes. As a result, the rail intermodal network running parallel to the West Coast is weak, since east-west traffic commands a much longer haul and is therefore more profitable to the railroads.

RORO services could possibly help fill this gap in the West Coast network, helping to relieve truck traffic congestion along I-5 and parallel corridors. In addition, RORO services could conceivably be used to help alleviate port capacity constraints at the major west cost ports such as Los Angeles / Long Beach (LA/LB) by promoting development of "satellite" ports linked by vessel feeder services. While the West Coast has only a very limited number of deep-draft international ports, there are numerous smaller ports potentially available for port development for RORO ships.

6.3 CONTAINER FORECAST RESULTS

Exhibit 38 shows how the transportation market changes in each of the corridors as a function of the fuel price, illustrating the prospects for a successful introduction of container shipping. All these results are based on 2005 Base Year traffic levels with modal shares adjusted for fuel price differentials.

Exhibit 38: Sensitivity by Domestic Corridor Container (FEU) Traffic to Diesel Fuel Prices ($2008)



Note: East and West Coast traffic estimates do not include most import and export containers.

For domestic traffic, as shown in Exhibit 38, the model results show that the best opportunities for introduction of water container services lie on the interior corridors: GLSLS, Mississippi, and Gulf Coast. This occurs because the primary production regions in the United States lie in the interior of the country. The East and West Coast economies are heavily focused on "New Economy" services, and so these two bi-coastal regions primarily consume, rather than produce, goods. These two markets primarily trade goods with the interior regions of the country rather than along the coasts.

6.3.1 EAST COAST DETAIL RESULTS

The total East Coast market potential was assessed at 103,207 FEU in 2005, about one-sixth the level of the comparable GLSLS forecast for the same year.

As shown in Exhibit 39, analysis of East Coast market potential suggest that many of the main East Coast water opportunities centered on the Port of Montreal. This reflects the strength of the Port of Montreal for import/export traffic, and the weakness of rail intermodal services from Montreal into the U.S. East Coast markets. This weakness has led the Port of Montreal into using long-haul trucking to reach important U.S. markets. As a result, water becomes an important competitor to trucking as fuel prices rise. However, this result should not be interpreted that vessels should immediately start providing service between Montreal and Boston. Because as oil prices rise, we see a high likelihood that this import/export traffic may shift either to Halifax, where it can use existing water feeder services to the New England states, or more likely to the Port of New York and New Jersey.

Exhibit 39: EAST Containerized Traffic -Top Ten Flows
(Annual FEU's Forecast by Corridor)

Origin port	Destination Port	Food	Raw	Semi-Finished	Finished	Total
"Montreal, PQ"	"Boston, MA"	6,948	248	9,509	0	16,705
"Montreal, PQ"	"Baltimore, MD"	1,204	644	8,782	12	10,642
"Montreal, PQ"	"Philadelphia, PA"	900	570	8,643	20	10,133
"Montreal, PQ"	"New York, NY"	108	73	8,842	45	9,068
"Montreal, PQ"	"Norfolk, VA"	127	1,113	5,778	1	7,019
"Norfolk, VA"	"Philadelphia, PA"	1,724	1,208	1,567	3	4,502
"Montreal, PQ"	"Springfield, MA"	943	28	2,442	3	3,416
"Montreal, PQ"	"Newark Terminal, NJ"	29	417	2,603	10	3,059
"Savannah, GA"	"Jacksonville, FL"	656	384	1,679	184	2,903
"Baltimore, MD"	"Philadelphia, PA"	1,984	388	259	3	2,634
Total All Flows		19,629	14,875	67,860	843	103,207

6.3.2 WEST COAST DETAIL RESULTS

The total West Coast market potential, excluding the existing Alaska and Hawaii trade (a few additional small Alaska and Hawaii flows were generated by our forecasting process) was assessed at 157,975 FEU in 2005, about one-fourth the level of the comparable GLSLS forecast for the same year.

As shown in Exhibit 40, analysis of West Coast market potential indicates an opportunity to develop vessel feeder services between Los Angeles and San Diego and Oakland. The potential volumes available for these services are probably understated since the analysis was constructed using only domestic flows. As such, it does not reflect the special characteristics of import and export containers that make this traffic much more likely to use an appropriately designed feeder service. The development of feeder services also for international would help ease West Coast port congestion, and would likely double or triple the forecast traffic presented here that are based only on domestic traffic flows.

Exhibit 40: WEST Containerized Traffic -Top Ten Flows
(Annual FEU's Forecast by Corridor)

Origin port	Destination Port	Food	Raw	Semi-Finished	Finished	Total
Los Angeles, CA	San Diego, CA	10,220	13,664	7,885	2,639	34,408
San Diego, CA	Los Angeles, CA	9,384	12,476	7,182	2,855	31,897
Los Angeles, CA	Oakland, CA	8,584	3,709	5,721	1,031	19,045
Oakland, CA	Los Angeles, CA	6,941	3,535	4,266	958	15,700
Vancouver, BC	Seattle-Tacoma, WA	4,941	185	10,359	3	15,488
Anchorage, AK	Seattle-Tacoma, WA	6,546	108	1,254	65	7,972
Vancouver, WA	Seattle-Tacoma, WA	4,787	547	207	0	5,541
Seattle-Tacoma, WA	Vancouver, WA	4,772	491	181	0	5,444
Vancouver, BC	Anchorage, AK	1,303	0	1,421	15	2,739
Vancouver, BC	Honolulu, HI	2,092	0	0	0	2,092
Total All Flows		66,497	35,927	47,502	8,050	157,975

6.3.3 GLSLS Detail Results

The total GLSLS market was assessed at 594,780 FEU in 2005, the same as the comparable GLSLS NC/NV forecast for the same year.

As shown in Exhibit 41, analysis of GLSLS market potential identifies a number of short haul lanes, including some Canadian services, which were included within the scope of the original NC/NV study and are still in the GLSLS database. These numbers are substantially less than some of the NC/NV projections through 2050, which also take demographic growth and traffic congestion into account. Based on 2005-freight flows only, these new results are reported to provide a comparison of the four new corridor results against the previous NC/NV benchmark.

Exhibit 41: GLSLS Containerized Traffic -Top Ten Flows
(Annual FEU's Forecast by Corridor)

Origin port	Destination Port	Food	Raw	Semi-Finished	Finished	Total
Montreal, QB	Toronto, ON	1,983	9,144	8,253	212	19,592
Toronto, ON	Montreal, QB	2,374	7,678	5,696	1,355	17,103
Chicago, IL	Milwaukee, WI	794	8,526	1,957	2,617	13,894
Milwaukee, WI	Chicago, IL	5,527	4,121	2,020	1,089	12,757
Chicago, IL	Burns Harbor	1,889	6,392	2,135	2,152	12,568
Burns Harbor	Chicago, IL	2,333	7,467	1,091	1,248	12,139
Cleveland, OH	Toledo, OH	1,425	7,199	1,693	1,140	11,457
Montreal, QB	Halifax, NS	614	7,345	1,240	354	9,553
Milwaukee, WI	Green Bay, WI	1,243	4,144	2,142	302	7,831
Detroit, MI	Cleveland, OH	2,680	2,759	843	1,463	7,745
Total All Flows		109,300	254,449	160,882	70,149	594,780

6.3.4 Gulf Coast Detail Results

The Gulf Coast market was assessed at 423,183 FEU in 2005, about two-third the size of the comparable GLSLS market forecast for the same year.

As shown in Exhibit 42, analysis of Gulf Coast market potential identifies a number of significant short-sea shipping markets, including Miami to Tampa and Corpus Christi to Galveston services. Pensacola also emerged as a significant potential Gulf Coast container port, if linked by feeder service to Miami.

Exhibit 42: Gulf Coast Containerized Traffic -Top Ten Flows
(Annual FEU's Forecast by Corridor)

Origin port	Destination Port	Food	Raw	Semi-Finished	Finished	Total
"Miami, FL"	"Tampa, FL"	2,821	101,053	2,881	554	107,309
"Tampa, FL"	"Miami, FL"	2,590	67,659	2,444	508	73,201
"Corpus Christi, TX"	"Galveston, TX"	4,896	32,886	3,503	764	42,049
"Galveston, TX"	"Corpus Christi, TX"	4,878	32,654	3,447	750	41,729
"Pensacola, FL"	"Tampa, FL"	711	21,045	627	90	22,473
"Tampa, FL"	"Pensacola, FL"	478	15,270	434	70	16,252
"Miami, FL"	"Pensacola, FL"	290	11,417	218	19	11,944
"Pensacola, FL"	"Miami, FL"	401	11,085	250	23	11,759
"Biloxi, MS"	"Biloxi, MS"	3,972	2,600	3,722	176	10,470
"Galveston, TX"	"New Orleans, LA"	612	8,882	340	31	9,865
Total All Flows		34,640	348,553	35,834	4,156	423,183

6.3.5 MISSISSIPPI CORRIDOR DETAIL RESULTS

The Mississippi containerizable traffic market was assessed at 425,110 FEU in 2005, about two-third of the size of the comparable GLSLS market forecast for the same year. This finding is especially significant in view of the fact that a COB service was assumed for the Mississippi system, whereas the GLSLS and three coastal corridors could use faster RORO ships.

As shown in Exhibit 43, analysis of Mississippi corridor market potential identifies a number of short haul lanes, which need to be reviewed in more detail to establish whether intermodal moves of this distance really fall within the realm of commercial feasibility. However, even if such COB services are not feasible at current fuel price levels, they could be in the future as fuel prices go up.

Exhibit 43: Mississippi Containerized Traffic -Top Ten Flows
(Annual FEU's Forecast by Corridor)

Origin port	Destination Port	Food	Raw	Semi-Finished	Finished	Total
Cincinnati-OH	Louisville, KY	1,104	65,083	1,420	51	67,658
Cincinnati-OH	Pittsburgh-PA	1,065	17,884	706	172	19,827
Peoria, IL	Davenport, IA	1,286	17,331	2	21	18,640
Davenport, IA	Peoria, IL	9,968	3,516	3,151	5	16,640
New Orleans, LA	Baton Rouge, LA	393	10,973	2,680	23	14,069
Cincinnati-OH	Huntington, WV	188	11,259	423	30	11,900
Baton Rouge, LA	New Orleans, LA	405	6,984	2,349	26	9,764
Jefferson City, MO	Kansas City-KS	4,167	2,062	3,364	9	9,602
Minneapolis-MN	Onalaska, Ill	4,246	761	4,019	18	9,044
Cincinnati-OH	Evansville, IL	383	6,773	154	5	7,315
Total All Flows		89,797	276,365	57,887	1,061	425,110

6.4 CONTAINERIZED FORECAST RESULTS

Exhibit 38 in the previous section clearly shows the strong growth potential that is associated with the GLSLS, Gulf, and Mississippi River corridors as fuel prices go up. Forecast traffic potential rises by a factor of 2 to 3 times as fuel prices rise from $2 up to $7. However, the $7 scenario is not such a remote possibility, since diesel fuel prices above $5 per gallon have already been seen this summer.

6.4.1 EAST AND WEST COAST – PORT FEEDER SERVICE POTENTIAL

A major caveat and exception needs to be noted with respect to the distribution of import and export containers within the East and West Coast regions, which is really beyond the scope of the FAF-based data available and so requires a special study. To understand the potential for feeder services in U.S. international trade requires access to more detailed port-specific data than were available for this study. Since import/export traffic is already concentrated at coastal seaports, the economics of keeping such traffic in the intermodal system as long as possible are generally favorable. Overall, two counteracting trends are at work in the maritime industry:

- Vessel economics naturally favors larger ships, as larger ships are more fuel efficient than smaller ones, and so maritime economics favors a continuation of this trend in coming years. The use of ever larger vessels, however, tends to concentrate more traffic at the few coastal "mega ports" that have the equipment and deep shipping channels to accommodate such large vessels. As a result, this heavy concentration of large ships in fewer ports also tends to increase inland distribution costs.

- In contrast, as fuel costs continue to rise, there is more of an economic incentive to bring containers closer to their ultimate destination, which can maximize the use of the lower-cost water mode and minimize the use of high-cost inland distribution such as trucking.

Both goals, however, are likely to be satisfied only by development of hub-and-spoke transshipment networks. A key question is the structure of these future networks. Are they going to be based in off-shore ports like Freeport, Bahamas; or will existing U.S. ports develop effective feeder systems that can help them maintain their own competitiveness and commercial relevance?

Another question regards the level of rail integration within these feeder networks? For example, there is little question that there would be sufficient traffic to support a barge feeder service from New York to New England, if the CSX and NS railroads would agree to use the barge to develop their own "satellite ramps" for New England rail traffic.

In short, the primary potential along the East and West coasts probably lies in development of feeder services for existing ports and rail services. Development of such services would provide a new freight distribution mechanism that can support existing rail and truck systems.

6.4.2 NOTE ON IMPORT / EXPORT PORT IMPACTS

Apart from the impact of recent high oil prices, the recent devaluation of the U.S. dollar (which may be ongoing) has been affecting the distribution of U.S. international trade patterns, which cannot be analyzed using the USDOT's FAF database as it does not identify the ultimate overseas origins or destinations of freight shipments.

First, the devaluation of the dollar has tended to reduce U.S. imports while boosting exports. While this has required some adjustments in liner shipping operations, overall it would appear that the trend is towards greater efficiency. Rather than running one way loaded and returning empty, ships now have a better ability to obtain a balanced load in both directions.

The decline in the growth rate of imports, moreover, has taken some of the immediate pressure off West Coast port capacity, although long-term concerns remain. Even if the pause is only temporary, however, the West Coast ports now have a little more time to implement infrastructure expansion plans to stay ahead of demand. This pause in import growth will also relieve rising congestion at the Panama Canal, as it completes its planned expansion for accommodating post-Panamax vessels and increased traffic volumes, which is due to be completed in 2014.

As a result, there does not appear to be any extreme urgency, from a capacity point of view, for shifting large amounts of Asian containers from West coast to East coast ports. Nonetheless, after the Panama Canal expands in 2014, some shift from West to East Coast ports should be anticipated as a result of the improved operating economics of larger ships now able to use the Canal.

Therefore, this study does not predict any radical traffic shifts as a result of recent large changes in fuel price and current exchange. Rather, there may be an opportunity for railroads to "price up" on their transcontinental double-stack services. While the railroads also need to raise prices to cover their own rising fuel expenses, they are likely to raise rates to maintain the current market equilibrium with respect to East versus West coast ports until after 2014, when expanded Panama Canal facilities are open for business. After 2014, shippers should anticipate a moderate traffic shift towards East Coast ports as carriers take advantage of improved vessel economics by transiting the Canal with larger vessels.

6.5 BULK DIVERSION POTENTIALS

Bulk traffic shifts have been modeled, and as in the case of containerized traffic significant differences between the corridors. Exhibits 44 through 48 summarize forecast results.

Exhibit 44: East Coast Bulk Volume (Millions of Short Tons) as a Function of Diesel Fuel Price

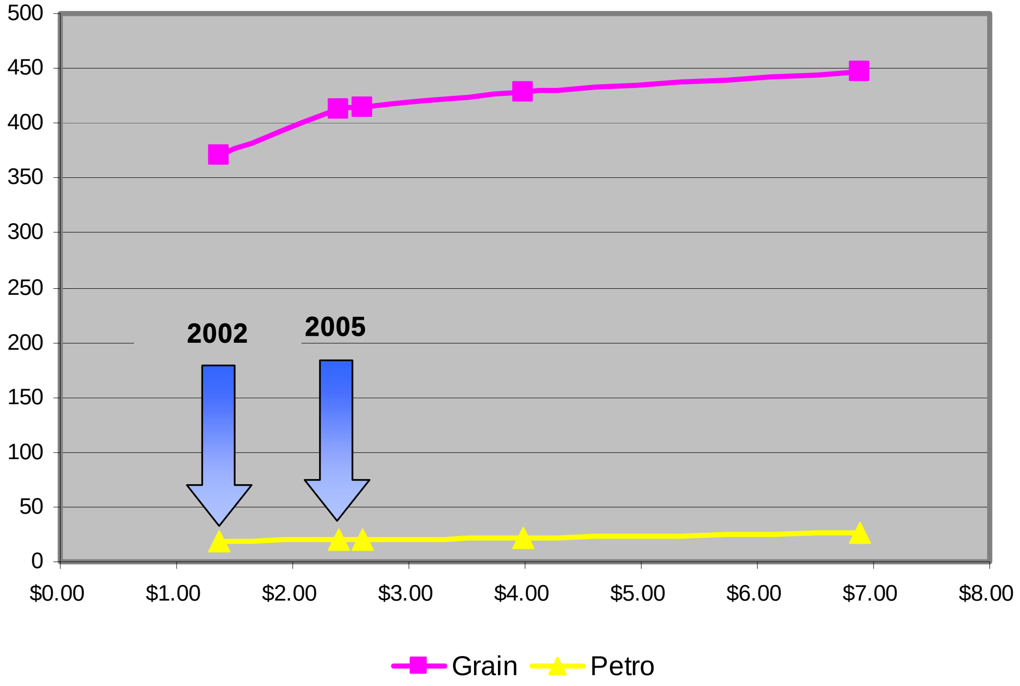


Exhibit 45: West Coast Bulk Volume (Millions of Short Tons) as a Function of Diesel Fuel Price

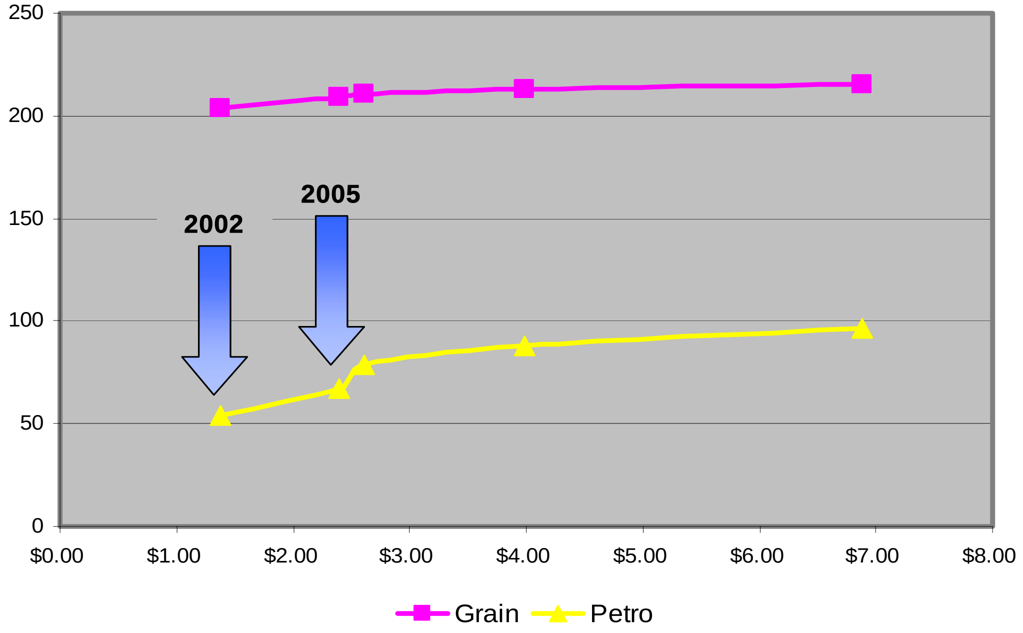


Exhibit 46: Gulf Coast Bulk Volume (Millions of Short Tons) as a Function of Diesel Fuel Price

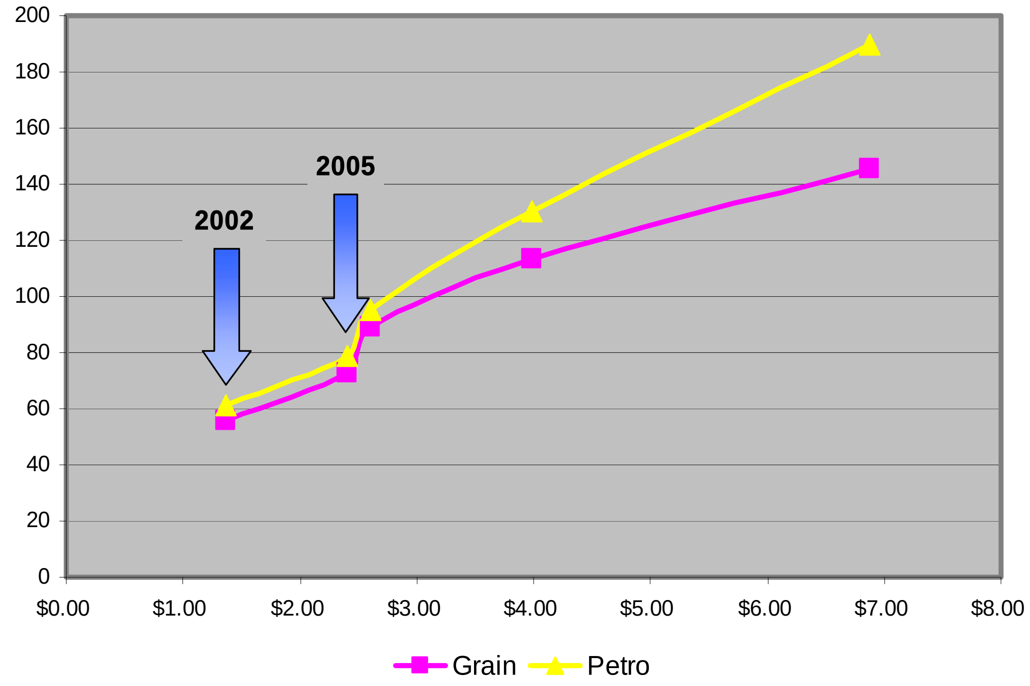


Exhibit 47: GLSLS Bulk Volume (Millions of Short Tons) as a Function of Diesel Fuel Price

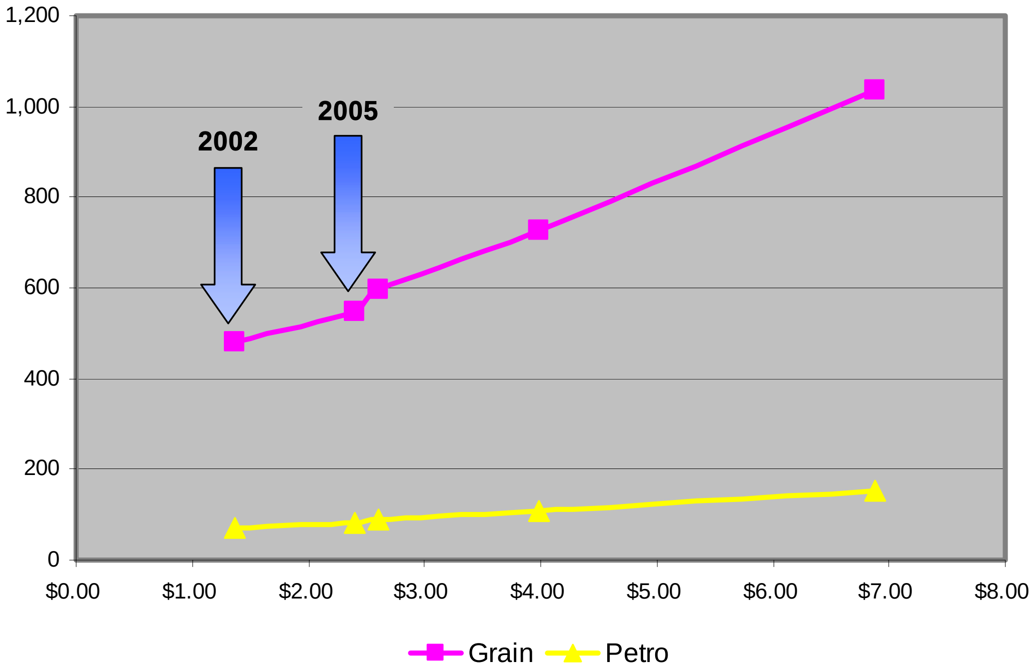
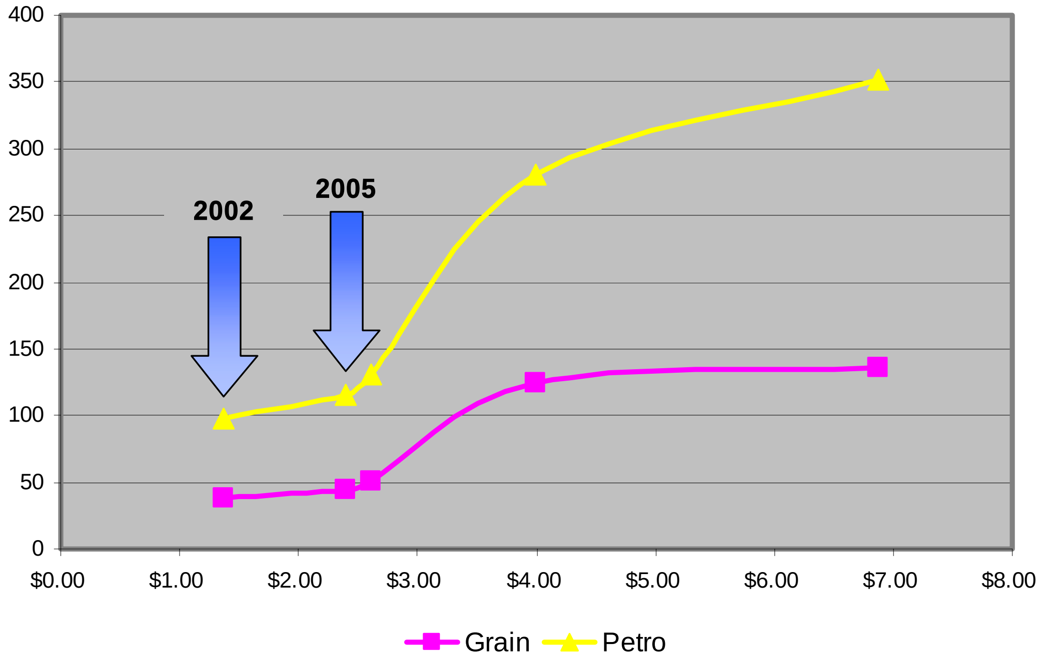


Exhibit 48: Mississippi Bulk Volume (Millions of Short Tons) as a Function of Diesel Fuel Price



In summary, it can be seen that East Coast bulk shipping has probably already captured as much traffic as can feasibly move by water. There appears to be an increased potential for West Coast petroleum shipping as fuel prices rise.

But the real bulk growth potential appears to be on the GLSLS, Mississippi, and Gulf Coast corridors where in recent years, rail productivity improvement has flattened water traffic growth. However the prospect of rising fuel prices is likely to shift the cost advantage back to water, which has a substantial energy efficiency advantage even over rail.

7

CONCLUSIONS AND RECOMMENDATIONS

7.1 KEY RESULTS BY CORRIDOR

This analysis has explored the effect of fuel prices on the likely prospects for implementation of Short Sea shipping on five corridors: East, West, Gulf, GLSLS, and Mississippi River.

The fuel price sensitivity encompasses a full range of diesel fuel prices from $1.37 per gallon (historic 2002 levels) to $6.88 (2020 pessimistic high-oil-price scenario). Within this wide range, a set of water modal share forecasts have been prepared to assess the likely prospects for both containerized freight and bulk movement by water.

Key results for each freight corridor are summarized in the following sections.

7.1.1 EAST COAST CORRIDOR

Relative to the other four corridors, the East Coast corridor is the weakest in terms of its potential for attracting domestic container traffic. Most East Coast freight moves to and from interior states, not up and down the coast. Nonetheless, there is a substantial volume of trucks moving on the I-95 corridor. This study assesses only the short-term potential for modal shift, since it is based on historical 2005 FAF data, and does not develop any projection of future traffic or levels of congestion. As such, it is quite plausible that given the anticipated congestion and lack of capacity on I-95, that water could attract some of this I-95 traffic in the future.

There appears to be an immediate potential, however, for developing container feeder services in conjunction with existing international gateway ports and rail intermodal services, for delivering trailers and containers closer to end–use points, particularly given rising corridor road congestion affecting truck service along Interstate 95 from Boston through the Virginia Beach area. The key consideration is modal integration between rail yards and maritime ports so that all services (import/export as well as domestic) can take advantage of the proposed new intermodal links. Arbitrarily limiting the use of such services only to international port traffic restricts their potential and may cause them to fall short of the minimum volume require to economically sustain the service.

With regard to bulk traffic, waterborne transportation appears to have has captured nearly all of the water-available traffic along the East Coast. As a result, corridor growth potential with respect to the impact of high fuel prices was found to be very limited.

7.1.2 WEST COAST CORRIDOR

The West Coast corridor has stronger domestic container traffic potential than the East Coast. A major opportunity has been identified for the development of feeder services from Los Angeles to both San

Diego and Oakland. In addition, there appears to be potential for growth in petroleum traffic as fuel prices rise.

7.1.3 GLSLS CORRIDOR

In a high fuel price environment, the GLSLS has the second strongest domestic container traffic potential, next the Mississippi River corridor. Compared to coastal corridors, perhaps this should come as no surprise, since both "sides" of the heavily industrialized and densely populated riverbank are capable of feeding traffic into the GLSLS, whereas a typical coastal region has the demographics of only one "coast" available to generate traffic.

The GLSLS also stands to gain in bulk traffic versus rail as fuel prices go up, since shipping is more energy efficient than rail.

7.1.4 GULF COAST CORRIDOR

The Gulf Coast corridor assessment came out second to the GLSLS and exhibits a very similar behavior. Its demand forecast rises three times as high as fuel prices go up, reflecting diversion of both truck and rail to the more efficient water mode.

This Gulf Corridor also stands to gain in bulk traffic, both grain and petroleum, as fuel prices increase, since shipping is more energy efficient than rail.

7.1.5 MISSISSIPPI RIVER CORRIDOR

The Mississippi River Corridor, unlike the other four corridors, used COB rather than ship. As the most energy efficient mode, COB shows the strongest response to fuel price with the demand forecast going up nearly four times as fuel prices rise.

In addition, higher fuel prices will help bulk traffic on the Mississippi River system as well, likely reversing years of an eroding or stable market share. Higher fuel prices would likely reestablish the historical relationship between rail and water prices, clearly establishing water as the low-cost mode.

7.2 NATIONAL IMPLICATIONS

In order for new water services to be competitive in freight corridors now dependent on truck and rail services, there needs to be a paradigm shift in decision-making for goods movement. As the cost of shipping rises with higher fuel prices, better environmental protection, and rising congestion, the speed of delivery of goods may become less significant in shipping decisions. In addition, institutional policies and regulatory and tax structures can be re-aligned so that industry is encouraged to make large new investments and to assume the associated risks. Furthermore, water and intermodal rail infrastructure at both coastal and inland ports needs to be developed to ensure the optimum distribution of freight through all modes of transportation so that the U.S. transportation network develops in an efficient and integrated manner.

7.3 CONCLUSION

In an environment of high oil prices, the results of this study, as well as the previous NC/NV Market Assessment, indicate that container shipping services are likely to become viable not only on the GLSLS but now also on the Mississippi River and Gulf Coast corridors as well. Further work to follow up such high level analysis with greater market detail appears to be warranted.

Meanwhile, in order to reduce excessive trucking distances from evolving mega-container ports, East and West Coast planners should seek to establish and improve the feeder-capability of local or “satellite” ports. Either COB or RORO ships could be viable options for developing feeder services, but commercial success may require a greater degree of modal integration than has existed in the past.

Overall, the impact of higher oil prices is to create a strong case for investing in the waterborne transportation industry – for both inland and coastal distribution. Potential increases in oil prices already forecast could increase transport costs two- to eight-fold. Despite the wide range in forecast oil prices, even the minimum forecast is creating a transportation environment more like that of Europe in the 1990’s than previous short-term fuel price hikes previously experienced in the United States.

Historically, coastal and inland waterborne transportation has enjoyed a larger market share in Europe than in the United States because of Europe’s higher inland rail and truck transport costs that make water cost-effective. The recent European experience also demonstrates that water-based logistics chains can work effectively, for distributing not only bulk goods and industrial products but consumer goods as well. This could well become the case in the United States, if the cost differential between truck, rail, and water transportation is sustained at the levels reached during the summer of 2008 as the result of higher oil prices.

Finally, it is recommended that fuel price levels be considered in future freight planning with respect to the relative roles of the various modes of transportation. While rail has enjoyed dramatically improved productivity in recent years, many of its gains relative to water stand to be erased should fuel prices rise to anticipated levels in coming years. As water is the most energy-efficient mode of freight transportation, planners should recognize it is likely to play a greatly expanded role in the future. Hence, national policy towards the water mode needs to become more proactive. Given higher oil prices, market forces could well promote a significantly enhanced role for water in the U.S. transportation system, provided that the potential for this modal shift is recognized and supported by public policies that are directed toward developing the needed infrastructure and in encouraging industry to make the needed investments.

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Appendices

A. MODAL SPLIT MODEL AND CALIBRATION

The model calibration process establishes a Base Case that reflects current market conditions. Calibration includes all the processes that are required to establish a base case, including the development of base year transportation networks and costs. The derivation of base year origin-destination traffic flows, and the performance of regression analyses for establishing the model parameter values (e.g. market elasticities with respect to cost, transit time, reliability and frequency) on a route and commodity basis.

The calibration establishes sets of logit coefficients that specify model elasticities with respect to the network variables, which in turn allows prediction of how market shares are likely to shift if network conditions change. In this study, the calibration is based on a Nested Logit Model (NLM) that has two levels as shown in the A.1. The first level consists of two modes: Rail and Water, and the second level has two modes: Fixed Route and Truck. Fixed Route is a composite mode made up of Rail mode and Water mode. The calibration starts from bottom to top i.e. from the first level to the second level. The following tables in A.2 show the calibration results and associated statistical measurements.

In terms of the calibration, the results for the Great Lakes and St Laurence Seaway, the Mississippi, and East Coast all produced very good t statistic and R2 results. The Gulf Coast corridor and the West Coast corridor were not quite as strong particularly for bulk products such as grain and petroleum. Only in the case of the Gulf Coast were any difficulties experienced for any of the container classifications. The issue for calibration in the few areas where significant t statistics were not obtained was probably due to the scale of zone system and the lack of details in the networks that were developed. A more refined zone system for the West Coast and Gulf Coast would likely improve the calibration. It should be noted, however, that all the parameters identified had correct signs and reflected appropriate shipper behaviors.

A.1 Hierarchy

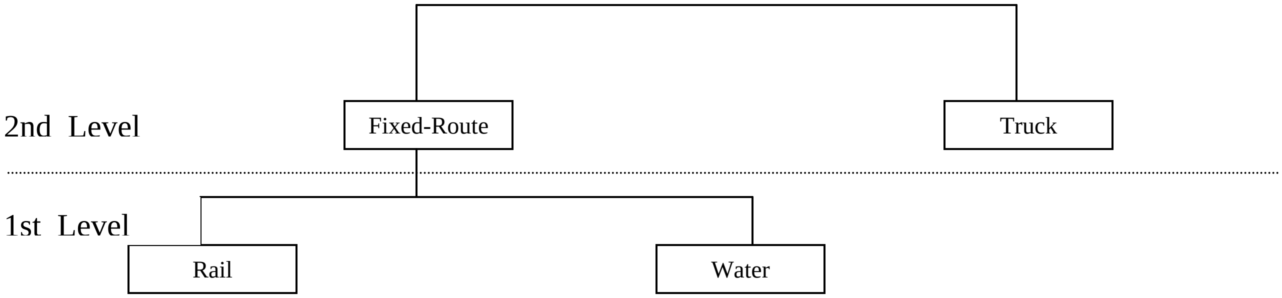

Exhibit 1

A.2 Calibration

A. 2.1 Great Lakes and St. Lawrence Seaway

a. Level 1: Rail vs Water

$$Ln(Rail/Water) = \alpha + \beta_1 \times GC_{Rail} - \beta_2 \times GC_{Water}$$

	α		β_1		β_2		R^2
	Para	*t Stat*	Para	*t Stat*	Para	*t Stat*	
Food	0.1942	3.06	-8.2E-05	-23.82	-7.6E-05	28.97	0.56
Raw material	0.00012	0.0026	-0.0001	-33.48	-9.5E-05	37.41	0.67
Semi-finished	0.1656	2.77	-0.00011	-33.07	-0.0001	42.73	0.69
Finished	0.000032	0.0034	-0.00014	-41.24	-0.000145	49.86	0.80
Grain	-0.4912	-8.53	-5.9E-05	-17.925	-4.09E-05	14.11	0.42
Petroleum	-1.5577	-0.74	-0.00016	-2.008	-0.000147	3.03	0.51

b. Level 2: Fixed-route vs Truck

$$Ln(Fixed/Truck) = \alpha + \beta_1 \times U_{Fixed} - \beta_2 \times GC_{Truck}$$

	α		β_1		β_2		R^2
	Para	*t Stat*	Para	*t Stat*	Para	*t Stat*	
Food	-4.0662	-51.32	0.2141	2.27	-0.000575	28.03	0.69
Raw material	-2.587	-16.93	1.8148	14.52	-0.000918	26.56	0.63
Semi-finished	-3.5561	-29.54	0.7886	6.47	-0.000756	28.71	0.61
Finished	-3.9342	-17.51	0.8295	4.76	-0.001263	17.22	0.54
Grain	1.0293	29.91	0.8401	19.02	-1.51E-05	10.19	0.47
Petroleum	-2.6083	-20.33	0.1438	3.34	-3.63E-05	9.70	0.54

A.2.2 Mississippi River Corridor

a. Level 1: Rail vs Water

$$Ln(Rail/Water) = \alpha + \beta_1 \times GC_{Rail} - \beta_2 \times GC_{Water}$$

	α		β_1		β_2		R^2
	Para	*t Stat*	Para	*t Stat*	Para	*t Stat*	
Food	0.1638	0.048	-0.00054	-2.47	-0.000298	2.42	0.38
Raw Material	0.72049	6.37	-0.00074	-9.30	-0.000149	1.62	0.55
Semi-finished	1.70904	5.14	-0.00156	-5.04	-3.82E-05	0.24	0.66
Finished	4.5217	6.44	-0.00018	-2.64	-0.000152	3.87	0.37
Grain	-4.4345	-1.14	-0.00029	-2.73	-0.000117	1.68	0.42
Petroleum	-1.5135	-1.75	-9.4E-05	-3.31	-0.000188	6.87	0.33

b. Level 2: Fixed-route vs Truck

$$Ln(Fixed/Truck) = \alpha + \beta_1 \times U_{Fixed} - \beta_2 \times GC_{Truck}$$

	α		β_1		β_2		R^2
	Para	*t Stat*	Para	*t Stat*	Para	*t Stat*	
Food	-2.9462	-19.37	0.0343	1.74	-0.000795	21.07	0.31
Raw Material	-1.1125	-6.40	0.1426	4.35	-0.000251	4.28	0.55
Semi-finished	-2.2792	-13.83	0.1402	3.67	-0.000507	8.15	0.48
Finished	-0.9003	-15.48	0.4037	14.84	-0.000374	24.21	0.45
Grain	-2.7958	-8.66	0.1096	1.65	-0.000161	14.11	0.32
Petroleum	-1.6064	-6.99	0.0248	0.51	-0.000112	10.90	0.41

A.2.3 Gulf Coast Corridor

a. Level 1: Rail vs Water

$$Ln(Rail/Water) = \alpha + \beta_1 \times GC_{Rail} - \beta_2 \times GC_{Water}$$

	α		β_1		β_2		R^2
	Para	*t Stat*	Para	*t Stat*	Para	*t Stat*	
Food	5.915	9.20	-1.7E-05	-0.062	-0.000119	1.51	0.27
Raw Material	1.3122	4.22	-0.0004	-5.24	-7.87E-05	3.29	0.32
Semi-finished	2.5853	13.27	-0.00012	-1.83	-2.63E-05	5.93	0.78
Finished	4.7816	29.09	-0.00043	-4.13	-0.000141	4.46	0.44
Grain	-2.9307	-2.28	-0.00035	-1.55	-0.00011	0.98	0.54
Petroleum	0.4356	0.88	-0.00049	-6.88	-0.000141	5.96	0.46

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b. Level 2: Fixed-route vs Truck

$$Ln(Fixed/Truck) = \alpha + \beta_1 \times U_{Fixed} - \beta_2 \times GC_{Truck}$$

	α		β_1		β_2		R^2
	Para	*t Stat*	Para	*t Stat*	Para	*t Stat*	
Food	-5.3284	-10.10	0.6332	1.55	-0.000541	5.16	0.34
Raw Material	-2.2334	-7.80	0.3506	1.24	-0.000561	7.01	0.31
Semi-finished	-7.5510	-1.07	0.9135	0.58	-0.000552	4.24	0.91
Finished	-2.4583	-7.51	0.1022	0.74	-0.00049	4.77	0.55
Grain	-5.9137	-10.88	0.4211	1.62	-8.85E-05	5.97	0.40
Petroleum	-0.8908	-10.84	0.2397	4.69	-2.08E-05	5.15	0.68

A.2.4 East Coast Corridor

a. Level 1: Rail vs Water

$$Ln(Rail/Water) = \alpha + \beta_1 \times GC_{Rail} - \beta_2 \times GC_{Water}$$

	α		β_1		β_2		R^2
	Para	*t Stat*	Para	*t Stat*	Para	*t Stat*	
Food	10.377	3.51	-0.00157	-4.42	-0.00204	5.92	0.34
Raw Material	2.89598	7.16	-0.00033	-6.90	-0.00038	7.72	0.49
Semi-finished	2.43071	5.44	-0.00035	-11.57	-0.00032	12.91	0.48
Finished	8.78931	24.88	-0.00057	-9.57	-0.00064	11.29	0.45
Grain	-0.84690	-4.75	-0.00011	-2.75	-0.00014	3.19	0.29
Petroleum	-2.07929	-8.90	-0.00049	-17.75	-0.00055	7.66	0.61

b. Level 2: Fixed-route vs Truck

$$Ln(Fixed/Truck) = \alpha + \beta_1 \times U_{Fixed} - \beta_2 \times GC_{Truck}$$

	α		β_1		β_2		R^2
	Para	*t Stat*	Para	*t Stat*	Para	*t Stat*	
Food	-2.8450	-6.08	0.00539	0.52	-0.00079	13.36	0.28
Raw Material	-2.10694	-29.33	0.05291	7.93	-0.00013	8.11	0.38
Semi-finished	-1.9321	-26.37	0.07439	7.53	-0.00041	26.57	0.39
Finished	-5.6099	-15.39	0.09412	3.21	-0.00073	11.91	0.28
Grain	-2.91851	-18.47	0.31415	7.80	-7.3E-05	16.12	0.27
Petroleum	0.11091	0.57	0.06809	6.09	-0.00013	26.53	0.36

A.2.5 West Coast Corridor

a. Level 1: Rail vs Water

$$Ln(Rail/Water) = \alpha + \beta_1 \times GC_{Rail} - \beta_2 \times GC_{Water}$$

	α		β_1		β_2		R^2
	Para	*t Stat*	Para	*t Stat*	Para	*t Stat*	
Food	7.93772	2.19	-0.00084	-1.42	-5.11E-05	0.32	0.53
Raw Material	0.59814	3.76	-0.00003	-1.91	-1.23E-05	1.75	0.31
Semi-finished	1.8440	0.83	-0.00075	-0.99	-3.74E-04	1.30	0.43
Finished	5.9848	4.75	-0.00243	-4.87	-7.05E-04	4.01	0.80
Grain	0.7135	0.95	-0.00014	-1.45	-1.07E-04	1.74	0.35
Petroleum	0.10572	6.14	-0.00009	-2.32	-1.06E-04	5.84	0.41

b. Level 2: Fixed-route vs Truck

$$Ln(Fixed/Truck) = \alpha + \beta_1 \times U_{Fixed} - \beta_2 \times GC_{Truck}$$

	α		β_1		β_2		R^2
	Para	*t Stat*	Para	*t Stat*	Para	*t Stat*	
Food	-3.4794	-5.45	0.44907	2.38	-6.80E-05	2.99	0.44
Raw Material	-3.5140	-16.03	0.72987	1.01	-1.68E-04	5.10	0.33
Semi-finished	-3.5175	-12.81	0.03325	1.34	-5.24E-04	13.12	0.57
Finished	-3.2038	-1.17	0.11145	0.41	-4.52E-04	1.24	0.67
Grain	-2.2508	-1.83	0.36131	3.58	-1.84E-04	4.98	0.30
Petroleum	-0.2341	-1.26	0.47273	4.69	-2.75E-04	12.47	0.28