PREPARED FOR:

MARITIME ADMINISTRATION,
U.S. DEPARTMENT OF TRANSPORTATION

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

EXECUTIVE SUMMARY

OCTOBER 2008

PREPARED BY:

TEMS

TRANSPORTATION ECONOMICS & MANAGEMENT SYSTEMS, INC.

EXECUTIVE SUMMARY

MAJOR FINDINGS

- According to U.S. and international forecasts, oil prices could range between a low of $60 to a high of $160 per barrel through 2020 (in constant 2008 dollars), but the Central Scenario indicates that oil prices could stabilize at around $90 per barrel.

- The more fuel-efficient rail and water modes are far less affected by fuel price increases than trucking, particularly over longer shipping distances and where Roll-On/Roll-Off vessels, which have significantly lower fixed intermodal drayage and port costs, can be used.

- Because the demand for rail/truck intermodal services is increasing, available rail capacity is being depleted, giving the railroads the ability to increase prices and making existing and potential water services even more attractive.

- Analysis of five major U.S. freight corridors that serve over 95 percent of the U.S. population – Great Lakes (and St. Lawrence Seaway), Gulf Coast, Mississippi River, East Coast, and West Coast – indicates that domestic waterborne containerized traffic has the potential to increase by a factor of 2 to 3 as diesel fuel prices increase from $2 up to $7 per gallon.

- The Great Lakes, Mississippi River, and Gulf Coast freight corridors (which can divert traffic from truck and, to a lesser extent, from rail transportation) generate sufficient domestic traffic volume to initiate new water services.

- Along both the East and West Coast, a portion of the huge and growing volume of U.S. international trade now distributed inland through gateway Atlantic and Pacific seaports can be moved by new coastal feeder services.

INTRODUCTION

Recent hikes in the price of oil are significantly raising the cost of transportation – be it by truck, rail, or water – and are leading to major changes in U.S. transportation industries. From an environment of steady or falling oil prices in the 1980's and 1990's, the price of oil has recently increased to unprecedented high levels. According to various predictive models, oil prices could still range between a low of $60 to a high of $160 per barrel through 2020 (where oil prices represent importer refiner acquisition costs that are stated in constant 2008 dollars throughout this report, unless otherwise noted). The impact of higher oil prices on the economy is two-fold:

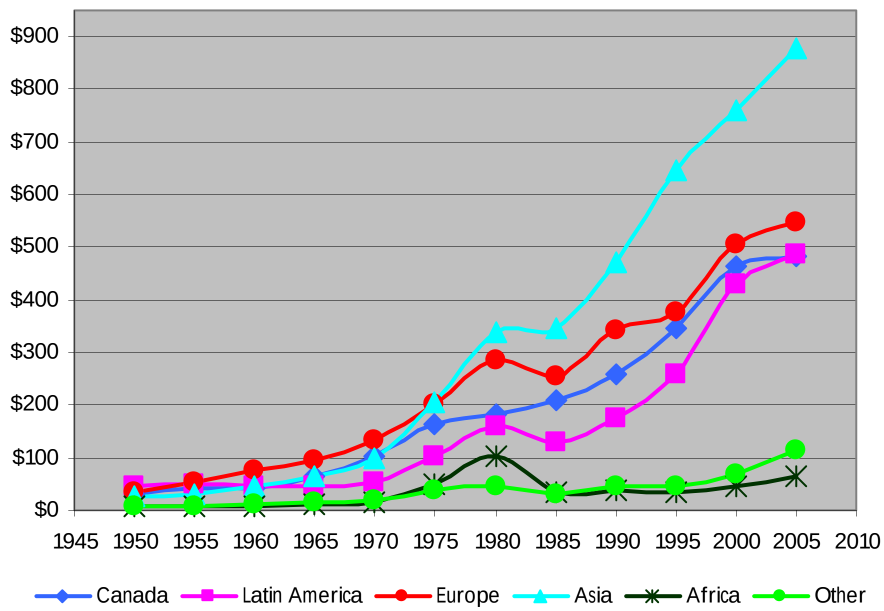
- One, higher oil prices have reduced consumption and the rate of economic growth in many countries, thereby slowing the world economy. As growth in demand for goods and services has slowed, so has trade and growth in demand for transportation services.

- Two, because it is more expensive to move goods long distances, logistic chains are changing and earlier trends towards economic globalization are slowing or reversing.

INTERNATIONAL AND DOMESTIC MARKETS

Over the past half century, international trade has become increasingly important to the U.S. economy, as reflected in the steady growth of U.S. imports and exports (as shown in Exhibit 1). While international trade represented only 5 percent of U.S. economic activity (as measured by gross domestic product or GDP) in the 1950's, it had expanded to one-fifth (20 percent) of GDP by the year 2000. Recent estimates projected that trade would account for around half (50 percent) of all U.S. economic activity by 2050, but this forecast was based on oil prices around $30 to $70 per barrel between 2005 and 2007, not the much higher prices recently experienced in 2008.

Exhibit 1: Growth in the Value of U.S. Exports & Imports, 1950-2005 (Billions of $2005)

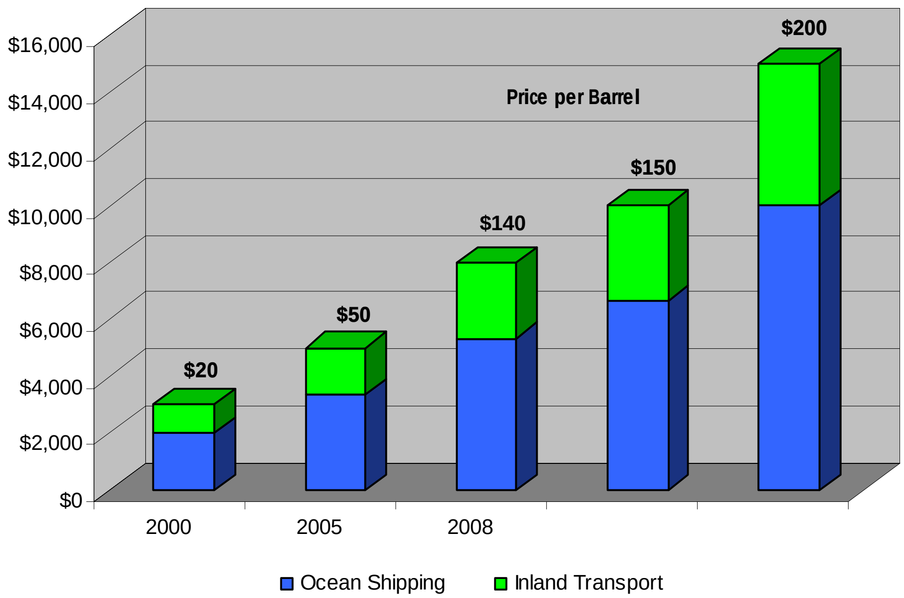


As recent events have demonstrated, the impact of higher oil prices on international freight transport can be dramatic. Since the year 2000, the cost of transporting a single forty-foot equivalent unit (FEU)[1] container from Shanghai to Columbus, Ohio in the heart of the U.S. consumer market has increased by 265 percent, from $3,000 per $8,000 (at around $130 per barrel).[2] If oil prices increase to $150 and $200 per barrel, the impact will be even more severe and costs will increase to $10,000 and $15,000 respectively (as shown in Exhibit 2). High oil prices have led to increased production costs for manufacturers and lower purchasing power for consumers, which has slowed trade growth worldwide as well as for the United States.

[1] An FEU is twice the size of a twenty-foot equivalent container (TEU).

[2] Jeff Rubin and Benjamin Tal, "Will Soaring Transport Costs Reverse Globalization?," *CIBC World Markets/StrategEcon* (May 27, 2008), pp. 4-7.

Exhibit 2: Cost of Transporting a Container (FEU) from Shanghai to Columbus, Ohio at Different Oil Prices ($2008)



Rising oil prices and higher transportation costs have offset the advantage of low-cost labor in Asia, making some domestically produced goods less expensive than imports. For some products (particularly heavy products such as steel coil, furniture, and automotive parts), the recent increase in transport costs has made imports too expensive and led to a return of some production to U.S. plants, which should generate opportunities for domestic waterborne as well as truck and rail transport. As a result, Chinese steel production fell by 20 percent during the first half of 2008, while U.S. steel production rose 10 percent.

The impact of recent increases in oil prices has also led ocean vessel operators to reduce speeds and save fuel. For example, reducing vessel speed from 25 to 17 knots can cut operating costs by as much as 20 percent. This is a reversal of the trend in the 1990's when the speed of the world's container fleet increased significantly. Higher oil prices will also encourage a move to even larger vessels to take advantage of economies of scale and lower the average cost of transporting a FEU. The combined impact of reduced speeds and larger vessels may be to concentrate future vessel calls by international carriers at major U.S. ports with deep-draft access (i.e., Los Angeles and Norfolk).

Completion of the Panama Canal expansion in 2014, moreover, will enable large ships from East Asia to call at East Coast ports. This may encourage the ongoing trend towards the greater use of regional distribution centers, rather than continued reliance on large national distribution centers on the West Coast. If this trend is reinforced by the comparative lower cost of water transport compared to truck and rail, there may well be a greater emphasis on the use of the Panama Canal and ports on the Gulf and East Coasts.

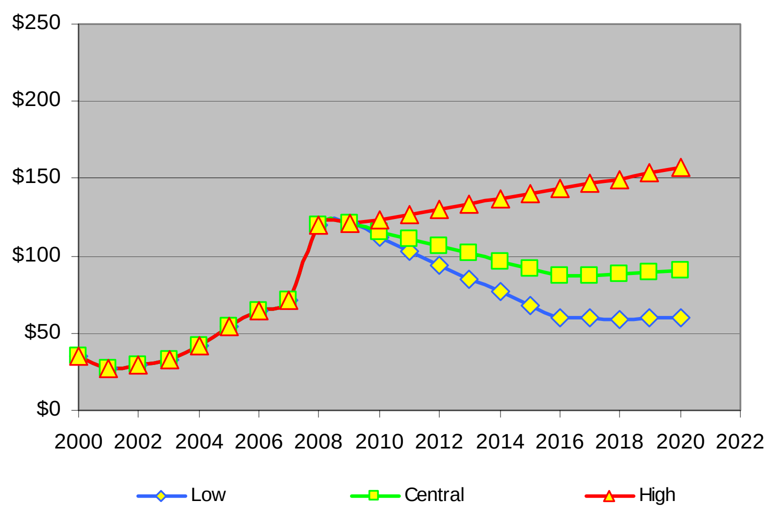
In domestic transportation markets, the impact of recent oil price hikes has been equally severe. The reduced size of the market caused by the economic slowdown and the rise in operating costs with the jumps in fuel prices have been squeezing out the most vulnerable suppliers, such as owner-operated trucking. Similarly, larger firms are being forced to amalgamate to realize economies of scale and to increase backhauls resulting from larger geographic market coverage.

High fuel prices are also motivating both higher price suppliers like trucking and lower cost suppliers such as rail (and potentially water) to integrate their services. Large trucking firms are increasingly using rail to move trucks, containers, and bulk goods over long distances. Because the demand for truck/rail intermodal services is increasing, available rail capacity is being depleted, giving the railroads the ability to increase prices. Furthermore, recent increases in truck and rail transport costs provide an opportunity for waterborne transportation to gain significant market share.

FUTURE OIL PRICES

There is still a wide range of opinions on where oil prices will be in the future. Even without accounting for speculation by large investors, industry analysts generally agree that, given limitations on supply and rising demand, oil prices over the coming decade or more will be volatile with significant fluctuations up and down between a low of $60 and a high of $160 per barrel (in constant 2008 dollars). This analysis developed three scenarios based on this potential range in oil price, as shown in Exhibit 3.

Exhibit 3: Forecast Average Annual Oil Prices ($2008 per Barrel)



By 2020, even the Optimistic (low-price case) Scenario suggests that any decline in the price of oil will bottom out at around $60 to $80 per barrel, a level that is still triple to quadruple its historical equilibrium price of around $20 per barrel during the 1990's. On the other hand, the Pessimistic (high-price case) Scenario suggests that the price of oil could increase by eight times. The Central (middle-price case) Scenario, however, indicates that the oil price could eventually settle at above $90 per barrel (somewhat lower than price levels reached in early September 2008).

HOW OIL PRICES IMPACT U.S. FREIGHT TRANSPORTATION

The impact of higher oil prices on the cost of U.S. freight transportation is dramatic, but there are significant differences in impact between different modes of transport. Exhibit 4 depicts the differences in diesel fuel price projections for inland transport in 2020 between the low, central and high case scenarios. In the central case where oil prices hold above $90 per barrel in 2020, truck line-haul costs increase from $1.41 per mile in 2002 to $2.28 in 2020, an increase of 62 percent ($0.87 per mile) over 2002. Over the same period, rail line-haul costs increase from $0.30 to $0.45 per mile, an increase of 50 percent ($0.15 per mile). For container on barge, the increase is much smaller, from $0.19 to $0.23 per mile, an increase of only 21 percent ($0.04 per mile).

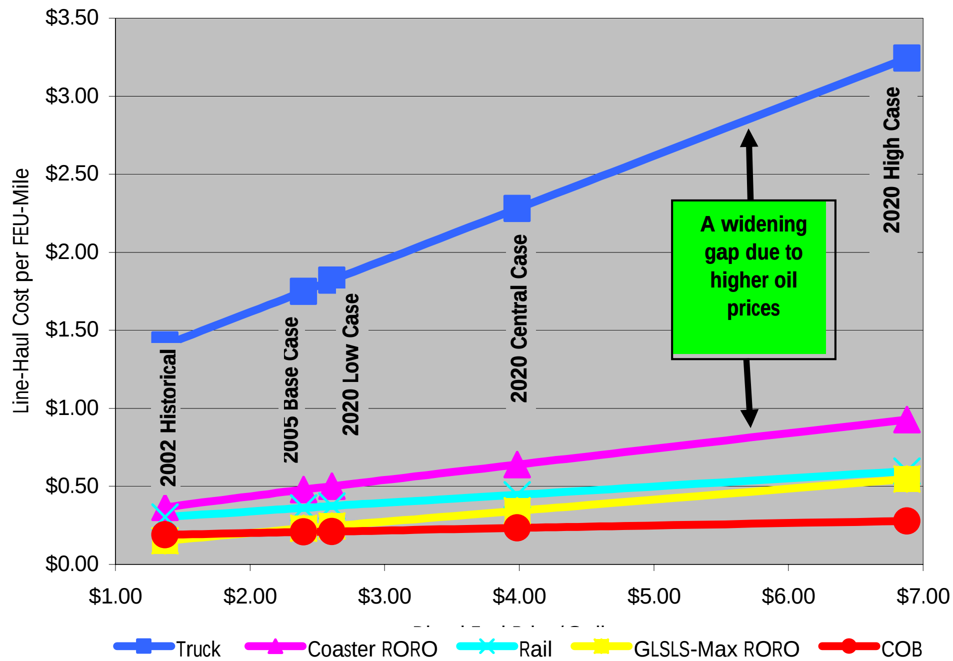
Exhibit 4: Comparison by Mode of Fuel Prices and Line-Haul Costs ($2008)

	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 5 shows the impact of increases in diesel fuel prices on line-haul costs. The more fuel-efficient rail and water modes, especially container on barge, are far less affected by fuel price increases than trucking. This gap between line-haul costs for truck versus rail and water widens as fuel prices increase, so that shippers can realize significant savings by using rail and water sources.

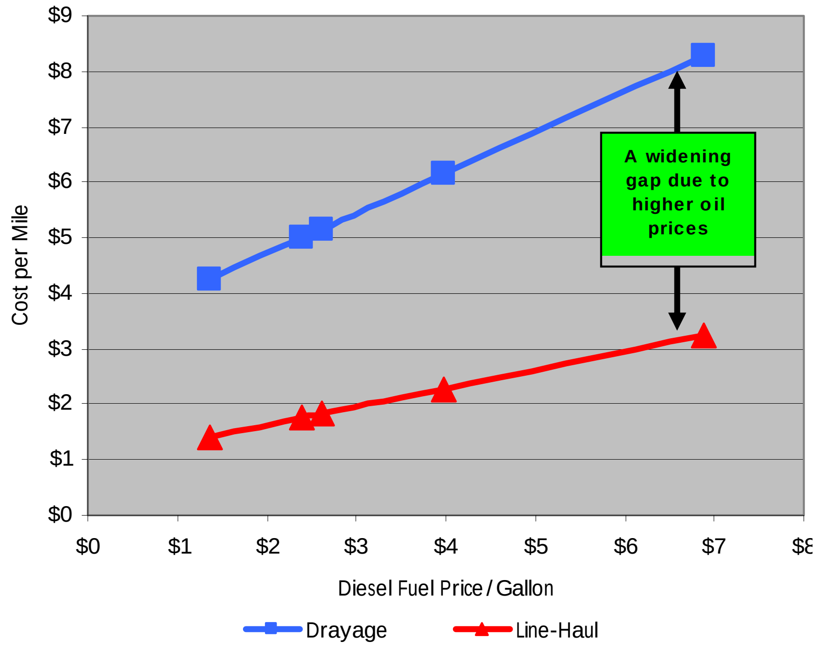
Exhibit 5: Comparison by Mode of the Impact of Diesel Fuel Prices on Line-Haul Costs ($2008)



However, an important issue for the rail and water modes is drayage – that is, the movement of goods from the rail terminal or port by truck to the final consignee. Like other trucking costs, these costs increase significantly when oil prices rise. Drayage costs per se are high because of the extra time needed for pick-ups and deliveries and because of the frequent absence of backhaul freight – that is, where there is no cargo for the return trip. Fortunately, drayage distances are usually short, limiting their impact on overall transport costs.

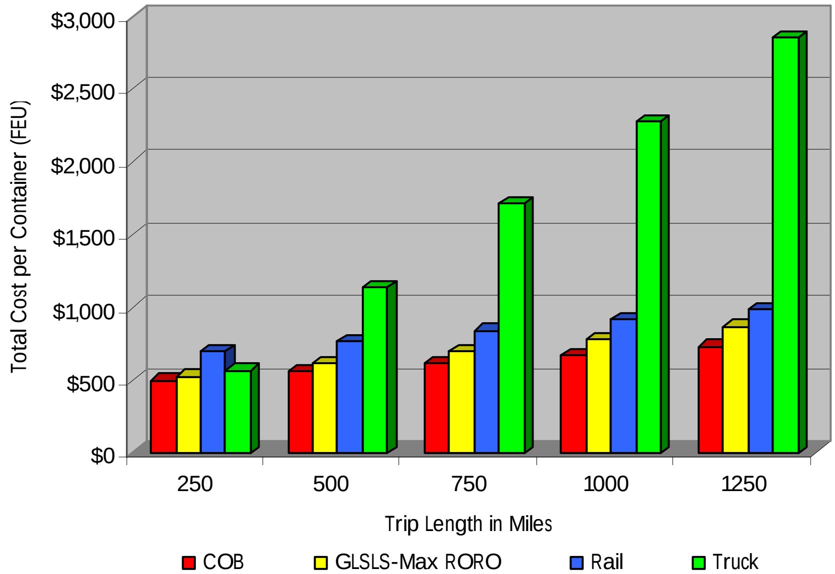
As typified by the central case scenario (shown in Exhibit 6), drayage costs rise substantially from $4.24 per mile in 2002 to $6.17 per mile in 2020, an increase of 46 percent ($1.93 per mile). This level of increase will encourage shippers that use intermodal services to locate manufacturing facilities or distribution centers even closer to ports and rail terminals to minimize drayage costs.

Exhibit 6: Impact of Fuel Prices on Drayage and Line-Haul Trucking Costs per Mile ($2008)



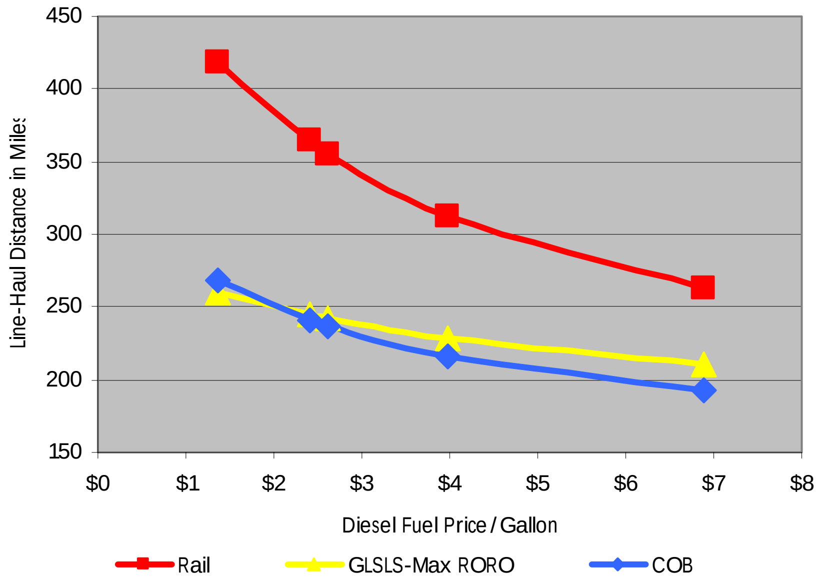
Even with typical drayage costs included, however, rail and water costs remain much lower than those of truck as fuel prices increase (as shown in Exhibit 7). Furthermore, because drayage and port costs remain relatively fixed, the advantage of rail and water transport increases over longer distances. Nonetheless, in the central case scenario where the diesel fuel price stabilizes at around $4 per gallon, shipping by water using Roll-On/Roll-Off vessels or barges (that avoids further intermodal transfers involving the costly operation of container cranes) can be cost-competitive with trucking for distances as short as 250 miles. However, rail transport still costs more than trucking at 250 miles because of the additional cost of intermodal container lifts between truck and rail.

Exhibit 7: 2020 Central Case Scenario - Comparison of Water, Rail and Trucking Total Costs per Mile for Line-Haul and Drayage ($2008)



The minimum line-haul breakeven distances needed to make intermodal shipping by water and rail able to compete with truck transportation is shown in Exhibit 8. Even accounting for the cost of drayage, rail and water services can compete with direct truck service over longer distances because the lower fuel efficiency of truck transport hurts its cost competitiveness. Even where faster shipping time is desirable, truck operation over long distances becomes very expensive because truck drivers are required to rest or sleep to assure that they are able to drive safely.

Exhibit 8: Line-Haul Breakeven Distance by Mode ($2008)



Although the minimum breakeven line-haul for rail is calculated at only 400 miles, railroads typically require at least 700 to 1,000 miles to generate a sufficient profit margin. Railroads need this profit margin because they must finance their own infrastructure costs for expanding capacity, and traditionally their short-haul traffic has not generated sufficient profit to justify the required infrastructure investment. Moreover, U.S. railroads (particularly those with east-west corridors) have struggled with capacity constraints over the past decade and so are limited in terms of how much additional traffic they can carry.

In contrast, expansion of water services would use existing waterways, which have considerable capacity available. For example, the St. Lawrence Seaway (which enables shipping between the Great Lakes and the Atlantic Ocean) has been estimated to be operating at around half (50 percent) of potential capacity in recent years. Therefore, waterborne transportation can compete for intermodal truck freight at distances where rail is not competitive or does not have the capacity to handle more freight traffic. This also implies that water may be able to complement or augment existing rail capacity rather than competing directly with rail in many freight corridors.

In the current market, water will tend to move intermodal freight that rail is unable to economically handle. This is especially true for the lower-cost water shipping options such as container on barge (COB). As future trade growth strains rail capacity to its limits, moreover, water may be able to move more cargo that would otherwise move on rail.

In terms of the different types of water vessels, one of the most important results of the analysis is the relative strength of slower moving, COB services. As fuel prices increase, COB service becomes more and more cost competitive with truck and rail. Although COB is slower than rail, its costs are much less affected by fuel prices than either Roll-On/Roll-Off (RORO) or rail services. Cost increases for COB services are only around one-third of those for ROROs.

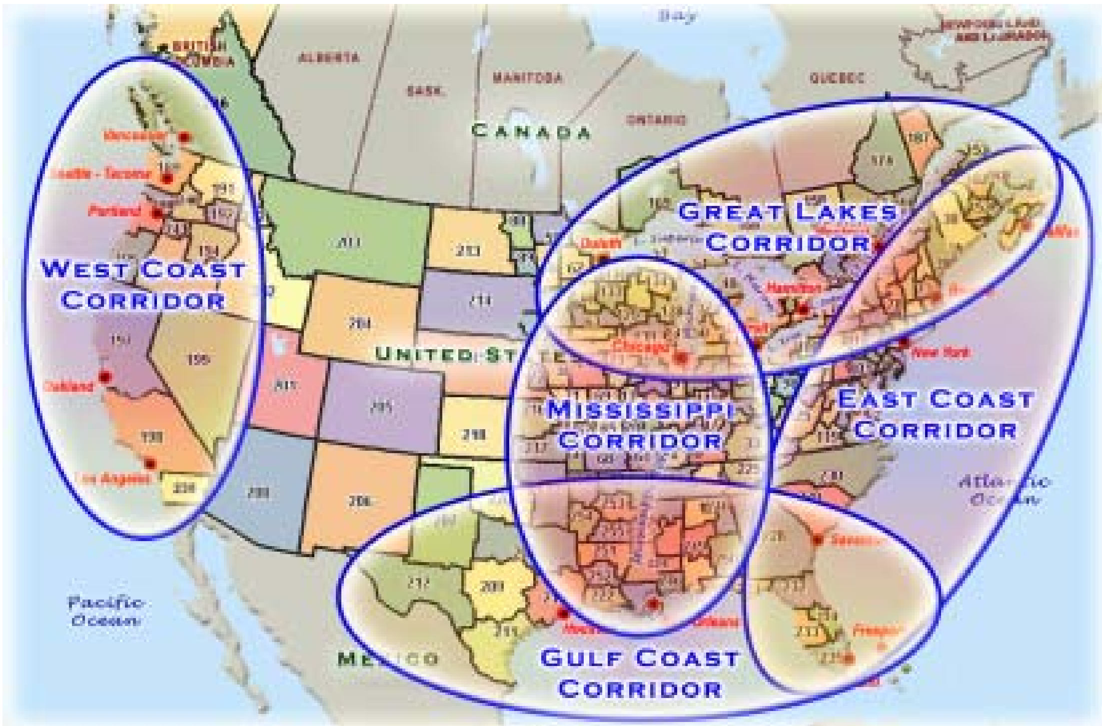
Previous analysis of large 22-knot inland or coastal RORO vessels (proposed for service on the Great Lakes and St. Lawrence Seaway[3]) suggest that waterborne transportation can already compete with rail and truck on a transit-time basis and will maintain its cost-competitiveness as fuel prices increase. In the past, COB service has not offered enough cost savings to attract much shipper interest. However, COB service may very well become attractive to shippers if fuel prices rise to levels that make alternative services too costly for low- and medium-value commodities.

REGIONAL TRANSPORTATION IMPACTS: THE FIVE CORRIDORS

A detailed analysis was undertaken for five major U.S. transportation corridors that serve over 95 percent of the U.S. population (as shown in Exhibit 9). These corridors run along or through the Great Lakes (and St. Lawrence Seaway), East Coast, Gulf Coast, Mississippi River, and West Coast. Based on the low, central, and high oil-price case scenarios discussed previously, equilibrium demand models (which hold supply and demand for oil in balance) were developed to identify the relative competitive positions and market shares of truck, rail, and water in domestic freight movements for these corridors.

[3] TEMS, Inc. and RAND Corporation, "Great Lakes - St. Lawrence Seaway: New Cargoes/New Vessels Market Assessment Report," prepared for the Maritime Administration, U.S. Department of Transportation and Transport Canada, January 2007 (http://www.marad.dot.gov/publications).

Exhibit 9: The Five Regional Corridors Evaluated in the Analysis

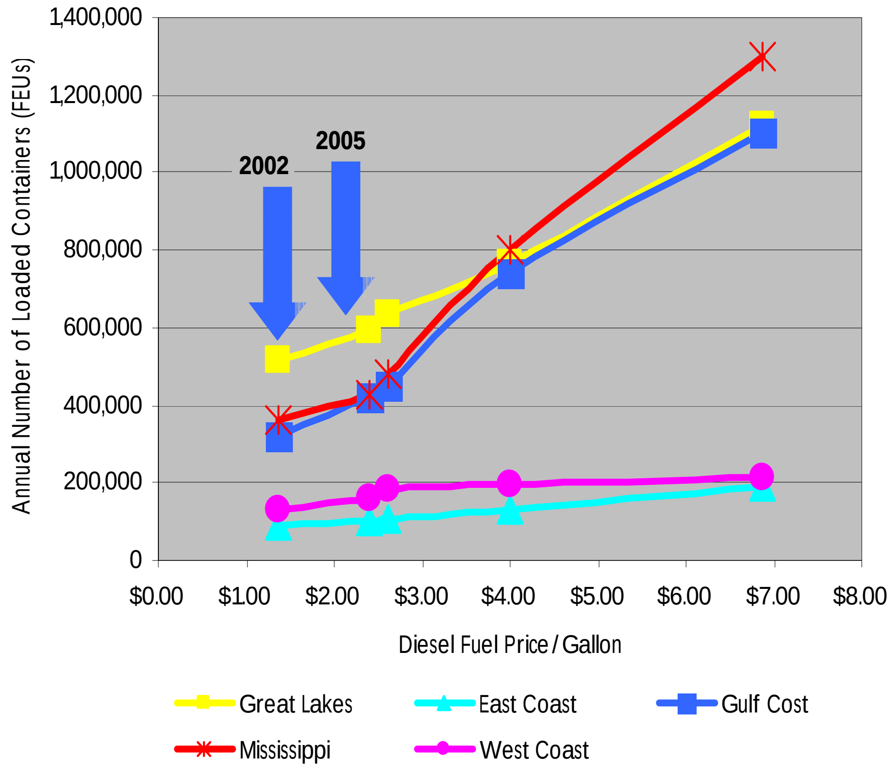


The results show that new waterborne services could move containerized cargo (in FEUs) in all five corridors, such that waterborne freight traffic increases by a factor of 2 to 3 as fuel prices increase from $2 up to $7 per gallon. The Great Lakes, Mississippi River, and Gulf Coast freight corridors (which can divert traffic from truck and, to a lesser extent, from rail transportation) generate sufficient domestic traffic volume to initiate new water services, while a portion of the huge and growing volume of U.S. international trade now distributed inland through gateway Atlantic and Pacific seaports also can be moved by new coastal feeder services. In assessing these results, it should be recognized that the $7 per gallon fuel price is not an unlikely possibility. Fuel prices were more than $5 per gallon this summer and, in a tightening oil market, are likely to continue rising over the next five years.

The results for bulk traffic are similar. Real growth potential for bulk traffic was indicated in the Great Lakes, Mississippi River, and Gulf Coast corridors, where improvements in rail productivity had stifled growth of waterborne transport in recent years. Rising fuel prices, along with a shortage of rail capacity, are likely to shift the shipping cost advantage back to water both in its traditional bulk markets and for lower value containerized freight.

Although the East and West Coast corridors have limited potential for increased domestic traffic, they have a major potential for developing water feeder services for distributing international containers from major ports (as shown in Exhibit 10). Given that international containers already at a port do not incur any additional drayage costs to use a feeder service, the economics for this type of feeder service are even stronger than for domestic intermodal services. This is because domestic intermodal services require additional drayage costs at both ends of the movement. In addition to limiting the impact of drayage cost increases, developing feeder systems for distribution from major ports to satellite ports would enable the major ports to maintain adequate capacity to handle increasingly larger ocean vessels.

Exhibit 10: Sensitivity by Corridor of Domestic Container (FEU) Traffic to Diesel Fuel Prices ($2008)



Note: East and West Coast container traffic does not include most import and export containers.

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.

CONCLUSION

Overall, the impact of recent oil price hikes has created a strong case for investing in waterborne transportation – for both inland and coastal freight distribution. Further increases in oil prices, which would increase fuel costs three- to eight-times over their historical equilibrium levels could make the U.S. transportation environment more like that of Europe in the 1990's. Historically, coastal and inland water transport has been far more significant in Europe than in the U.S. because of higher European inland rail and truck transport costs that make water cost-effective. The 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 U.S. if the cost differential between the three modes is maintained at the levels reached in 2008 because of much higher fuel prices.

In summary, higher oil prices could well promote a significantly enhanced role for water in the U.S. transportation network. This study reveals the potential for such a modal shift in the market attractiveness of waterborne freight transportation. However, this potential can only be recognized if it is supported by public policies that encourage industry and its public partners to invest in the ships, ports, and other infrastructure needed.