FHWA National Gateways and Corridors Concepts

August 2013

U.S. Department of Transportation
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16. Abstract

Freight corridors and gateways are key elements of the transportation network, and thus investment in them is critical to maintain economic competiveness. To make sure our future needs are met while ensuring economic competitiveness, there is a need for the United States and its North American partners to identify proactively where new infrastructure should be built to handle changes in trade patterns, demographics and freight flows with a focus on the role of transportation infrastructure in facilitating exports. Thus, the focus of the National Gateways and Corridors Concepts project is to identify and document multimodal corridor and gateway needs, trends, and opportunities to assist in the development of future national infrastructure plans that will assure U.S. and North American competiveness.

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SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
	NOTE: volumes greater than 1000 L shall be shown in m^3			
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		TEMPERATURE (exact degrees)		
°F	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	°C
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	$candela/m^2$	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
		TEMPERATURE (exact degrees)		
°C	Celsius	1.8C+32	Fahrenheit	°F
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	$candela/m^2$	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380.
(Revised March 2003)

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1.0 Introduction

1.1 STUDY OVERVIEW

The freight transportation system in North America is vital to improve the region's economic competitiveness. Over the past two decades, significant growth of Asian economies has shifted global trade patterns dramatically and affected the United States' businesses in tremendous ways. To maintain and enhance economic competiveness, the United States must in part rebalance its trade by increasing net export activities. Freight cost and system reliability, speed, and efficiency are critical to achieving this goal as businesses depend on the transportation network to get their products to consumers on time and to get supplies when they need them in the global market place.

Freight corridors and gateways are key elements of the transportation network, and thus investment in them is critical to maintain economic competiveness. However, the freight transportation system in the United States is facing increasing demand and insufficient investment that has resulted in deteriorating highways, bottlenecks and congestion, along with insufficient last-mile connectors between highways and port and railroad facilities. Forecasts indicate that the freight flows in the United States will grow by 236 percent from 2007 to 2040 by value.[1] The increase in freight flows can be attributed to population growth and demographic shifts that will place additional strain on the existing network.

To make sure our future needs are met while ensuring economic competitiveness, there is a need for the United States and its North American partners – Mexico and Canada, to identify proactively where new infrastructure should be built to handle changes in trade patterns, demographics and freight flows with a focus on the role of transportation infrastructure in facilitating exports. Thus, the focus of the National Gateway and Corridor Concepts project is to:

- Identify and document multimodal corridor and gateway needs, trends and opportunities to assist in the development of future national infrastructure plans that will ensure U.S. and North American competitiveness.

[1] FHWA Freight Analysis Framework 3 (FAF 3).

1.2 SUMMARY OF GATEWAY AND CORRIDOR FLOWS

Over the last two decades export and import activities in the United States increased dramatically, along with growth in GDP and other variables. The values of trade goods have been growing at a rate of 6.6 percent annually for exports and 7.4 percent annually for imports from 1992 to 2012.[2] The 2012 total values of exports reached $2,211 billion, while imports reached $2,745 billion.

To understand how important trade activities are to the United States, a comparison to the national GDP is useful to look at. Since net export values (export minus import) are used to calculate GDP, we can compare the export and import values to the GDP to get a sense of the share of the international trading values as compared to the total domestic U.S. economy. Table 1.1 shows the export and import values for the past two decades, and the percent share of GDP. As we can see, the shares of GDP for exports have grown by about 4.4 percent over the 20-year period, while for imports it has grown by 8 percent over the 20-year period, nearly double that of export growth.

The trend that imports are forming an increasingly larger share of our GDP is evident in the trade balance figures as well, since the trade deficit has increased by almost 400 percent over the last 20 years, peaking in 2006. Graphically, as we can see on Figure 1.1, export growth is comparable to that of GDP growth, but import growth has been much more robust in the past two decades. The economic crisis in 2009 brought down growth for all three areas and seemed to have, at least temporarily, narrowed the trade balance gap.

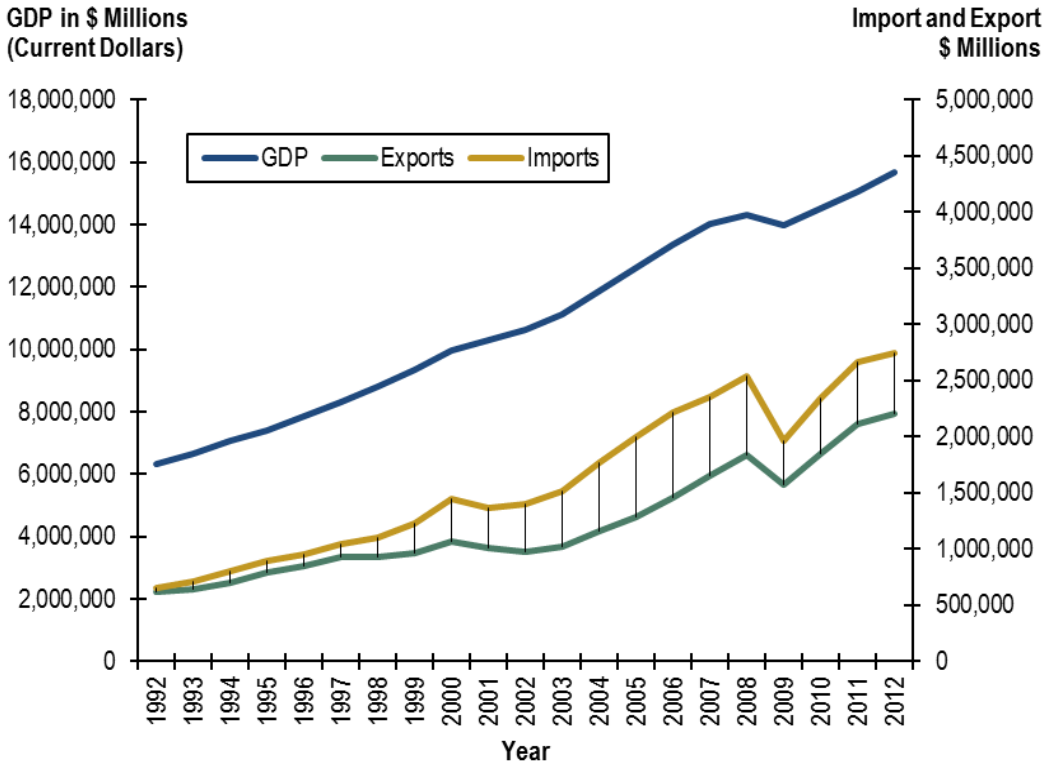
[2] U.S. Bureau of Economic Analysis.

Table 1.1 U.S. Export and Import Values and GDP Share
1992 to 2012, Billions of Dollars

	Exports		Imports		
Year	Values	% Share GDP	Values	% Share GDP	Trade Balance
1992	617	9.7%	656	10%	-39
1993	643	9.6%	713	11%	-70
1994	703	9.9%	802	11%	-99
1995	794	10.7%	891	12%	-97
1996	852	10.9%	956	12%	-104
1997	934	11.2%	1,043	13%	-109
1998	933	10.6%	1,099	13%	-166
1999	967	10.3%	1,231	13%	-264
2000	1,073	10.8%	1,450	15%	-377
2001	1,008	9.8%	1,370	13%	-362
2002	981	9.2%	1,399	13%	-418
2003	1,024	9.2%	1,514	14%	-490
2004	1,164	9.8%	1,769	15%	-605
2005	1,288	10.2%	1,996	16%	-708
2006	1,461	10.9%	2,213	17%	-752
2007	1,653	11.8%	2,352	17%	-699
2008	1,840	12.9%	2,543	18%	-703
2009	1,578	11.3%	1,962	14%	-384
2010	1,844	12.7%	2,344	16%	-500
2011	2,113	14.0%	2,670	18%	-557
2012	2,211	14.1%	2,745	18%	-534

Source: Compiled with data from National Incomes and Products Accounts Tables, Bureau of Economic Analysis.

Figure 1.1 Growth Trends of Exports, Imports and GDP
1992 to 2012

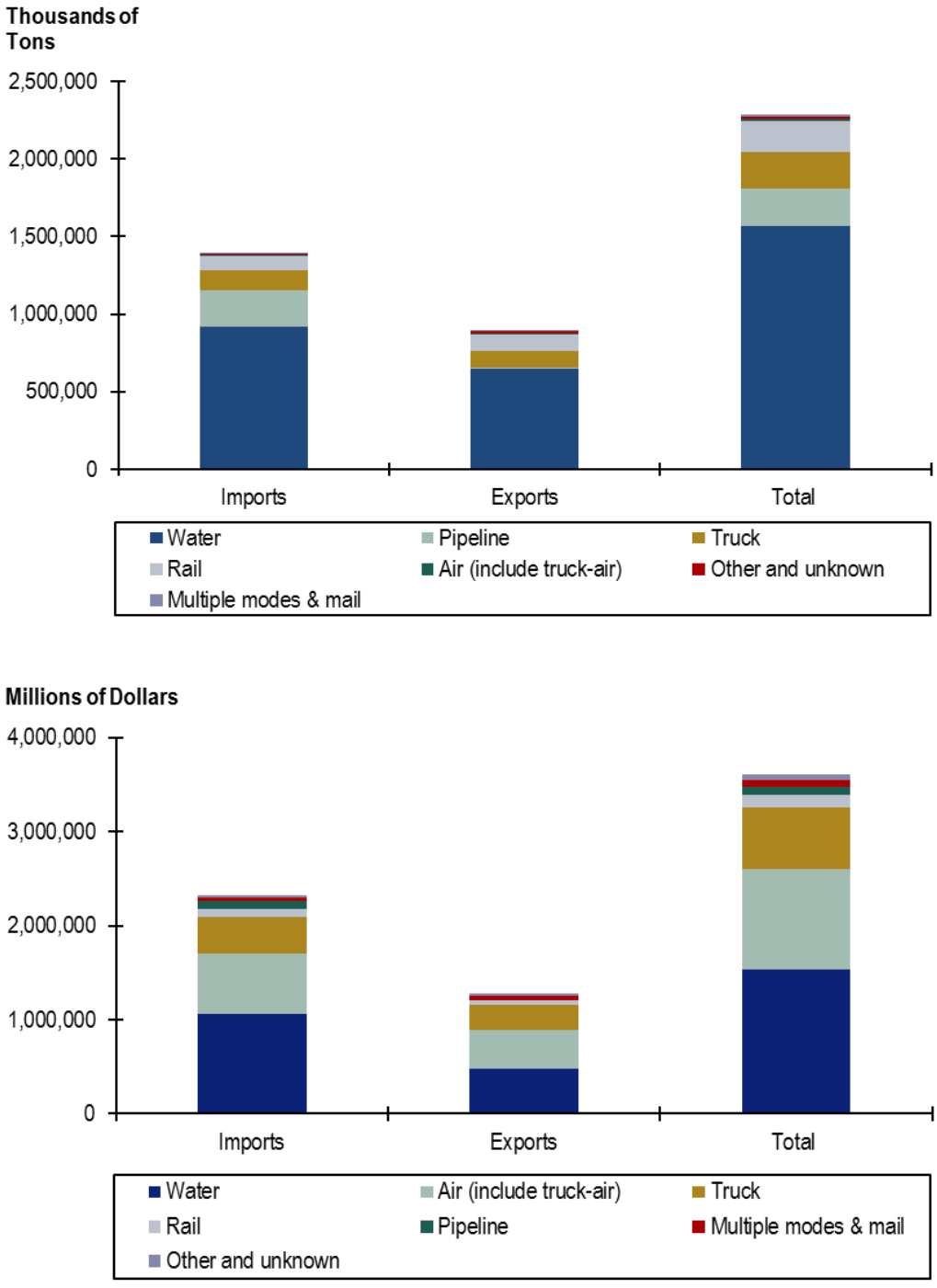


Source: Compiled with data from National Incomes and Products Accounts Tables, Bureau of Economic Analysis.

Modes of Transport

International merchandise is brought into and out of the U.S. by a variety of transport modes. Trans-oceanic shipment of containers and bulk cargoes on large vessels can transport goods between the U.S. and various key trading partners, such as China and European countries, in an efficient and economic manner providing the majority of international transport by weight. As shown in Figure 1.2, about 68 percent of total freight tonnage entering and leaving the U.S. is moved by water. By weight, the share of air freight moved drops to below 1 percent, while truck, pipeline, and rail drop to about 10 percent each.

Figure 1.2 Modal Shares of Exports and Imports by Weight and Value, 2011



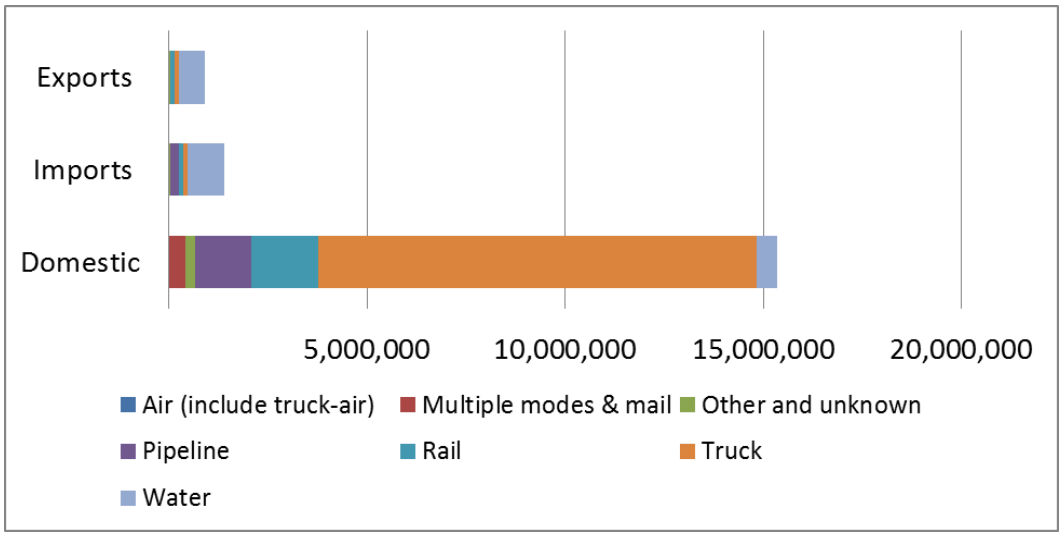
Source: Compiled with data from FAF3, FHWA.

The value of waterborne freight entering and leaving the U.S., however, equates to only about 43 percent of all freight movement by value as many high dollar value items travel by other modes. By value, air and truck account for 29 percent

and 18 percent of total freight movement, respectively. Rail and pipeline account for the remaining 10 percent by value. Notable is the fact that modal share for imports and exports is very similar with the exception of pipelines, evidencing attempts on the part of carriers to achieve some balance in the trade lanes.

In addition to looking at the modes of transport by which goods are transported outside of the entry/exit points with the United States, it is also useful to look at the modes by which goods are transported within the United States, from the origin location to the exit point for exports, and from the point of entry to the destination location for imports. Figure 1.3 shows the modal share of exports and imports by domestic mode, by tonnage. As we can see, a majority of goods are moved by trucks for exports, followed by rail. However, for imports, more than 37 percent of goods also come from pipelines, indicating the vast volumes of petroleum and gas products that the United States consumes. Comparing export/import with domestic volumes indicate that export and import together only form about 10 to 20 percent of the domestic goods flow volumes.

Figure 1.3 Domestic Modes of Transport for Export, Import and Domestic Goods Movement
2011, Thousands of Tons



Source: Compiled with data from FHWA FAF3.

Top Trading Partners

Table 1.2 shows the United States' top 15 trading partners by total trade value in 2012. Canada is the top trading partner with the U.S., making up 16 percent of all trade value in 2012. This is followed by China, which makes up about 14 percent of the total trade value. However, unlike Canada where import and export values are comparable, the U.S. imports almost four times as much goods from China as it exports. The third top trading partner is Mexico, which makes up about 13 percent of total trade values and receives almost twice as many U.S. exports as China. Together, the top three countries make up 43 percent of all trade by value.

The remaining countries include Japan, South Korea, Taiwan, and India in Asia; Germany, United Kingdom, France, Netherlands and Italy in Western Europe; Brazil in South America and Saudi Arabia in the Middle East. In general, the top 15 countries make up 72 percent of total trade values. For all of these countries, with the exceptions of Brazil and Netherlands, U.S. imports exceed exports. These findings indicate that U.S. trades are dominated by a relatively small number of countries and regions resulting in specific trade corridors, and change in trading dynamic with any one of these countries can affect these trade lanes and their importance.

Table 1.2 Top 15 U.S. Trading Partners by Total Trade Value
2012, Billions of Dollars

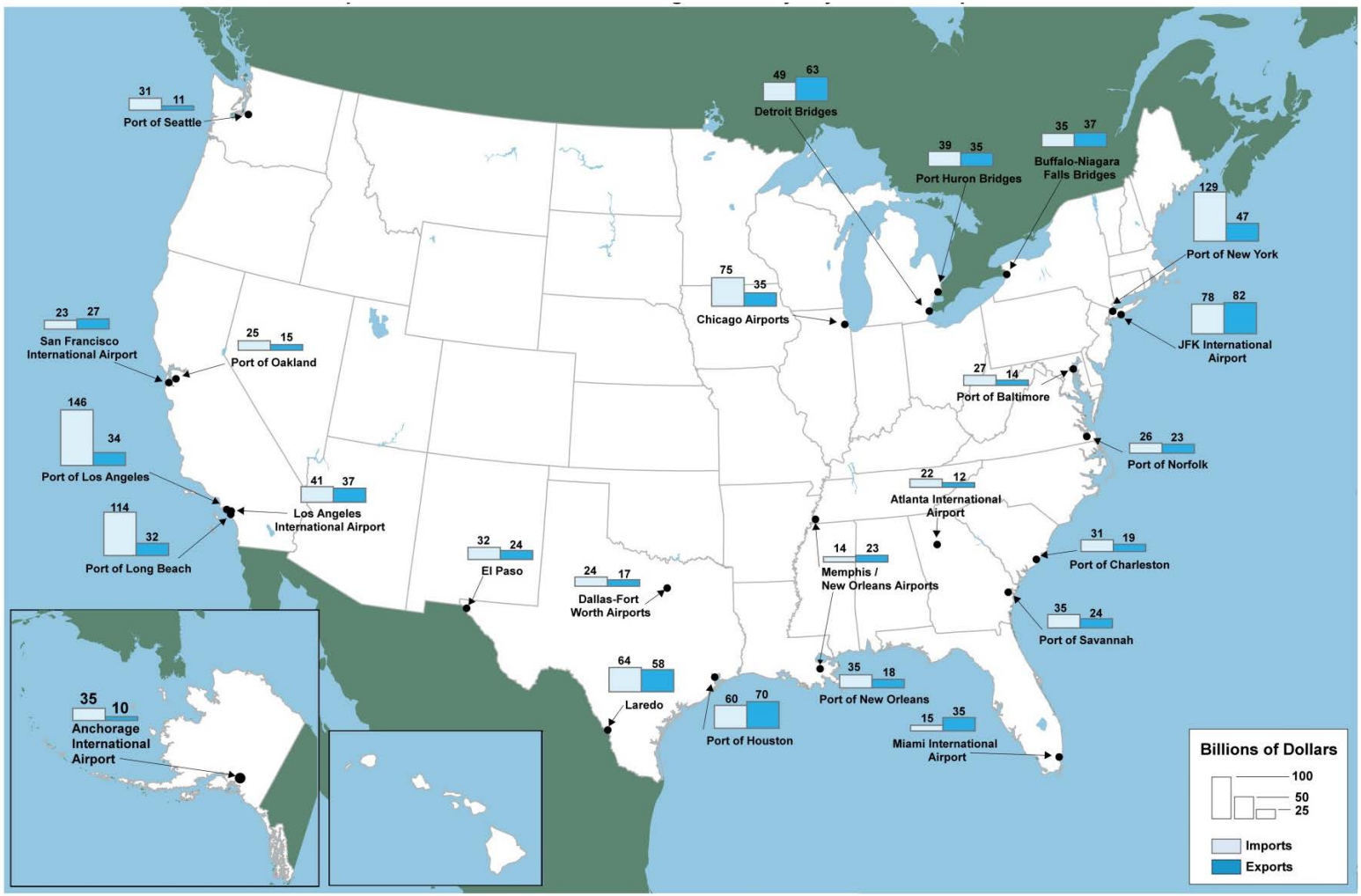
Rank	Country	Exports	Imports	Total Trade	Percent of Total Trade
---	Total, All Countries	1,547	2,275	3,822	100%
---	Total, Top 15 Countries	1,049	1,703	2,752	72%
1	Canada	292	324	617	16%
2	China	111	426	536	14%
3	Mexico	216	278	494	13%
4	Japan	70	146	216	6%
5	Germany	49	109	157	4%
6	United Kingdom	55	55	110	3%
7	Korea, South	42	59	101	3%
8	Brazil	44	32	76	2%
9	Saudi Arabia	18	56	74	2%
10	France	31	42	72	2%
11	Taiwan	24	39	63	2%
12	Netherlands	41	22	63	2%
13	India	22	41	63	2%
14	Venezuela	18	39	56	2%
15	Italy	16	37	53	1%

Source: U.S. Census Bureau, Foreign Trade Statistics.

Top Trade Gateways

All merchandise for international trade have to go through gateways along the U.S. borders and coasts and inland air gateways. The top 25 gateways by value of shipments for 2010, as shown in Figure 1.4, include 11 water ports, 5 land-border crossings, and 9 air gateways.

Figure 1.4 Top 25 Foreign-Trade Freight Gateways by Value
2010



Source: Freight Facts and Figures, FHWA, 2012.

Although a few ports are major export centers, the vast majority of the top ports have more import activities than export. These major trade gateways include the Port of Los Angeles, Port of New York and JFK International Airport, Port of Long Beach, Port of Houston, and the land border ports of Detroit and Laredo. Regions with major gateway crossing activities include the Great Lakes region and the Southwestern U.S., most notably Texas. U.S. trade relationships have a significant impact on the import and export patterns at various gateways, and evolving trade relationships will continue to shape trade gateways and corridors in the future.

Table 1.3 displays the value of the imports and exports for the top 25 ports for the year 2011. The top 25 ports together account for 62 percent of total U.S. exports and 60 percent of total U.S. imports, suggesting that goods move through the U.S. at a few locations, but in large quantities.

Table 1.3 Top 25 Trade Gateways by Mode and Value
2011, Billions of Dollars

Gateway	Type	Rank	Exports	Imports	Total	Percent Total
Total U.S. Trade		–	1,547	2,275	3,882	100.0%
Top 25 Ports		–	938	1,353	2,291	59.0%
Los Angeles, CA	Water	1	44	170	215	5.5%
New York, NY	Water	2	57	150	207	5.3%
John F. Kennedy International Airport, NY	Air	3	96	94	190	4.9%
Houston, TX	Water	4	87	80	168	4.3%
Long Beach, CA	Water	5	34	119	153	4.0%
Laredo, TX	Land	6	68	77	145	3.7%
Detroit, MI	Land	7	66	55	121	3.1%
Chicago, IL	Air	8	36	80	115	3.0%
Los Angeles International Airport, CA	Air	9	40	43	83	2.1%
Port Huron, MI	Land	10	40	43	83	2.1%
Buffalo-Niagara Falls, NY	Land	11	44	38	82	2.1%
Savannah, GA	Water	12	31	41	72	1.8%
Miami International Airport, FL	Air	13	41	20	61	1.6%
El Paso, TX	Land	14	27	33	60	1.5%
New Orleans, LA	Air	15	24	35	59	1.5%
Charleston, SC	Water	16	22	37	59	1.5%

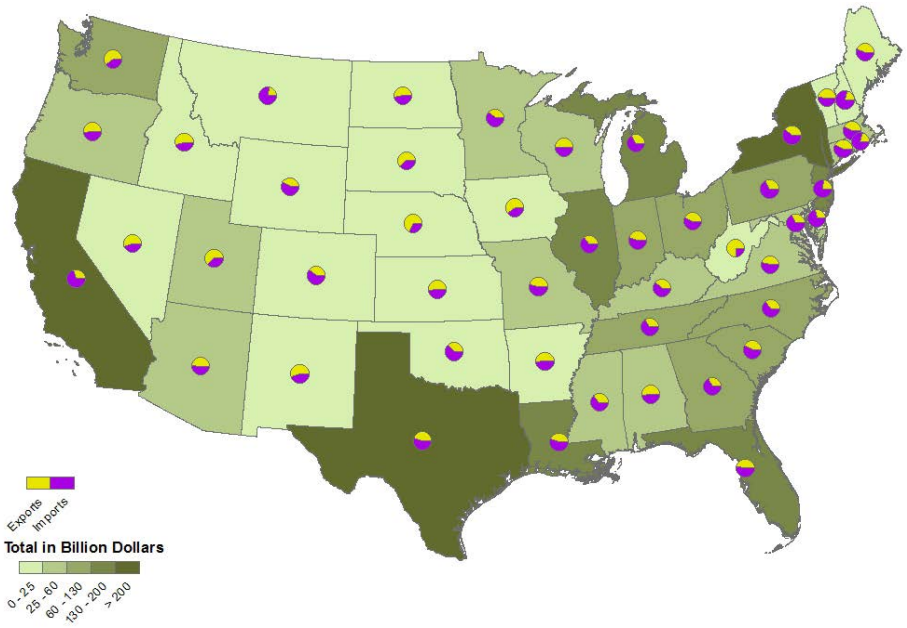
Gateway	Type	Rank	Exports	Imports	Total	Percent Total
Norfolk, VA	Water	17	28	30	58	1.5%
Baltimore, MD	Water	18	20	31	51	1.3%
San Francisco International Airport, CA	Air	19	26	24	50	1.3%
Oakland, CA	Water	20	18	28	46	1.2%
Dallas-Fort Worth, TX	Air	21	17	29	46	1.2%
Anchorage, AK	Air	22	10	35	44	1.1%
Seattle, WA	Water	23	14	29	43	1.1%
New Orleans, LA	Water	24	23	19	42	1.1%
Cleveland, OH	Air	25	23	15	38	1.0%

Source: National Transportation Statistics, BTS, 2012.

Top Trading States

Goods moving through gateways can come from the vicinity or from inland areas. As Figure 1.5 shows, the majority of the value of goods for international trade comes from the Great Lakes region, Texas, the West Coast and the Southeast, where access to international markets is most direct and gateways and corridors are well developed. This does not mean the mountain states play no role in international trade. On the contrary, these sparsely populated states are usually responsible for more exports than imports.

Figure 1.5 Import/Export Trade in Million Dollars by State
2012, Billions of Dollars



Source: Compiled using data from Freight Trade Data, U.S. Census Bureau, 2012.

Table 1.4 shows the top 10 exporting states by export value in 2012, and top two commodity exports from each of them. Most exports are from the manufacturing sector. The largest oil exporter state is Texas, and 21 percent of its State's exports are petroleum products (including light oil).

Table 1.4 Top 10 Exporting States Key Commodities by Value
2012, Millions of Dollars

State	Manufactured Exports	Nonmanufactured Exports	Total Exports	Top Commodity	Share of State Total	Top Commodity 2	Share of State Total
Texas	210,597	13,673	265,352	Petroleum oil	13%	Light oils	8%
California	104,433	20,183	161,700	Aircraft engines, parts	4%	Diamonds, nonindustrial	3%
New York	46,215	10,831	79,189	Diamonds, nonindustrial	14%	Gold	8%
Washington	56,814	15,863	75,525	Aircraft engines, parts	49%	Soybeans	7%
Illinois	54,764	4,630	68,026	Dumpers	7%	Light oils	4%
Florida	52,084	4,040	66,398	Gold	12%	Aircraft engines, parts	8%
Louisiana	41,510	21,211	63,156	Petroleum oil	29%	Soybeans	20%
Michigan	48,736	3,246	56,902	Passenger vehicle	10%	Freight motor vehicles	7%

State	Manufactured Exports	Nonmanufactured Exports	Total Exports	Top Commodity	Share of State Total	Top Commodity 2	Share of State Total
Ohio	42,011	2,319	48,535	Aircraft engines, parts	11%	Spark ignition engines	4%
Pennsylvania	30,724	3,093	38,869	Nucleic acids and salts, other heterocyclic CMP	4%	Bituminous coal	3%

Source: Compiled with data from Freight Trade Data, U.S. Census Bureau, 2012.

The relative share of each product is small to moderate, indicating that most states export a variety of products. However, a few states rely exclusively on exporting one or two products. For instance, 49 percent of Washington's exports are airplanes and parts in terms of value (due to Boeing). Airplanes are generally transported on rail with airplane parts being transported on both rail and truck to be delivered to final destinations.

As mentioned before, the emergence of a large Chinese middle class has significantly increased demand for agriculture feed products. Large quantities of soybeans, corn, and wheat are grown in the U.S. and exported to China. As a result, soybeans are the second top commodity exported from Washington State and Louisiana, where for the latter, soybeans make up a whopping 20 percent of total export value. Agriculture products have historically been transported on bulk rail, but recently intermodal rail has increasingly been used for transport of agriculture products.

It is important to keep in mind that the top commodities in terms of weight may be drastically different than those in terms of value. This is important because high-weight and high-value commodities have different requirements for the transportation system. For instance, New York exports mostly highly valuable jewelry and art works that are likely to be relatively low in terms of weight, thus, impacting physical condition of the ground transportation system only minimally, but requiring considerable reliability, security, and visibility throughout transport.

Top importing states do not differ significantly from the top exporting states in terms of commodities, as shown in Table 1.5. For California, about 8 percent of imports are crude oil, and about 7 percent are passenger vehicle. Texas, a top petroleum products exporting state, imports a large share of crude oil (32 percent of total state imports). This means that crude oil gets processed in Texas, where a portion of it gets exported while the rest is distributed for domestic consumption. This is even truer for Louisiana, where 72 percent of its imports are crude oil. Another interesting pattern to notice is that Michigan also imports a significant number of passenger cars, even though it is a key automobile manufacturing center in the U.S.

Table 1.5 Top Importing States Key Commodities by Value
2012, Millions of Dollars

State	Manufactured Imports	Nonmanufactured Imports	Total	Top Commodity 1	Percent of State Total	Top Commodity 2	Percent of State Total
California	324,559	51,741	376,300	Crude oil	8%	Passenger vehicle	7%
Texas	212,307	117,888	330,195	Crude oil	32%	Petroleum oil	5%
Illinois	90,057	36,771	126,828	Crude oil	23%	Cellphones	7%
New York	104,353	19,869	124,221	Diamonds, nonindustrial	14%	Painting, drawings	3%
New Jersey	100,909	19,928	120,837	Crude oil	12%	Light oils	9%
Michigan	108,006	8,251	116,257	Passenger vehicle	22%	Med passenger vehicles	11%
Louisiana	20,508	60,400	80,908	Crude oil	72%	Petroleum oil	12%
Pennsylvania	63,293	17,397	80,690	Crude oil	17%	Medical products	8%
Georgia	69,501	2,902	72,403	Med passenger vehicles	9%	Large passenger vehicles	5%
Florida	60,684	10,529	71,213	Gold	9%	Petroleum oil	5%

Source: Compiled with data from Freight Trade Data, U.S. Census Bureau, 2012.

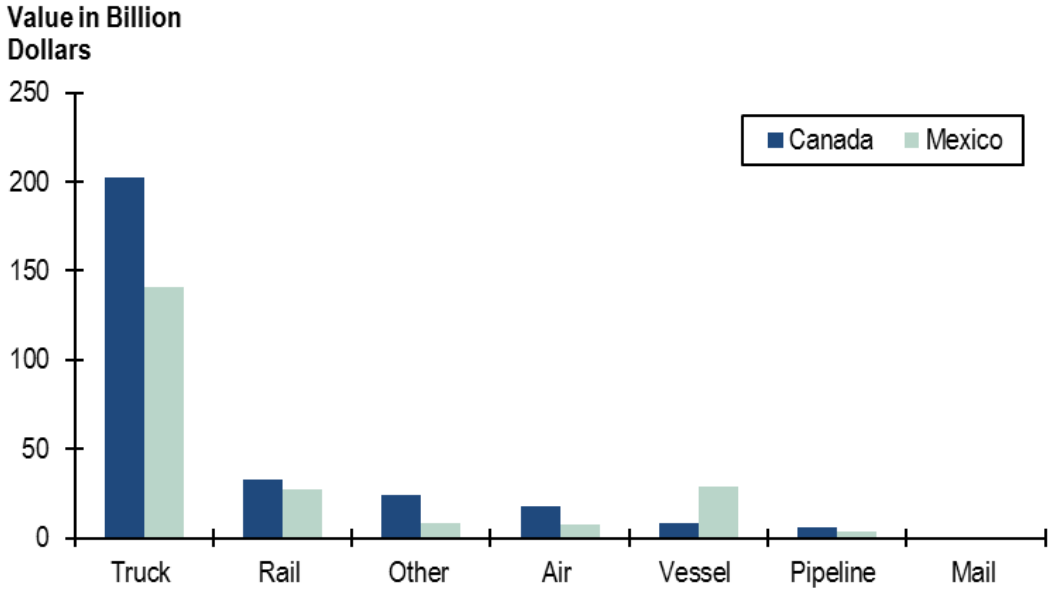
1.3 NAFTA TRADE

Trade blocs are intergovernmental agreements where regional barriers to trade are reduced or eliminated among the participating countries. The North American Free Trading Agreement (NAFTA) came into force on January 1, 1994. This agreement between the United States, Canada and Mexico enabled the creation of the world's largest trading bloc. Trading blocs have significant economic and social implications for all partnering countries, such as increased market power and influence. For the first seven years following passage of NAFTA, the United States tripled trade and had the largest expansion of jobs in its history.

Modes of Transport

In 2012, the U.S. exported $292 billion worth of goods to Canada and $216 billion to Mexico. Not surprising, exports to Canada and Mexico are predominately moved by trucks, then by rail (Figure 1.6). Exports to Canada are higher for all modes, except for vessel, due to maritime trade on the Gulf of Mexico.

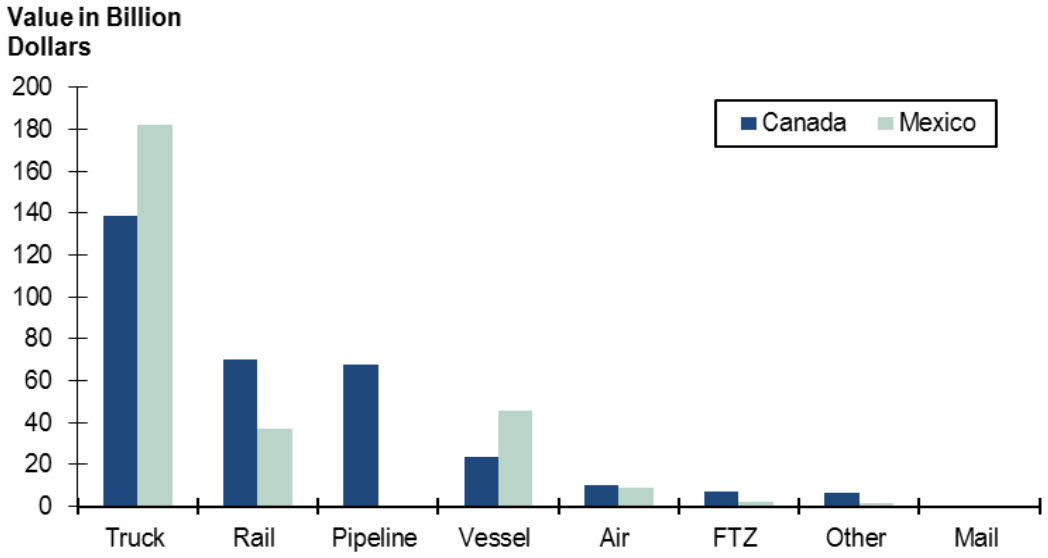
Figure 1.6 Export Values by Mode
2012, Billions of Dollars



Source: Compiled with data from North American TransBorder Freight Data, BTS, 2012.

In the same time period, the U.S. imported $324 billion worth of goods from Canada, and $278 billion from Mexico, as shown by Figure 1.7. Imports are primarily transported by trucks, followed by rail for both Canada and Mexico. However, pipeline imports come exclusively from Canada, while much more vessel imports came from Mexico than Canada.

Figure 1.7 Import Values by Mode
2012, Billions of Dollars



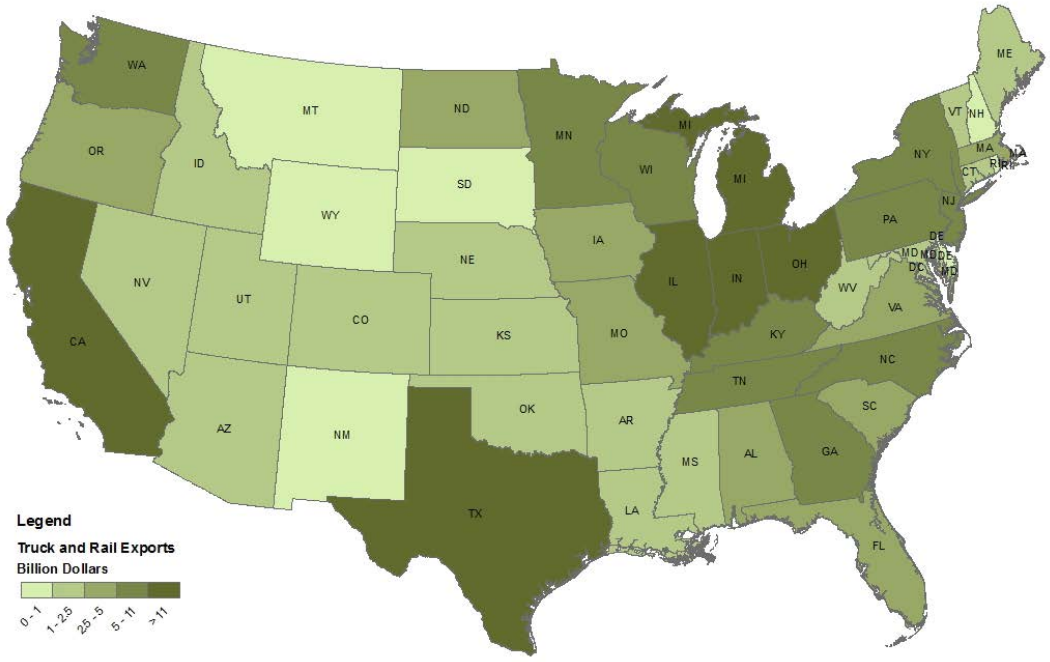
Source: Compiled with data from North American TransBorder Freight Data, BTS, 2012.

Trade between U.S. States and Canada

Figure 1.8 shows exports by state to Canada. While the Great Lakes and the Northwestern states are expected to have high amounts of export activities, Texas and California are also top exporters to Canada. This means that goods moving from California and Texas to Canada have to travel long distances on rail and by trucks.

Table 1.6 shows the top two export commodities from the top 10 exporting states to Canada, which are dominated by vehicles, computers and machinery. Exports from Michigan and Indiana especially are highly dominated by vehicles.

Figure 1.8 Values of Export to Canada by Truck and Rail
2012, Billions of Dollars



Source: Compiled with data from North American TransBorder Freight Data, BTS, 2012.

Table 1.6 Top 10 Exporting States to Canada and Their Top Commodities
2012, Billions of Dollars

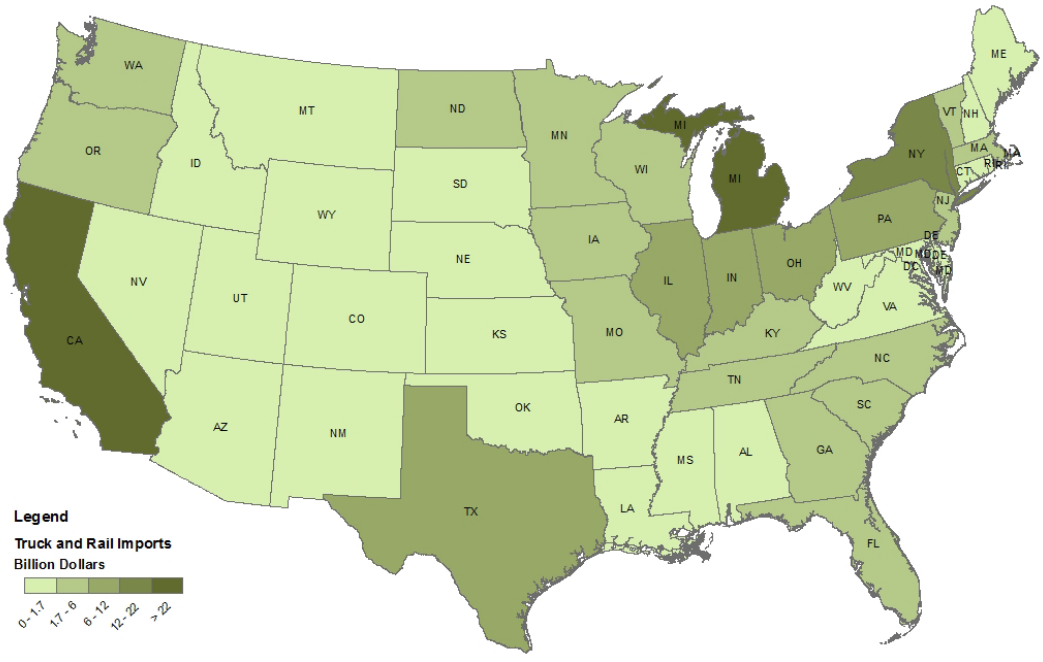
State	Exports		Top Commodity 1		Top Commodity 2	
	Value (Billions Dollars)	Percentage of U.S. Export	Name	Percentage of Total State Exports	Name	Percentage of Total State Exports
MI	22.2	9%	Vehicles Other than Railway	56%	Computer-Related Machinery and Parts	13%
OH	18.8	8%	Vehicles Other than Railway	26%	Computer-Related Machinery and Parts	19%
TX	18.7	8%	Electrical Machinery; Equipment and Parts	18%	Computer-Related Machinery and Parts	17%
IL	15.7	7%	Computer-Related Machinery and Parts	26%	Vehicles Other than Railway	14%
CA	13.7	6%	Computer-Related Machinery and Parts	21%	Electrical Machinery; Equipment and Parts	17%
IN	11.4	5%	Vehicles Other than Railway	45%	Computer-Related Machinery and Parts	12%

State	Exports		Top Commodity 1		Top Commodity 2	
	Value (Billions Dollars)	Percentage of U.S. Export	Name	Percentage of Total State Exports	Name	Percentage of Total State Exports
NY	10.8	5%	Special Classification Provisions	24%	Computer-Related Machinery and Parts	11%
PA	10.6	4%	Computer-Related Machinery and Parts	15%	Electrical Machinery; Equipment and Parts	10%
TN	8.2	3%	Computer-Related Machinery and Parts	35%	Vehicles Other than Railway	16%
WI	7.1	3%	Computer-Related Machinery and Parts	25%	Vehicles Other than Railway	8%

Source: Compiled with data from North American TransBorder Freight Data, BTS, 2012.

Figure 1.9 shows imports by value from Canada and Table 1.7 shows the top two commodities imported by the top 10 importing states. States with the highest imports from Canada include California and Michigan, followed by other states with large metropolitan areas. Imports are dominated by one or two commodities, in this case vehicles and petroleum oil and products.

Figure 1.9 Values of Import from Canada by Truck and Rail
2012, Billions of Dollars



Source: Compiled with data from North American TransBorder Freight Data, BTS, 2012.

Table 1.7 Top 10 Importing States from Canada and Their Top Commodities
2012, Billion Dollars

	Import		Top Commodity 1		Top Commodity 2	
State	Value	Percentage of U.S. Import	Name	Percentage of Total State Imports	Name	Percentage of Total State Imports
MI	43.2	21%	Vehicles Other than Railway	76%	Computer-Related Machinery and Parts	6%
CA	22.3	11%	Vehicles Other than Railway	68%	Computer-Related Machinery and Parts	3%
NY	14.6	7%	Pearls; Stones; Metals and Imitation Jewelry	17%	Computer-Related Machinery and Parts	9%
TX	11.8	6%	Computer-Related Machinery and Parts	18%	Mineral Fuels; Oils and Waxes	11%
IL	10.3	5%	Vehicles Other than Railway	10%	Plastics and Articles	9%
OH	9.8	5%	Vehicles Other than Railway	14%	Computer-Related Machinery and Parts	13%
PA	8.8	4%	Paper and Paperboard	8%	Pharmaceutical Products	7%
IN	7.5	4%	Vehicles Other than Railway	18%	Computer-Related Machinery and Parts	11%
MA	6.0	3%	Pearls; Stones; Metals and Imitation Jewelry	27%	Fish and Crustaceans	16%
WA	5.9	3%	Aircraft; Spacecraft and Parts	16%	Wood and Articles	9%

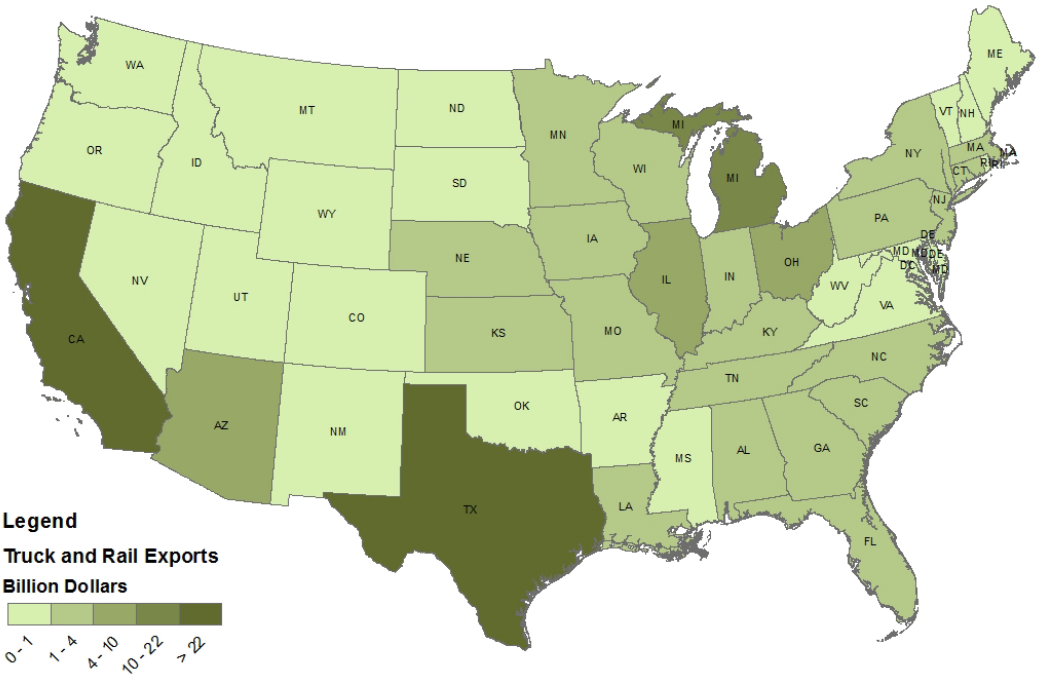
Source: Compiled with data from North American TransBorder Freight Data, BTS, 2012.

Trade between U.S. States and Mexico

Unlike exports to Canada, exports to Mexico come mostly from Southwestern states and a few Great Lake states (Figure 1.10). As Table 1.8 shows, Texas alone accounts for 43 percent of exports by value to Mexico, followed by California at 22.7 percent. Top commodities exported to Mexico are similar to that of export commodities to Canada, and include computer, electrical equipment, machinery and vehicles.

Imports from Mexico exhibit a similar pattern to exports as shown in Figure 1.11 and Table 1.9). Texas imported the largest share of goods at 31 percent in 2012, followed by Michigan at 11 percent. Key import commodities from the top importing states similarly include computer, electrical equipment, machinery and vehicles.

Figure 1.10 Values of Export to Mexico by Truck and Rail
2012, Billions of Dollars



Source: Compiled with data from North American TransBorder Freight Data, BTS, 2012.

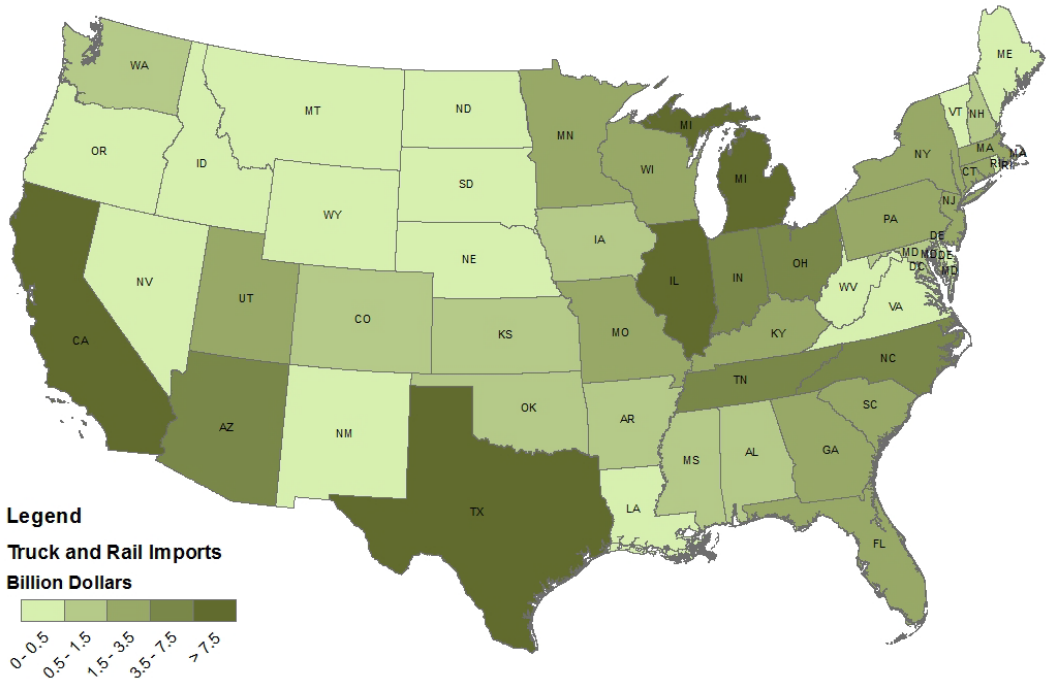
Table 1.8 Top 10 Exporting States to Mexico and Their Top Commodities
2012, Billions Dollars

	Export		Top Commodity 1		Top Commodity 2	
State	Value	Percentage of Export for All States	Name	Percentage of Total Export for State	Name	Percentage of Total Export for State
TX	72.9	43%	Electrical Machinery; Equipment and Parts	24%	Computer-Related Machinery and Parts	22%
CA	22.7	13%	Computer-Related Machinery and Parts	26%	Electrical Machinery; Equipment and Parts	20%
MI	10.3	6%	Vehicles Other than Railway	31%	Computer-Related Machinery and Parts	21%
IL	5.9	4%	Computer-Related Machinery and Parts	18%	Electrical Machinery; Equipment and Parts	16%
AZ	5.8	3%	Electrical Machinery; Equipment and Parts	26%	Ores; Slag and Ash	17%
OH	4.4	3%	Vehicles Other than Railway	26%	Computer-Related Machinery and Parts	15%

State	Export		Top Commodity 1		Top Commodity 2	
	Value	Percentage of Export for All States	Name	Percentage of Total Export for State	Name	Percentage of Total Export for State
TN	4.0	2%	Computer-Related Machinery and Parts	21%	Vehicles Other than Railway	18%
IN	3.7	2%	Computer-Related Machinery and Parts	36%	Vehicles Other than Railway	28%
PA	2.6	2%	Electrical Machinery; Equipment and Parts	13%	Iron and Steel	13%
IA	2.2	1%	Cereals	30%	Sugars and Sugar Confectionery	12%

Source: Compiled with data from North American TransBorder Freight Data, BTS, 2012.

Figure 1.11 Values of Import from Mexico by Truck and Rail
2012, Billion Dollars



Source: Compiled with data from North American TransBorder Freight Data, BTS, 2012.

Table 1.9 Top 10 Importing States from Mexico and Their Top Commodities
2012, Billion Dollars

State	Value	Percentage of Import for All States	Top Commodity 1 Name	Top Commodity 1 Percentage of Total Import for State	Top Commodity 2 Name	Top Commodity 2 Percentage of Total Import for State
TX	68.2	31%	Computer-Related Machinery and Parts	28%	Electrical Machinery; Equipment and Parts	27%
MI	37.8	17%	Vehicles Other than Railway	67%	Computer-Related Machinery and Parts	13%
CA	33.8	15%	Electrical Machinery; Equipment and Parts	42%	Vehicles Other than Railway	13%
IL	7.6	3%	Beverages; Spirits and Vinegar	20%	Computer-Related Machinery and Parts	19%
AZ	6.7	3%	Edible Vegetables and Roots	26%	Electrical Machinery; Equipment and Parts	22%
OH	6.2	3%	Computer-Related Machinery and Parts	27%	Vehicles Other than Railway	22%
NC	4.8	2%	Computer-Related Machinery and Parts	31%	Electrical Machinery; Equipment and Parts	19%
TN	4.5	2%	Computer-Related Machinery and Parts	30%	Vehicles Other than Railway	23%
IN	3.5	2%	Vehicles Other than Railway	28%	Electrical Machinery; Equipment and Parts	25%
GA	3.3	2%	Electrical Machinery; Equipment and Parts	31%	Computer-Related Machinery and Parts	31%

Source: Compiled with data from North American TransBorder Freight Data, BTS, 2012.

Top Border Crossing Gateways

Since export goods mainly come from a few clusters of states, it is expected that export activities are concentrated in a few ports. This is true based on the values shown in Table 1.10. Laredo handled the highest amount of exports, making up 15 percent of all NAFTA exports by value. Detroit comes in a close second and is followed by Buffalo-Niagara Falls and Port Huron in Michigan. The most important ports for export are concentrated in the Great Lakes Region and Texas. This is also true on the imports side. Some of the biggest ports for imports include Laredo, Detroit and Port Huron.

Figure 1.12 through 1.14 show the relative size of shipments for major ports/ gateways along the Canadian and Mexican borders for ports with total combined land value of trade exceeding $12 billion. The values shown include import and export shipments across all land modes: truck, rail, pipeline and other. While

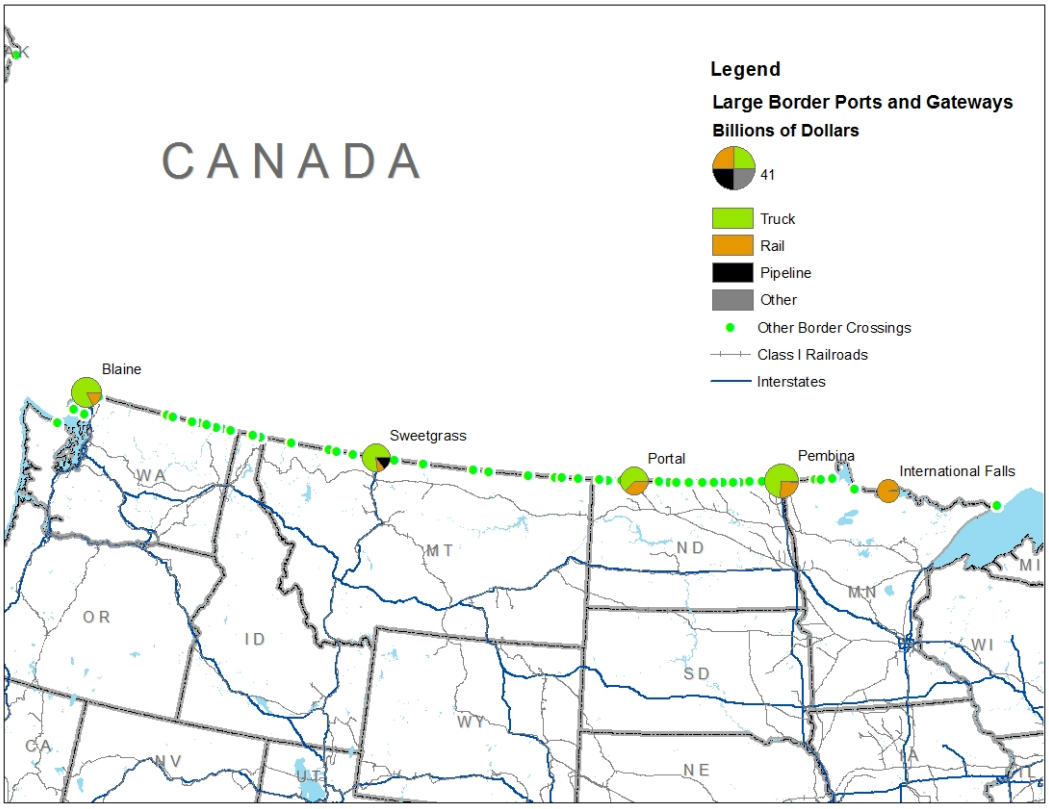
most of the goods are moved by truck, a few ports have significant rail movement activity, including International Falls, Portal, Detroit, Port Huron, Laredo and Eagle Pass. Sweetgrass (Montana), Port Huron and Buffalo-Niagara Falls also have significant pipeline movements. In most cases, the ports are served by a major interstate and/or rail-line. In isolated cases, such as Portal, no interstate serves the port. This indicates that corridors connecting the ports are critical to the smooth movement of goods between the trading partners.

Table 1.10 Top 15 NAFTA Ports, by Value in Million Dollars
2012, Billions of Dollars

	Export			Import		
Rank	Port	Value	Percent Total	Port	Value	Percent Total
1	Laredo – Texas	76.8	15%	Laredo – Texas	86.8	14%
2	Detroit – Michigan	70.4	14%	Detroit – Michigan	60.9	10%
3	Buffalo – Niagara Falls - New York	44.6	9%	Port Huron – Michigan	40.9	7%
4	Port Huron – Michigan	40.3	8%	Buffalo-Niagara Falls – New York	38.5	6%
5	El Paso – Texas	29.7	6%	El Paso – Texas	36.0	6%
6	Pembina – North Dakota	14.3	3%	Chicago – IL	23.3	4%
7	New Orleans – LA	14.0	3%	Otay Mesa – California	22.4	4%
8	Blaine – Washington	12.9	3%	Houston – Texas	16.1	3%
9	Portal – North Dakota	12.4	2%	Hidalgo – Texas	15.6	3%
10	Otay Mesa – California	12.3	2%	Nogales – Arizona	14.6	2%
11	Hidalgo – Texas	10.1	2%	Eagle Pass – Texas	13.8	2%
12	Sweetgrass – Montana	10.0	2%	Champlain-Rouses Point – New York	13.0	2%
13	Houston – Texas	9.9	2%	Port Arthur – Texas	12.9	2%
14	Champlain-Rouses Point – New York	9.4	2%	New Orleans – LA	12.1	2%
15	Nogales – Arizona	8.9	2%	Santa Teresa – New Mexico	11.8	2%

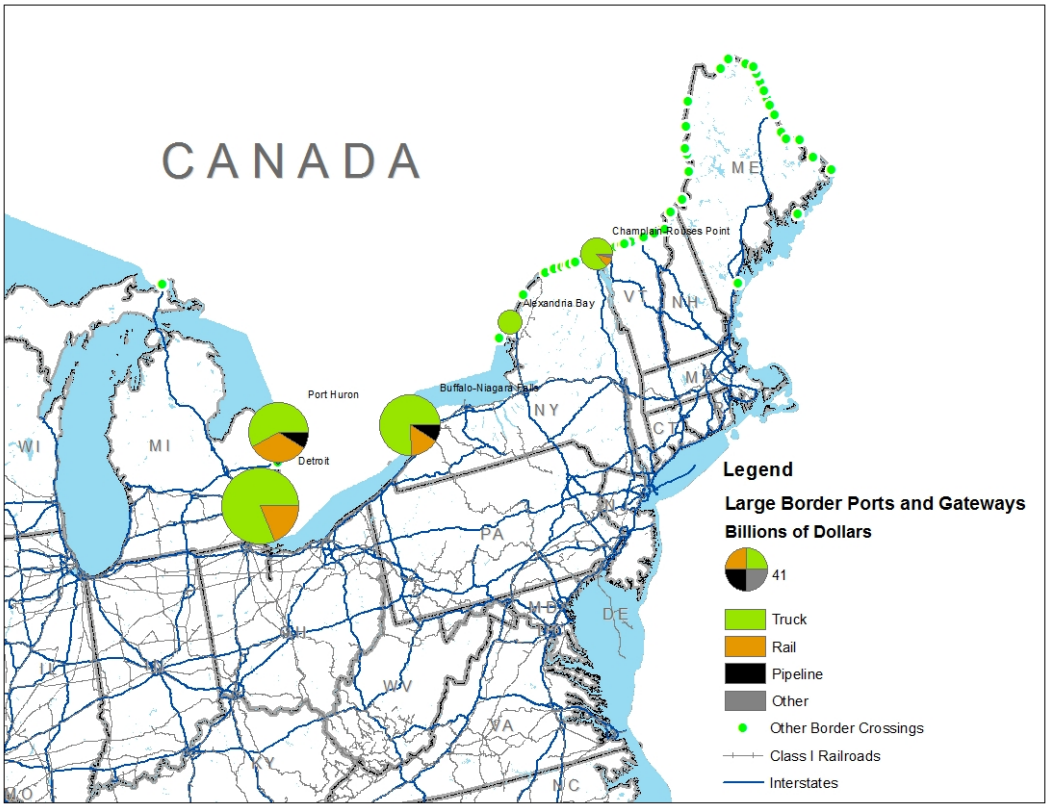
Source: Compiled with data from North American TransBorder Freight Data, BTS, 2012.

Figure 1.12 Port Trade Values by Mode along Western U.S.-Canada Border
2012



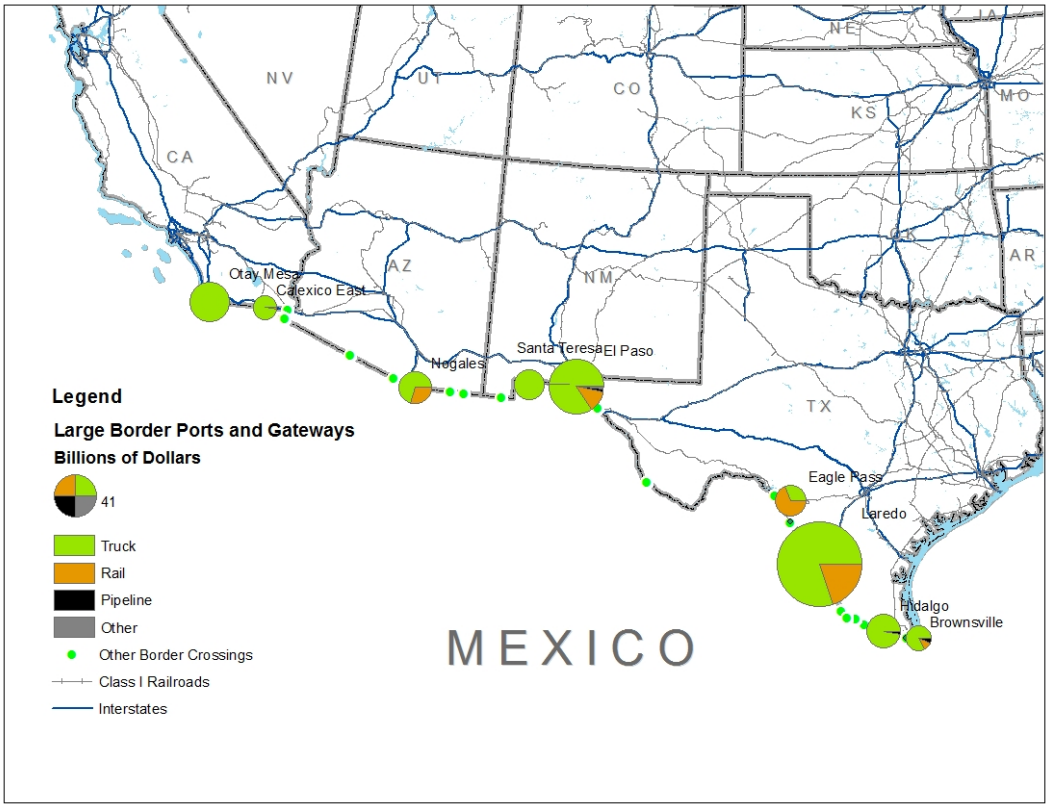
Source: Compiled with data from North American TransBorder Freight Data, BTS, 2012.

Figure 1.13 Port Trade Values by Mode along Eastern U.S.-Canada Border *2012*



Source: Compiled with data from North American TransBorder Freight Data, BTS, 2012.

Figure 1.14 Port Trade Values by Mode along U.S.-Mexico Border
2012



Source: Compiled with data from North American TransBorder Freight Data, BTS, 2012.

1.4 STUDY APPROACH

This report examines gateway and corridor planning from various perspectives, including case studies throughout the world and an examination of key U.S. industry supply chains. In addition, the approach taken for the National Gateway and Corridors Concepts combines traditional planning and scenario planning as a foundation for developing a flexible, robust long-term investment program.

Traditional planning establishes purpose and need for long-range transportation investments by comparing and evaluating existing and projected future conditions based on current trends. Most of the border communities and states have established long-term needs and plans based on long-term trend forecasts. However, while any type of future forecasting is difficult, planning for infrastructure investments that align with dynamic private sector markets and supply chains is especially challenging. These predictions are multimodal, multi-jurisdictional, and subject to numerous exogenous and uncontrollable factors, ranging from fuel costs to trade agreements, and from consumer

demands to general global and regional economic conditions. It is unrealistic to expect reliable or precise long-term forecasts and stakeholder buy-in when high levels of external uncertainty exist.

Future gateway and corridor investments face significant uncertainty due to global trade patterns, population growth, energy futures, technology, geopolitical climate and other unknowns. However, these factors are key to establishing the need for national transportation infrastructure priorities. While some gateways and corridor investment plans have broad support, other investments plans' documented need are based on what some stakeholders view as overly aggressive forecasts that may no longer suit current economic conditions or trends.

Scenario planning is a technique that, when combined with the traditional planning process, overcomes challenges associated with long-range planning of complex, uncertain projects with diverse stakeholders. Rather than trying to predict the state of the world 30 or more years in the future, scenario planning allows plans and planners to accommodate a range of plausible futures. Combining traditional planning and scenario planning results in a robust and flexible plan that supports an equally robust investment program.

1.5 REPORT ORGANIZATION

Following this introduction chapter, the remainder of the report is organized as follows.

- **Section 2.0, International Gateway and Corridor Plans.** This section reviews gateway and corridor initiatives in other countries and regions including major U.S. trading partners and emerging economies;
- **Section 3.0, Role of Gateways and Corridors.** This section documents the role of U.S. gateways and corridors in selected industry supply chains including strategic industries and key export and import commodities;
- **Section 4.0, Private Sector Input and Observations.** This section presents the findings from the multiple private sector focus groups and forums held throughout the country; and
- **Section 5.0, Conclusion.** This section summarizes the key findings and takeaways from the research and private sector input conducted as part of the study effort.

2.0 International Gateway and Corridor Plans

This section of the report reviews gateway/corridor initiatives in other countries and regions including Canada's Gateways and Corridors Concepts, Mexico's multimodal corridor master plan, EU's revised TEN-T policy and developing economies including China, India and Brazil.

In addition, this section reviews efforts within the U.S. that address gateway/corridor concepts and frameworks for understanding future freight flows. It concludes with a summary of key points learned from the different initiatives.

2.1 CANADA

The Canada-U.S. economic trading relationship is the largest single-nation trading relationship in the world.[3] Fostering ties with Canada and trading with other emerging economies is important for the U.S., and understanding Canada's Gateways and Corridors Strategies will be beneficial for U.S. in terms of collecting insights into how investments in Canada may impact the U.S. freight transportation network.

Canada has a fully developed framework for gateways and corridors. Rather than creating a central strategy first, Canada's national strategy was born out of the success of the Asia-Pacific Gateways and Corridors Initiative (Pacific Strategy) in 2006. The specific successes of the initiative led to the creation of the National Policy Framework for Strategic Gateways and Trade Corridors (National Gateway Framework), which acts as an overarching policy framework. This framework is also a major part of Building Canada, Canada's strategic infrastructure plan for 2007 to 2014. Out of the National Gateway Framework, two regional strategies are born, The Ontario-Quebec Continental Gateway and Trade Corridor Strategy, and The Atlantic Gateway and Trade Corridor Strategy. The national framework and the strategies are discussed in subsequent sections.

[3] Source: http://www.atlanticgateway.gc.ca/strategy/chapter3.html.

Canada's National Policy Framework for Strategic Gateways and Trade Corridors

Motivation and Purpose

The National Gateway Framework was born out of the Pacific Strategy that aimed at strengthening Canada's competitive position in international commerce by more effectively linking Asia and North America. A National Gateway Framework, guided by Building Canada, was developed based on the success of the Pacific Strategy.

The purpose of the National Gateway Framework is to improve Canada's Global competitiveness through an integrated/systems approach to physical and policy transportation infrastructure. Additionally it aims at improving transportation system effectiveness and efficiency.

Framework Structure

The Framework involves analysis through five policy lenses which interact together (Figure 2.1). All gateways and corridors strategies must be based on compelling analysis through these five lenses:

1. **International Commerce Strategy.** Strategies must help align Canada's major transportation systems with Canada's most important opportunities and challenges in global commerce.
2. **Volumes and Values of National Significance.** Strategies should be targeted where volumes and values are most significant for Canada's economy overall.
3. **Future Patterns in Global Trade and Transportation.** Strategies must be forward looking and focus on the long term. More importantly, to understand the future, empirical evidence and analysis must be used.
4. **Potential Scope of Capacity and Policy Measures.** Strategies should go beyond infrastructure systems and address integration on several levels – across modes of transportation, between investment and policy, public and private sectors and among levels of government.
5. **Federal Role and Effective Partnerships.** Strategies must ground Federal action in concrete responsibilities and effective partnerships with other government and the private sector.

Figure 2.1 The Five Policy Lenses of the National Gateway Framework

Source: Canada's National Policy Framework for Strategic Gateways and Trade Corridors.

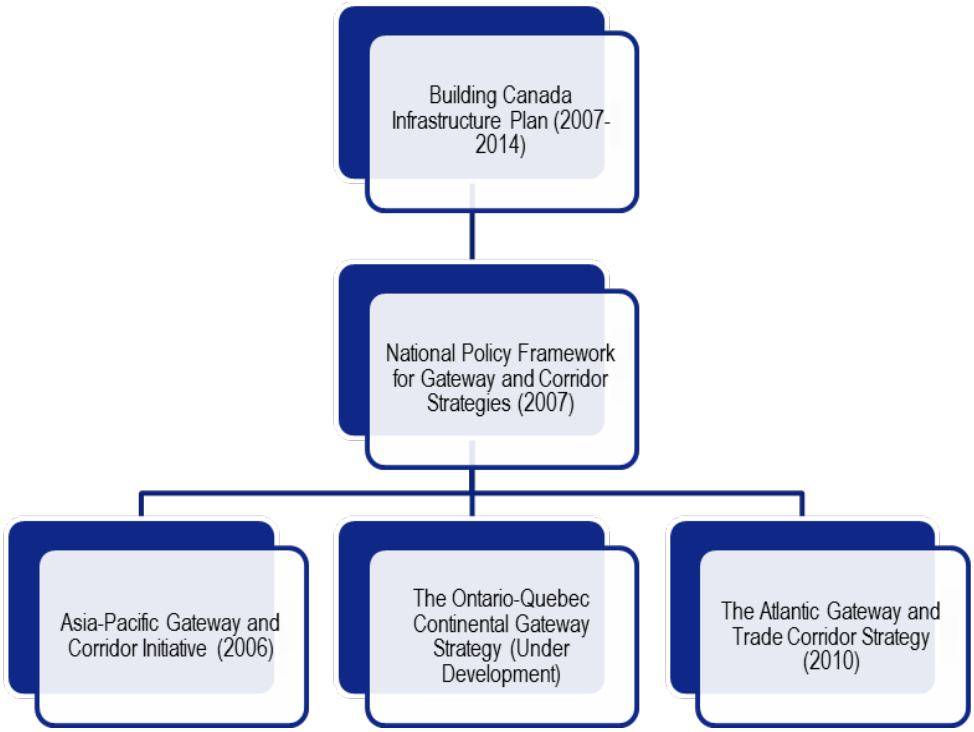
Stakeholder Roles and Funding Structure

The National Gateway Framework regards the Federal role as especially important for developing successful strategies, however it acknowledges that no single jurisdiction or firm can unilaterally address all issues that determine success of a gateway/corridor. A central objective of Federal involvement will be to foster a "systems" approach in investment, planning and policy developed. Gateway councils and other stakeholders are also key to advancing regional strategies with national benefits. While this National Framework did not specifically identify all stakeholders, it did provide an example of how municipalities, private companies (railways) and other agencies (port authorities) worked towards a successful rail corridor project with a cost-sharing structure. It is expected that good strategies should involve all stakeholders, and pull resources from all of them, since the projects will benefit all.

The funding for all of the gateways and corridors strategies that are identified from the National Gateway Framework comes from the Building Canada Infrastructure Plan, which devotes $2.1 billion over seven years to borders and corridors.

In short, the National Gateway Framework calls for an **integrated** strategy that aligns with the nation's **commerce** interests, targets **economically significant** areas, and relies on **data and empirical analysis** to understand the **future,** which requires collaboration and support with various levels of government, and more so, the **private sector**. The relationship between the plans, frameworks and strategies, summarized in Figure 2.2, demonstrates a well-integrated strategic planning and monitoring framework.

Figure 2.2 Relationship between Canada's Gateway Initiatives



Source: Consultant Analysis.

Asia-Pacific Gateways and Corridors Initiative (Pacific Initiative)

Background and Purpose

The Pacific Initiative, launched by Prime Minister Stephen Harper in October 2006, is the first application of the gateway approach. The rapid growth of China and the subsequently dramatic increase in both import and export activities along Canada's Pacific coast provides the motivation for this initiative. In order to seize the opportunity to benefit from economies of scale, Canada must invest significantly to serve the entire North American market. The overall purpose of the initiative is aligned with that of the National Gateway Framework, which is to improve economic competitiveness of Canada. More specifically, it seeks to:

- Boost commerce with the Asia-Pacific region;
- Increase the Gateway's share of North America bound container imports from Asia; and
- Improve the efficiency and reliability of the Gateway for Canadian and North American Exports;

Approach

The approach to the Pacific Strategy is to create projects based on five core elements. These elements include:

- **Strategic infrastructure.** Address emerging bottlenecks and multi-modal transfer points to allow for reliable, efficient and secure goods movement;
- **Private investment and innovation.** Attract private investment and create policies that can do so, especially investment in innovation and technology;
- **Security and border efficiency.** Create measures that will improve security and border efficiency;
- **21st century governance.** Set up partnerships in governance to reflect outward looking perspective of global commerce. Commit to integration within the Federal government, and among all governments and the private sector; and
- Policy renewal – work with various government organizations to integrate and renew policies that impact transportation infrastructure, such as land use policies, labor market issues, and other related issues.

These policies reflect a comprehensive framework that includes not only the traditional construction project approaches, but also emphasizes other policy, and strategic type measures that are vital components for success. Immediate measures (projects) are developed under each element, from construction projects (such as bridge replacement) to policy measures (such as marketing the Pacific Strategy).

The Pacific Initiative consists of strategic transportation infrastructure projects including British Columbia's Lower Mainland, their principal road and rail connections stretching across Western Canada and south to the United States, key border crossings, and major Canadian ports. The complete map of the projects is shown in Figure 2.3.

Figure 2.3 Pacific Gateway Investment Map

Source: http://www.pacificgateway.gc.ca/investments-map/mainmap_e.html.

Funding and Governance

Each project can be funded by the Federal government completely or partially (using the Building Canada funds). Other funding sources for each project will likely come from both public and private stakeholders involved in that project. It is also important to note that one key element is to foster private investment, not in the sense of letting the private sector invest in public infrastructure, but rather in leveraging public monies to spur invest in private infrastructure, which in turn will benefit the public.

A cooperative partnership was established in 2007 with goals to plan and implement infrastructure projects, establish funding partnerships and so on. The partnership consists of senior officials from Transport Canada and International Trade and the British Columbia Ministry of Transportation. The partnership

conducts discussions with government agencies, airports, ports, railways, Gateway Councils and other stakeholders to advance its objectives.[4]

Results

So far, between 2006 and 2010, $389 million in Federal funding was spent on completed projects, $738 million in Federal funding are dedicated to projects underway, and in total over $1.4 billion in Federal funding has been announced.[5] In the near future, the Pacific Initiative will continue its completion of other projects identified, and continue the dialogue with stakeholders to make the Asia-Pacific corridor and gateway more successful, especially in anticipation of the Panama Canal Expansion.

The Atlantic Gateway and Trade Corridor Strategy (Atlantic Strategy)

Background and Purpose

Soon after the development of the National Gateway Framework, the development of the Atlantic Strategy began in 2007. Complete in 2010, the strategy addresses ways to enhance the region's economic competitiveness through the following objectives:

- Strengthen Canada's competitiveness in attracting a larger share of global commerce to and from traditional markets and with emerging international economies;
- Advance a safe, secure, efficient and sustainable multimodal transportation system that contributes to the economic prosperity of the Atlantic provinces and Canada; and
- Promote the Atlantic Gateway and Trade Corridor's transportation system assets, specialized services and niche opportunities to exporters and importers, at home and internationally.

Approach

The Atlantic Strategy includes immediate measures (projects), and also longer-term directions to guide ongoing collaboration and future actions defined by a framework of nine core strategic elements. These elements are similar, but expand upon the Pacific Strategy. It includes the following:

- Strategic Infrastructure;
- International Trade Promotion and Marketing;

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[4] Source: http://www.pacificgateway.gc.ca/media/documents/Canada-BC-MOU.pdf.

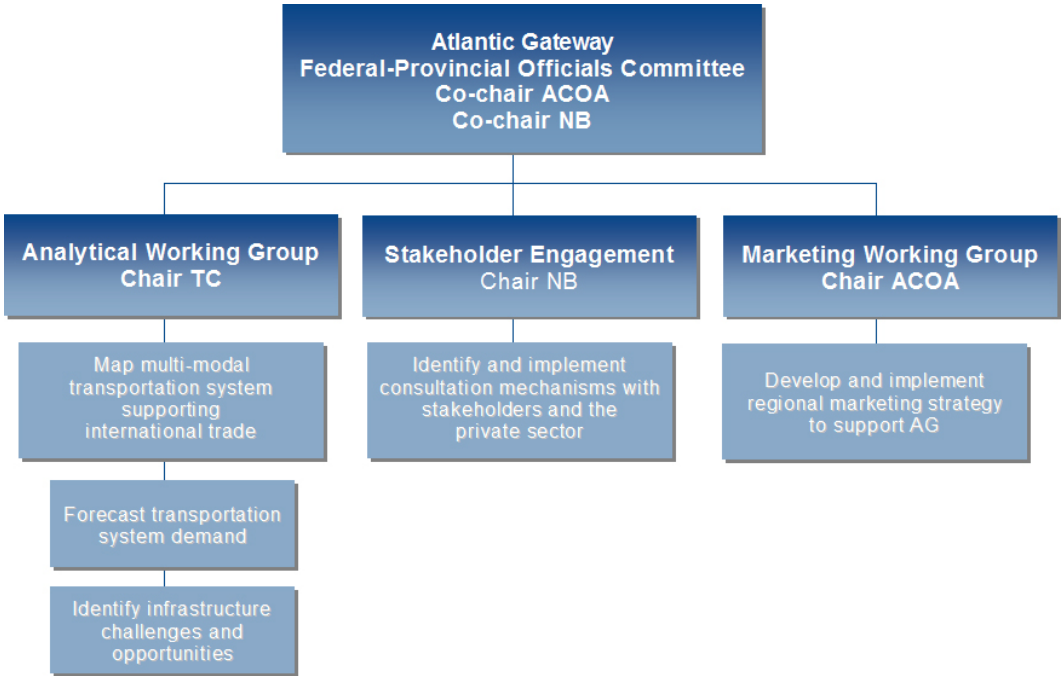
[5] Source: http://www.pacificgateway.gc.ca/reaches-a-milestone.html.

- Economic Growth Opportunities;
- Border Efficiency and Security;
- Policy and Regulatory Issues;
- Technology and Innovation;
- Knowledge and Skills;
- Environment; and
- Governance.

Governance

The executive body of the Atlantic Strategy is the Atlantic Gateway Federal-Provincial Officials Committee, which consists of top officials from the various provinces in the Atlantic region and Transport Canada and the Atlantic Canada Opportunities Agency. Its role is to provide leadership in the implementation of the Atlantic Strategy, identify deliverables, develop stakeholder engagement strategies, and formulate an analytical work plan, which will result in project selection. The core elements identified above are through the workings of the Committee. The organization chart of the Committee is shown in Figure 2.4.

Figure 2.4 Governance Structure of the Atlantic Gateway Strategy



Source: http://www.atlanticgateway.gc.ca/newsletters/april-2009.html.

In addition to the Committee, there is also an Atlantic Gateway Advisory Council which is the private sector representation for the Atlantic Gateway Strategy. This directly falls out of the eighth element of the strategy –

partnership with private sector. The Council consists of 13 CEO-level representatives from the private sector and works with the government to provide advice on how best to address issues in the Atlantic Gateway area.

Project Selection and Funding

Figure 2.4 shows a dedicated analytical working group is established under the Committee, with the sole responsibility of advancing objective analysis of future demand and opportunities that will guide infrastructure decision-making. As part of the framework, a number of studies were commissioned that are reviewed by various stakeholders:

- The *Multimodal Freight and Passenger Traffic Flows and Infrastructure Study*, undertaken by Transport Canada on behalf of the Atlantic Gateway Officials Committee;
- *The Study of Road Access to Intermodal Terminals and Transload/Distribution Centres in Atlantic Canada*, undertaken by Transport Canada on behalf of the Atlantic Gateway Officials Committee;
- The *Atlantic Gateway Border Traffic and Infrastructure Study*, undertaken by New Brunswick Department of Transportation on behalf of the Atlantic Gateway Officials Committee;
- *Study on Potential Hub and Spoke Container Transshipment Operations in Eastern Canada for Marine Movements of Freight (Short-sea shipping)*, undertaken by Transport Canada on behalf of the Atlantic Gateway Officials Committee;
- The *National Commodity Flow, Trade and Traffic Forecasts Study*, undertaken by Transport Canada on behalf of the Atlantic Gateway Officials Committee;
- *The Atlantic Canada Cruise Study,* undertaken by the Atlantic Canada Cruise Association on behalf of the Atlantic Gateway Officials' Committee; and
- *Energy Study – Transportation of Liquid Bulk Fuels in Atlantic Canada,* undertaken by Newfoundland and Labrador on behalf of the Atlantic Gateway Officials' Committee.

The projects are developed based on the rigorous technical analysis through the studies done above, through private stakeholder suggestions, and through suggestions from all levels of government, such as provincial governments and specific agencies such as port agencies. To date, immediate measure projects have been created under each of the nine elements.

While each of the infrastructure projects is funded through differing financial arrangements, they all involve a combination of Federal, local and private funds. Federally, funds not only come from Building Canada, but also come other sources, such as the 2009 Economic Stimulus Package where nearly $300 million are dedicated to airport-related projects.

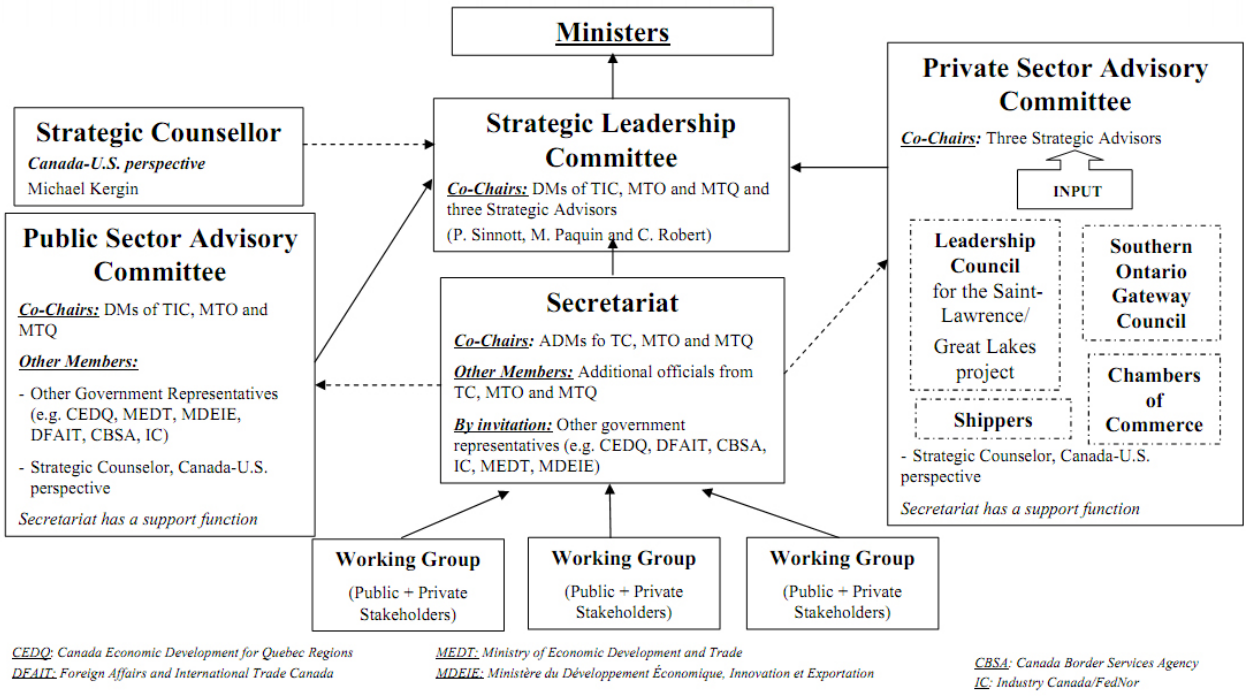
The Ontario-Quebec Continental Gateway and Trade Corridor (Continental Initiative)

The Continental Initiative is the third gateway strategy established under the National Gateway Framework. While the official strategy has yet to be released, its purpose is to develop a sustainable, secure and efficient multimodal transportation system that keeps Canada's economic heartland competitive, attractive for investment and essential for trade.

In order to create the strategy, a governance structure was established (see Figure 2.5). The governance structure is slightly different than the Atlantic Gateway's governance structure. It consists of the private sector advisory committee that is made up of shippers, carriers, chambers of commerce as well as the St. Lawrence – Great Lakes Leadership Council and the Southern Ontario Gateway Council; and the public sector advisory committee, that is composed of representatives from various Federal departments and agencies and provincial ministries with mandates linked to trade and transportation.

It is important to note because the Gateway is the major linkage between U.S. and Canada Trade, a Canada-U.S. counselor is also included in the governance structure, to help present the U.S. perspective.

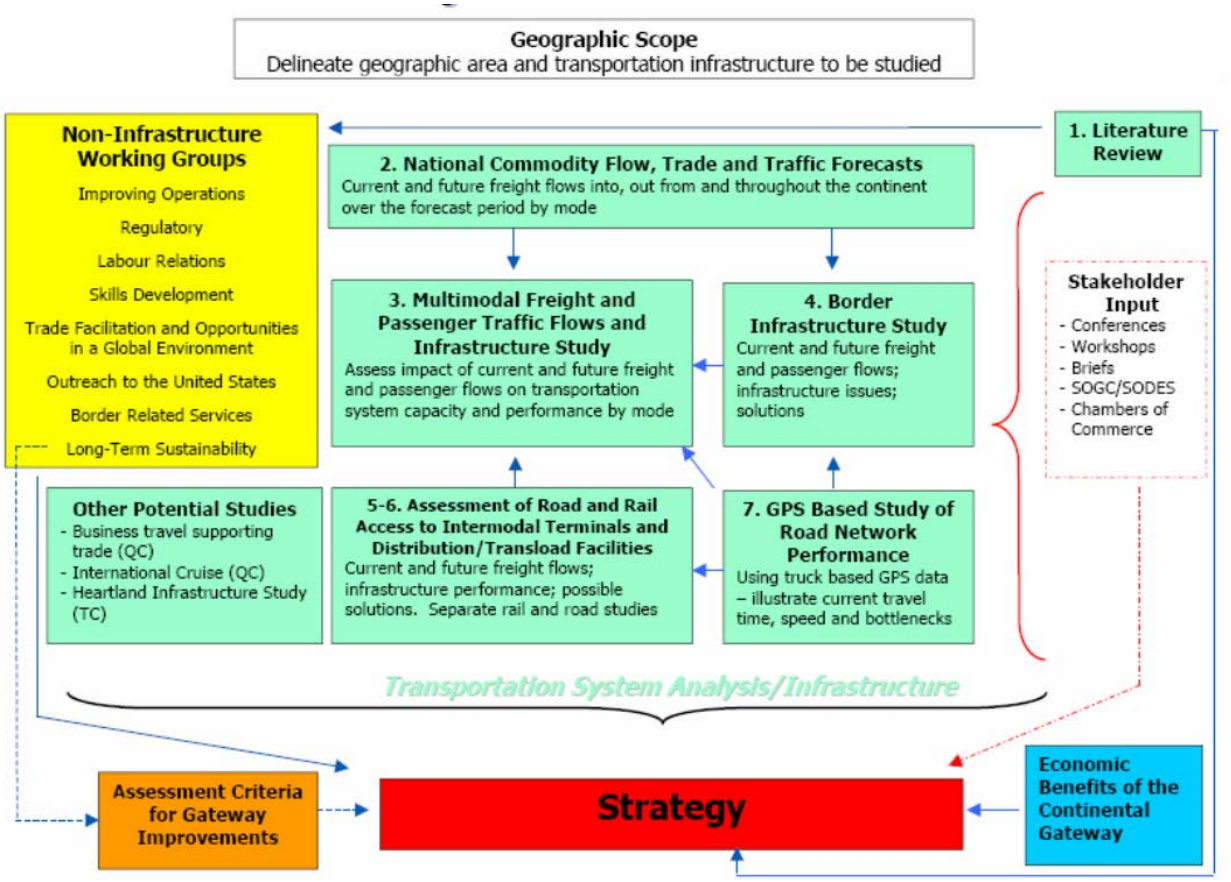
Figure 2.5 Continental Gateway Governance Structure



Source: Presentation by Ontario-Quebec Continental Gateway at the 2008 North Atlantic Transportation Planning Officials Conference, August 12, 2008.

A comprehensive work plan has been developed to guide the Continental Gateway's research and consultation activities. The research program provides the analytical basis for developing a multimodal Continental Gateway strategy, very similar to the Atlantic Gateway. The full analytical framework is shown in Figure 2.6, where the connections between different framework components are delineated. Three separate plans will be combined to form the final Gateway Strategy, which include an Infrastructure Plan, Noninfrastructure Plan, and a Communications Plan.

Figure 2.6 Continental Gateway Strategy Analytical Framework



Source: Presentation by Ontario-Quebec Continental Gateway at the 2008 North Atlantic Transportation Planning Officials Conference, August 12, 2008.

The Continental Gateway is a key component of Canada's multimodal transportation system. The central location of the Continental Gateway facilitates international trade with the United States and other key trading partners. The Continental Gateway includes strategic ports, airports, intermodal facilities and border crossings, as well as essential road, rail and marine infrastructure that ensures this transportation system's connection to, and seamless integration with, Canada's other gateways: Asia-Pacific and Atlantic.

Summary of Canada's Experience

In Canada, the development of the National Gateways and Corridors Framework as well as the three regional Gateway Strategies are important milestones. Some key considerations for the U.S. effort include:

- The National Gateway Framework is strategic, and helps align various regional strategies to serve towards the same purpose.
- Federal backing is essential. The National Gateway Framework has significant financial backing from Building Canada, the Federal infrastructure plan that essentially also acts as a transportation investment plan.
- It is not necessary for a top-down approach to initiate gateway strategies. Strategies that already exist at the regional level can be worked into, and help inform the national strategy in a bottom-up approach, as in the case of the Asian Pacific Gateway Strategy.
- In addition to Federal funding and other local funding, a great emphasis is placed on private funding. Attracting investment from the private sector is essential since public funding usually takes long to come by and may not be enough.
- Success in Gateway/Corridor strategies must be done in partnership with all relevant stakeholders, including all levels of government, as well as the private sector.
- Gateway Projects must be backed by rigorous analytical research that looks into all relevant topics affecting modal and intermodal transportation, and the supply chain in the present and future.

2.2 MEXICO – MULTIMODAL CORRIDOR MASTER PLAN

Background and Purpose

The Multimodal Corridor Master Plan for Mexico (MCMP) is the Mexican government´s tool to plan and promote, along with transportation stakeholders, the development of infrastructure systems, coordination agreements, and logistics to meet the needs of domestic trade, and international trade with NAFTA partners and other countries. The Master Plan details the actions and strategies required for the use, operation, and development of a multimodal system in Mexico. The plan also details the commitments required from stakeholders. This section focuses on a long-term MCMP developed using a grant from the Unites States Trade and Development Agency (USTDA). In addition to this plan, every Mexican administration develops a specific five-year transportation infrastructure plan which represents their priorities. The Mexican

Ministry of Communications and Transport (SCT) realized the need to tackle the multimodal transportation issue to gain competitiveness in the world marketplace. This is evident from the results of the 2009-2010 Global Competitiveness Index of the World Economic Forum, where Mexico is ranked Number 60 among 133 countries.[6] The problem is evident after analyzing the results and finding that the only reason why Mexico's ranking is not below 60 is due to positive performance indicators of macroeconomic stability and market size. For the rest of the indicators the country is ranked below 60.

The MCMP was developed with the idea that isolated improvements are not enough and that a set of coordinated actions between the public and private sectors is needed to improve the performance of the Mexican Multimodal Transportation System.

Objectives and Strategies

MCMP objectives were developed by analyzing information from transportation modes including statistics, historical background, and public and private partnerships currently in place in Mexico. An important element for the development of the objectives is the 2007-2012 National Infrastructure Program. The objectives identified include:

- Develop a multimodal transportation network for Mexico that meets the requirements of world class multimodal transport systems that will integrate with the North American transport network and with the rest of the country´s trading partners.
- Develop the infrastructure and operating practices to provide seamless integration among and within transportation modes.
- Provide a framework that allocates and rationalizes public and private resources to support the supply chain to improve Mexico's competitiveness in the global market.
- Prioritize corridor investments in order to align cost-effective infrastructure development with corridor-specific needs and overall network requirements.
- Provide the legal and regulatory framework to promote modal integration and a competitive transportation environment.
- Provide a tool to measure the productivity and efficiency of the freight transportation network that has sufficient flexibility to respond to requirement changes.
- Promote policies and strategies to develop the multimodal transportation system. Determine the specific commitments of stakeholders to improve

[6] The Global Competitiveness Report 2009-2010 © 2009 World Economic Forum.

competitiveness and to contribute to Mexico's emergence as an important player in global logistics.

In short, a multimodal transport system in Mexico is required in order to:

- Incorporate the characteristics of world-class systems.
- Achieve seamless integration between and within modes of transport
- Enhance Mexico's competitiveness in the world's markets

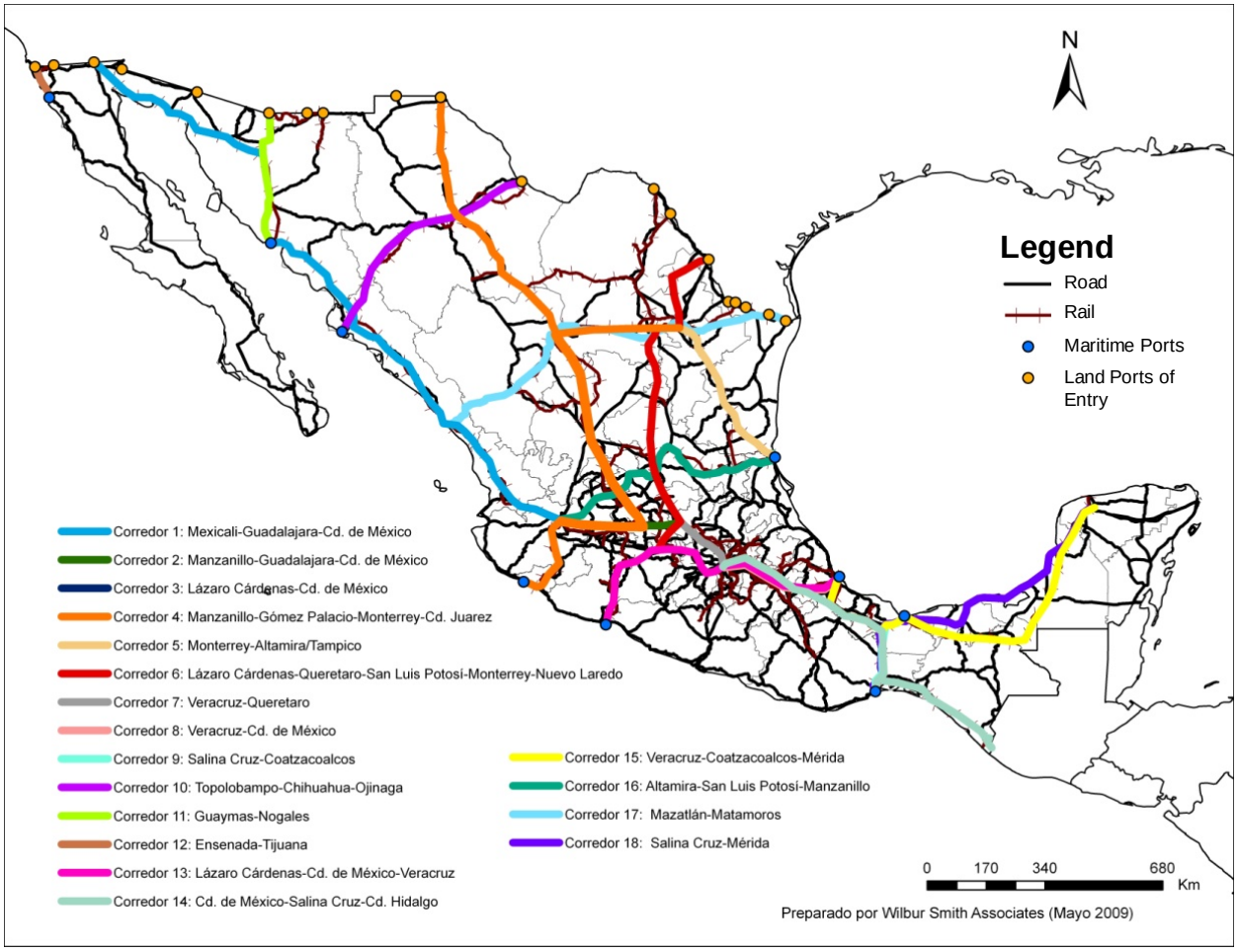
Approach

In order to achieve the objectives, it was important to include the following elements in the master plan:

- Provide the SCT with a tool to guide investments and actions needed to make the multimodal transport system in Mexico more efficient.
- Provide the legal regulatory framework to promote modal integration.
- Provide tools to measure productivity.

To reach the plan objectives and incorporate the various plan elements, eight major tasks were conducted so far in the course of the study. These include the establishment of objectives and planning framework, analysis of primary cargo flows, profiling of Mexico's transportation system, identification and needs analysis of priority corridors, establishment of performance measures, impact analysis and finally preparation for the master plan. Perhaps one of the most critical steps for the development of the plan is the identification of priority corridors. This is similar to identification of bottlenecks for the plan for Canada, but in this case the priorities are identified on a corridor level, and not at a regional, or nodes level. Figure 2.7 presents the results of the initial tasks where the corridors were identified.

Figure 2.7 Identified Corridors for the MCMP



Source: Mexico Multimodal Freight Corridor Master Plan, SCT, 2009.

Once the corridors were identified, a detailed analysis of each of the 18 corridors was made using criteria that include markets served by corridor, economic activities along the corridor, freight generated and attracted by corridor, current and future traffic volumes, logistics and transportation services, corridor infrastructure, and connection with other corridors.

After evaluating the 18 corridors according to the criteria listed above, a second level of analysis was performed using the MCMP objectives. Then, several criteria were identified by stakeholders to prioritize corridors and reach the Master Plan objectives, which led to the generation of six assessable factors, including:

- Future demand,
- Rail diversion potential,
- Containerization potential,
- Regional economic development,

- Connectivity, and
- Potential to reach world class standards.

These factors are then evaluated using the multi-attribute utility theory, conducted by members of the project committee, for which specific weights were given to each criterion. The evaluation resulted in three groups of corridors, where the short and medium-term projects are to be evaluated in more detail in the subsequent tasks.

The Master Plan includes a detailed needs assessment for each corridor, prioritizing investments by aligning the development of infrastructure to specific needs of each corridor, as well as general requirements of the entire multimodal network of the country.

Stakeholders and Funding

Private- and public-sector stakeholders play an important role in the planning and operation of the Mexican multimodal transportation system. In the public sector, the main stakeholder is SCT, which consists of two main divisions: infrastructure and transportation.

Private-sector stakeholders are also important because the Mexican road systems are increasingly built through public-private partnerships (PPPs), using build-operate transfer schemes. Railroads in Mexico are operated by the private sector via 50-year concessions, and there are three main railroads that operate in Mexico. In addition, port terminals in Mexico are operated by privately owned concessionaires.

During the Master Plan development, a committee of public-sector stakeholders, mainly comprised of individuals from different divisions within the SCT, was involved in the plan's decision-making process, defining prioritizing criteria. Even though the private sector stakeholders did not participate in this process, needs assessment was performed through consultation with private sector stakeholders.

While no particular funding structure is identified for each project, potential options for funding are discussed. Given the Mexican government's extensive use of PPPs, it is entirely possible that significant amount of projects can be funded privately, or through partnerships.

The Mexico MCMP was developed with the idea that isolated improvements are not enough, and that a set of coordinated actions between the public and private sectors is needed to improve the performance of the Mexican Multimodal Transportation System. Other key takeaways include:

- Use of objective data combined with stakeholder input facilitated a more fact-based selection of priorities;

- Process focused on national priorities, but did not prohibit local participation in advancing any local or regional priorities; and
- Flexibility is essential to ensuring plan robustness and longevity.

2.3 EUROPEAN UNION – THE TRANS-EUROPEAN TRANSPORT NETWORK (TEN-T)

Background

Since the EU was formed, it was recognized that for the common European market to function smoothly an integrated transportation system that allows the free movement of goods within EU territory was needed. The concept of the Trans-European Transport Network (TEN-T), included in the 1993 Maastricht Treaty, made it possible to develop a plan for transportation infrastructure at the European level with the help of EU funding. During the Corfu European Council (EC) of June 1994, the EC agreed on a first list of 11 transportation priority projects. In 1996, the EC initiated the Transport Infrastructure Needs Assessment (TINA) project with the aim of stimulating development of a multimodal transport network in EU accession candidate countries and defining the future Trans-European transport infrastructure network in the expanded EU. At the end of 1999, the TINA project was completed, and the final document estimated the necessary investments from 1998 to 2006 at about €87 billion.

With the imminent enlargement of the EU in 2003, the TEN-T policy was reviewed to cover the new member states. The result of the new policy was a set of 30 priority axes and projects, covering high-speed and conventional railways, road motorways, the "Motorways of the Sea," multimodal corridors, airports, inland waterways, and the Galileo navigation system.[7].

Approach

In 2009, the EC began a new review of the TEN-T policy by publishing a green paper. A main objective of the review is to define how to shape the future multimodal network and ensure timely completion, with network planning as a key issue. Because the TEN-T policies will affect all member states as well as those surrounding the member states, the process for shaping the policies is through extensive public feedback. Key messages from stakeholders on the general policy framework included:

[7] The Galileo program is Europe's initiative for a state-of-the art global satellite navigation system.

- Low carbon transport,
- Territorial cohesion, and
- Need for a planning tool and not just a funding instrument.

To achieve these objectives, a conceptual planning framework needs to be established that also rests on larger objectives set by the EU white paper on Transport. According to the latest proposal for a new TEN-T guideline by EU in 2011[8], stakeholders supported a dual-layer approach that consists of a comprehensive network and a core network. The comprehensive network constitutes the basic layer of the TEN-T. It consists of all existing and planned infrastructure meeting requirements of the Guidelines. The comprehensive network is to be in place by end of 2050 at the latest, and its responsibility largely rests on the member states. The core network overlays the comprehensive network and consists of its strategically most important parts, and is thus smaller and more focused. It constitutes the backbone of the multi-modal mobility network. It concentrates on TEN-T components with the highest added values: cross border missing links, key bottlenecks and multi-modal nodes. The core network has a shorter timeline, all to be completed by 2030. According to the latest news release as of October, 2011, the new core network established connects:

- 83 main European ports with rail and road links;
- 37 key airports with rail connections into major cities;
- 15,000 km of railway line upgraded to high speed; and
- 35 cross border projects to reduce bottlenecks.

The core network will form the economic lifeblood of a single market that allows the free-flow of people and goods around the EU. The implementation of the core network will be facilitated using a corridor approach. Ten corridors will provide the basis for the coordinated development of infrastructure within the core network.[9] Figure 2.8 presents the core network that is recently adopted. The green lines show the networks that are completed in 2011, and the black lines show the remaining parts of the network to be completed by 2030.

Because of the complexity involved in identifying the core network across national boundaries, a rigorous analytical methodology backs the identification of the core network projects. The methodology is based on three primary steps. The first step is the selection of major nodes meeting certain statistical criteria. The second step involves the process of linking up these nodes with land transport modes – rail, inland waterway, and road. The third primary step is, incorporating a detailed analysis of major traffic flows – passenger and freight.

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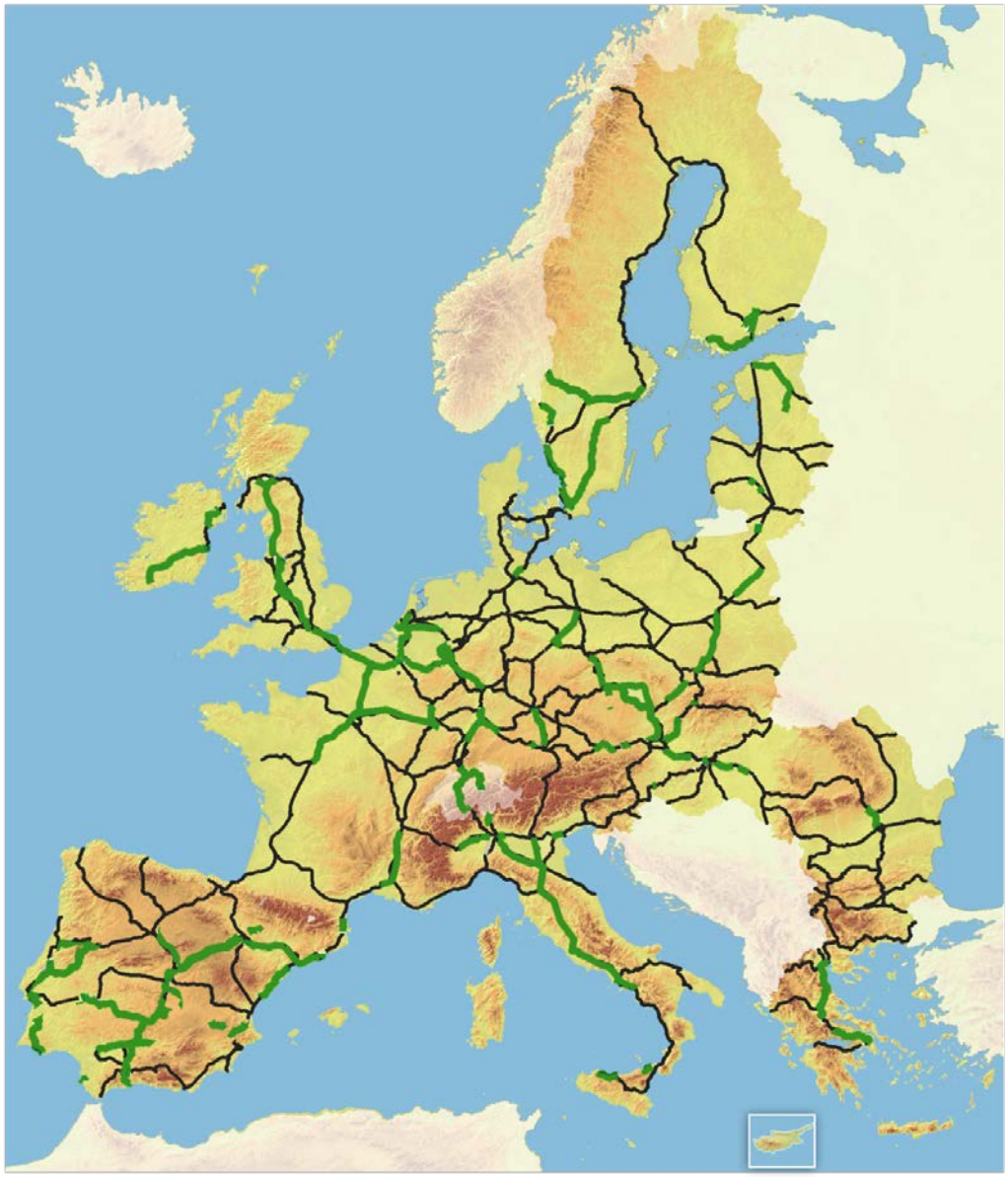
[8] Source: http://ec.europa.eu/transport/infrastructure/connecting/doc/revision/legislative-act-ten-t-revision.pdf.

[9] http://europa.eu/rapid/pressReleasesAction.do?reference=MEMO/11/706&format=HTML&aged=0&language=en.

This is essential to define priority sections for the core network and to see clearly priority sections, where infrastructure needs upgrading, building, or where bottlenecks need to be removed.[10]

Figure 2.8 EU Core Network for 2030



Source: European Commission.

[10]Source: http://europa.eu/rapid/pressReleasesAction.do?reference=MEMO/11/706&format=HTML&aged=0&language=en.

Stakeholders and Funding

The initial green paper developed in 2009 was released to the public for comments which received about 300 comments. After the comments are received, six expert groups were created and tasked with analyzing a number of key aspects of future TEN-T development. The recommendations from the expert groups where summarized and released to the public for another round of comments, where more than 530 comments were received. The comments received were used to inform the development of the new TEN-T transportation planning network. While the planning stages involved participation from the public as well as the member states, the implementation stage will call for more engaged participation from member states and relevant stakeholders.

For each of the 10 corridors identified under the core network, EU will bring together the member states, as well as the relevant stakeholders, for example infrastructure managers and users. European coordinators will chair "corridor platforms" that will bring together all the stakeholders – these will ensure coordination, cooperation and transparency.

As far as funding, the previous TEN-T networks are co-financed by various community grants and loans from the EU budget, as well as funding from member states that constitute the majority of monies. For the proposed new network, €31.7 billion have been made available to fund the core network for the 2012 to 2020 financial period. However, this is still short of the estimated €250 billion needed to fund the whole core network. This funding level can be met through the leverage effect, where €1 million spent at the EU level is believed to generate €5 million from member states and €20 million from the private sector. The funding for the comprehensive network will largely come from individual member states since it is believed that projects that belong to the comprehensive network will be funded under each country's transportation/regional policy plan.[11]

FHWA Scan on Freight Corridor Programs in EU

In 2010, FHWA led a scan effort called "Understanding the Policy and Program Structure of National and International Freight Corridor Programs in the European Union" to evaluate the experience of the EU in developing the TEN-T policy.

The purpose of the scanning study was to learn from the EU and various member states how they developed, evolved, and implemented freight transportation corridor programs on a national and cross-jurisdictional level. The scan identified opportunities for North American freight corridors and

[11]Source: http://europa.eu/rapid/pressReleasesAction.do?reference=MEMO/11/706&format=HTML&aged=0&language=en.

developed contacts in other countries that the United States may partner with in the future.

The implications of the EU's TEN-T process to freight transportation gateway and corridor development in the United States include:

- A unifying vision linking transportation and the economy is a key foundational element of the TEN-T;
- Multijurisdictional transportation planning and implementation will require new management, funding, and coordination strategies;
- Awareness must evolve from an exclusively national and local understanding of freight movement to an international understanding of how freight movement connects to international markets;
- Any movement toward corridor-level thinking in the United States must be grounded in objective, transparent facts and market analysis;
- Benefit-cost analysis is a valuable tool in project selection and policy evaluation;
- Freight policy must align with related policies, such as economic, trade, environmental, and land use policies; and
- Stable multiyear funding provides continuity and minimizes delays, particularly on large-scale projects.

2.4 PEOPLE'S REPUBLIC OF CHINA

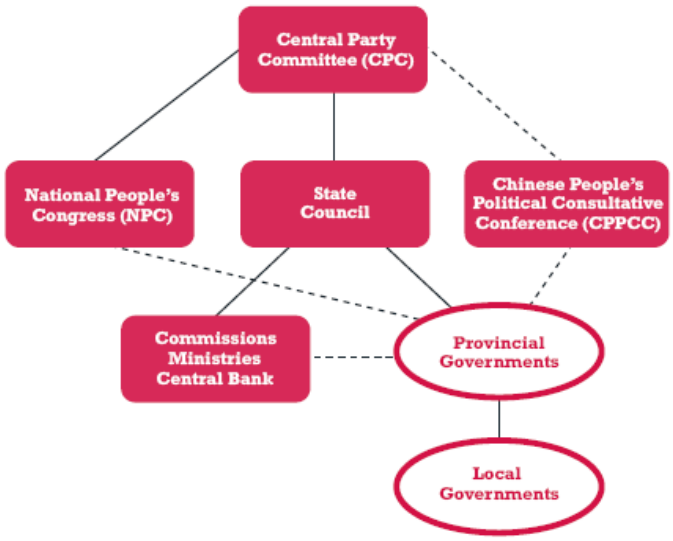
Background

The People's Republic of China (PRC) has implemented several initiatives in recent years to improve its freight transportation and general logistics infrastructure in order to improve its ability to move goods both domestically and internationally. The government structure under which freight transportation planning takes place in China is quite different than that in the United States and several domestic institutional changes have occurred since 2008 when the U.S. Federal Highway Administration (FHWA) published its International Technology Scanning Program Report, *Freight Mobility and Intermodal Connectivity in China* in May 2008.[12] Chapter 2 of that report provides a good overview of the existing governmental structure for decision-making within China as depicted in Figure 2.9 below. While this overall governing

[12] U.S. Federal Highway Administration (FHWA), Freight Mobility and Intermodal Connectivity in China, International Technology Scanning Program, Washington, D.C., May 2008.

structure remains intact, changes have occurred at the ministry level that have altered how and through whom improvement plans are implemented.

Figure 2.9 Chinese Governmental Decision-making Structure



SOURCE: Liu, Z., "Planning and Policy Coordination in China's Infrastructure Development," Paper prepared for the ADB-JBIC-World Bank East Asia Pacific Infrastructure Flagship Study, undated.

In April 2008, shortly before the FHWA report was published, the PRC Ministry of Communications, which had previously overseen planning for roadways and waterways, was incorporated into a new Ministry of Transportation, however the Ministry of Railways remained as a separate entity. In early 2009, to assist in recovery from the worldwide economic downturn and to address several factors in the Chinese logistics system, the State Council implemented a *Logistics Industry Restructuring and Revitalization Plan* (described more fully below) which designated logistic corridors and called for improvements to China's inland waterways, highways, and railways. Subsequently, in 2011, the PRC adopted its *12th Five-Year Plan* for the years 2011-2015 with one of its emphasis areas being development of new logistics capacity and further improvements including an emphasis on "green" freight transportation initiatives.

In March 2013 the National People's Congress, recognizing additional shortcomings in its freight rail infrastructure and to address internal management problems at the Ministry of Railways, abolished that ministry and divided its functions. Its administrative functions were absorbed into the Ministry of Transportation with the other modes of transportation, while its operational and commercial functions, including freight and passenger business and rail construction, were established as a separate, government-owned

enterprise known as the China Railway Corporation.[13] These changes signify the commitment of the Chinese government to restructuring existing ministries and planning structures as necessary to achieve improved handling of freight and addressing trade corridor issues.

Addressing System Needs

In China, infrastructure improvement, regulatory changes, and operational practice approaches are being employed to address the domestic freight transportation needs of the country. While there is strong central planning at the government level, funding of the projects is often carried out at the ministry, provincial government, or local government levels resulting in uneven development across the country. Provincial and local development in the more affluent, traditional areas for foreign investment near the eastern and southern coasts of China has far outpaced that of the western and more rural regions of the country. New freight transportation policies supporting more development in those interior areas, away from the coastal regions are a major thrust of recent freight transportation initiatives.

Asian Development Bank (ADB) analysis of the Chinese logistics network cite the following negative factors that must be addressed to improve the flow of goods domestically:[14]

- Low transport cost, high inventory cost, and high management cost;
- Total cost of logistics is 18.1% of GDP—higher than directly competing countries (Brazil – 11.6 percent, India – 13.0 percent, Mexico – 14.9 percent) and the world average and nearly twice the cost in the U.S. (9.3 percent);
- Insufficient investment in logistics management technology (supply chain software);
- Long transit times (especially for rail transport); and
- Unreliable logistics service quality, supply chain complexity, and insufficient supply chain visibility.

China's strategies are also focused upon reducing their internal/domestic logistics costs in order to better compete on a global basis. When comparing PRC to the U.S., Europe, and the World Average for logistics costs to total product costs as calculated by consultants from the Asian Development Bank (ADB) in 2010,[14] logistics costs are 4 to 5 times higher as a percentage in the PRC than in the U.S.

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[13] "China Plans Overhaul of Railway System," Colum Murphy, The Wall Street Journal, March 10, 2013. Available at: WSJ.com.

[14] Asian Development Bank, Transport Efficiency through Logistics Development: Policy Study, Mandaluyong City, Philippines, 2012.

When further breaking down the components of logistics costs and directly comparing the PRC and the U.S., the area where the discrepancy is the highest is in management where the PRC's costs average over three times as much as in the U.S. As a result, the PRC has implemented measures to standardize paperwork and procedures and also to implement better information systems to process freight movements across the country.

Objectives and Strategies

Logistics Industry Restructuring and Revitalization Plan

After the 2008 international economic downturn, in early 2009 the PRC State Council directed and began to implement the *Logistics Industry Restructuring and Revitalization Plan* in order to address the needs of the PRC's logistics industry. Prior to implementation, statistics showed that over 40% of logistics providers had seen profits decline and many had withdrawn or closed. A separate plan specifically crafted for implementation of the broader restructuring plan was produced which involved over 32 departments of the government at the ministry, commission, and provincial/local government levels. [15]

Plan Objectives

Specific stated objectives of the plan to correct these trends were to:[15]

1. Produce a number of international-level logistics enterprises able to compete on a level playing field in the global environment;
2. Increase scope, capacity, utilization, operation, and efficiency of outsourced logistics and 3PL and 4PL firms;
3. Realize an annual growth rate of 10 percent in added value within the sector; and
4. Further lower logistics cost to GDP ratio in line with more developed, mature markets.

Designation of Priority Logistics Areas

Measures to implement these goals included the designation of 10 priority focus areas for development within the logistics industry. Those areas include the following:

1. Energy distribution (petroleum/coal/major mining products);
2. Agricultural products (quality standards system/cold chain logistics);

[15] China Intelligence Online, Logistics Stimulus and Revitalisation Strategy White Paper 2009, Available at: http://www.slideshare.com, accessed March 25, 2013.

3. Establishment of a nationwide network for daily distribution of consumer goods;
4. Increased efficiency in dispatching of food, salt, tobacco, and publications;
5. Pharmaceutical logistics for centralized purchasing and dispatching;
6. Further regulation, tracking, and monitoring of dangerous chemicals transport;
7. Auto and auto parts logistics;
8. Encouragement of reverse logistics and green logistics (including product packaging and recycling) to protect the environment;
9. Postal and express delivery; and
10. Emergency logistics to respond to war, disasters, or epidemics.

Policy Actions to Aid Implementation

Means of further implementing the strategic goals at the government level were planned to take place through specific policy action areas. These policy actions were:

- **Increased outsourcing of logistics within the domestic manufacturing sector.** Large-scale manufacturers (many State or quasi-State-owned) encouraged to replace in-house logistics management with professional logistics providers;
- **Promotion of "Green Supply Chains".** Provide funding assistance and supporting regulation to encourage development of environmentally friendly technologies and practices within the logistics industry and especially among larger, state-owned logistics providers;
- **Taxation restructuring.** Restructuring of logistics-related taxation and fees to address profitability concerns/small profit margins during the economic downturn;
- **Fuel Tax Reform.** Beginning on January 1st, 2009 six types of fees on road and waterway maintenance were canceled and tolls on second-class roads were to be phased out in favor of higher fuel taxes to encourage examination of cost structure and break-even points of various transportation modes;
- **Fuel Tax Case Study.** Application of an overall higher direct fuel tax in combination with reduction of fees and tolls to encourage use of environmentally friendly vehicles and technology development while reducing local government control and interference with long-distance freight movement;
- **Increased efficiency and technological development.** Financial assistance will be made available to state-owned logistics/supply chain enterprises to

apply new technologies and implement best practices related to management and information technology; and

- **Streamlined procedures and regulations.** Measures to streamline administrative and management practices such as customs clearance to improve cargo handling and reduce inefficiency within the supply chain.

Formation of Domestic Logistics Zones and Corridors

To develop an infrastructure framework through which to move freight, the plan organized the country into nine "logistics zones" and identified 10 major logistics corridors for freight movement within the country. The plan also called for the creation of national logistic corridors that would connect 21 main cities with 17 cities serving as regional logistic hubs.

The nine logistics zones outlined by the plan include:

1. **Beijing, Tianjin** centered North China logistics region;
2. **Shenyan, Dalian** centered Northeast logistics region;
3. **Qingdao** centered Shandong Peninsula logistics region;
4. **Shanghai, Nanjing, and Ningbo** centered Yangtze River Delta logistics region;
5. **Xiamen** centered Southeast coastal logistics region;
6. **Guangzhou and Shenzhen** centered Pearl River Delta logistics region;
7. **Wuhan and Zhengzhou** centered central logistics region;
8. **Xi'an, Lanzhou, and Urumqi** centered Northwest logistics region; and
9. **Chongqing, Chengdu, and Nanning** centered southwest logistics region.

The 10 logistics corridors designated by the plan include:

1. **Northeast Corridor** connecting the Northeast regions to the rest of China;
2. **North-South Eastern Corridor** connecting the south and north of the eastern regions;
3. **North-South Central Corridor** connecting the south and north of the central region;
4. **East-West Northern Corridor** connecting the eastern coastal region and the northwestern region;
5. **East-Southwest Corridor** connecting east coastal regions and southwest regions;
6. **Southwest-Northwest Corridor** connecting the southwest and northwest regions;
7. **Southwest-Ocean Corridor** connecting the southwest region to the ocean;

8. **Yangtze Corridor** connecting the Yangtze river and the Grand Canal;
9. **Coal Corridor** for coal distribution; and
10. **A specialist export and import focused corridor**.

A primary goal of implementing these zones and corridors is to shift the economic activity further inland to the west and encourage additional foreign investment in those regions where lower cost labor pools are available and limited investment have occurred. The plan calls for a number of key projects to stimulate growth in these areas. These included development of multimodal and transshipment facilities, logistics parks, citywide dispatching systems, and bulk commodities facilities near Shanxi, Inner Mongolia, and Shaanxi. It also calls for manufacturers to outsource logistics practices in order to focus on their core business functions, implementation of standardization in warehousing/ transshipment facilities/transportation equipment, and implementation of common information platforms for ports, bulk commodity transaction platforms, and transportation information platforms.

PRC 12th Five-Year Plan

The PRC adopted its *12th Five-Year Economic Plan* in early 2011 which included several transportation and logistics related goals designed to further strengthen those of the previous logistics sector restructuring plan. The *12th Five-Year Economic Plan* for all sectors continued a strong emphasis on development of clean energy and this initiative carried over to the transportation/logistics sector which has been noted as a "significant carbon emitter."[16] Specific goals of the plan include improvement of inland waterways and rail infrastructure to divert some of the expected growth in road transport. Other goals include further development of a stronger third- and fourth-party logistics base to replace the current fragmented system with thousands of individual carriers. More effective use of the existing inland waterway system to transport containers in addition to traditional shipping and cargo movement methods is also a part of the plan.[16] Table 2.1 outlines the specific transportation system improvements called for in the *12th Five-Year Plan* by mode.[17]

[16] KPMG Advisory (China) Limited, China's 12th Five Year Plan: Transportation and Logistics, April 2011.

[17] British Chamber of Commerce in China, Full-Text English Translation of the 12th Five-Year Plan, Available at: http://www.britishchamber.cn/search. Accessed: March 26, 2013.

Table 2.1 Traffic Construction Measures in the 12th Five-Year Plan, 2011

Railways

- Construct 4 longitudinal and 4 transverse passenger transport special lines, inter-city rail traffic trunk lines in city groups, the second double line of the Lan-Xin Railway and such interregional trunk lines as Zhengzhou-Chongqing.
- Complete an expressway railway network with an operating mileage of 45,000 kilometers, and basically covering cities with a population of over 500,0000, and western China trunk lines, such as the Lhasa-Shigatse Railway.
- Construct coal transport lines from central and south Shanxi, and western Mongolia to central China.
- Study the feasibility of constructing the Qiongzhou Strait sea-crossing project and the Sichuan-Tibet Railway.

Urban Rail Traffic

- Build urban rail traffic network systems in Beijing, Shanghai, Guangzhou and Shenzhen, etc., complete main urban rail traffic frameworks in Tianjin, Chongqing, Shenyang, Changchun, Wuhan, Xi'an, Hangzhou, Fuzhou, Nanchang and Kunming, etc.
- Plan rail traffic backbone lines in Hefei, Guiyang, Shijiazhuang, Taiyuan, Jinan and Urumqi, etc.

Highways

- Complete a national expressway network consisting of 7 radial lines, 9 longitudinal lines and 18 transverse lines largely, with an available mileage of 83,000 kilometers, basically covering cities with a population of over 200,000.
- Strengthen the improvement of national and provincial trunk highways, increase the proportion of Class 2 or above national highways to over 70%, and connect almost all county towns with appropriate conditions to Class 2 or above highways.

Coastal Ports

- Construct:
  - Coal loading ports in northern China,
  - Coal transit and storage bases in eastern and southern China,
  - Large crude oil handling terminals in Dalian and other ports,
  - Large iron ore handling terminals in Ningbo, Zhoushan and other ports, and
  - Container terminals in Shanghai, Tianjin and other ports.
- Construct about 440 10,000-ton and above deep berths.

Inland Water Transport

- Regulate the upper Yangtze River channel
- Implement the channel management project for the Jingjiang River section of the Yangtze River
- Extend the 12.5-meter-deep channel at the estuary of the Yangtze River upward.
- Implement the Xijiang River trunk shipping channel capacity expansion project, and the Beijing-Hangzhou Canal improvement project
- Promote the construction of the high-grade channel network of the Yangtze River Delta, and other high-grade channels.

Civil Aviation
• Construct a new airport in Beijing
• Expand the airports of Guangzhou, Nanjing, Changsha, Haikou, Harbin, Nanning, Lanzhou and Yinchuan
• Construct a number of new branch line and general-purpose airports
• Study the feasibility of constructing new airports in Chengdu, Qingdao and Xiamen Accelerate the construction of new-generation flight control systems.
Integrated traffic hubs
• Construct 42 national integrated traffic hubs.

Source: British Chamber of Commerce in China, Full-Text English Translation of the 12th Five-Year Plan, Available at: http://www.britishchamber.cn/search, accessed: March 26, 2013.

China is aggressively implementing measures to address lacking infrastructure and adverse operational practices in the freight transportation and logistics sectors. Key considerations include:

- Lower logistics costs to GDP ratio to be more in line with advanced economies;
- The designation of domestic logistics areas or industries; and
- The designation of nine logistics zones and ten corridors connecting twenty-one main cities, of which seventeen are identified as regional logistics hubs.

For example, the PRC through its five-year plan is calling for the formation of domestic logistics zones and corridors. The goal is to expand capacity across multiple modes and shift additional economic activity further inland in hopes of ensuring a more equitable distribution of the benefits arising from national investment.

2.5 INDIA'S TRADE CORRIDOR DEVELOPMENT

Like China, India uses five year plans to steer the major elements of its economy. The development of freight corridors in the Eastern and Western Zones of the country were a key element in the 10th five-year plan 2002 to 2007. For the 11th plan a major policy shift occurred in which the intention to separate passenger and freight traffic on trunk routes was made explicit. The plan also called for the construction of new terminals and rolling stock capacity.[18]

[18]http://planningcommission.nic.in/aboutus/committee/wrkgrp11/wg11_railway.pdf.

Planning Structure

The Infrastructure Planning Secretariat handles major elements of India's transportation infrastructure planning process, particularly for elements that involve private sector participation. The Secretariat handles six different sectors

1. Highways,
2. Railways,
3. Ports,
4. Airports,
5. Telecom, and
6. Power.

In 2010 a high-level committee was constituted to make recommendations relating to financing of the projected investment of Rs. 40,99,240 crore (U.S. $1,024.81 billion) during the Twelfth Five-Year Plan period 2012 to 2017.[19]

The following are the terms of reference for the committee:

(i) To assess the investment required to be made by the Central and State Government), Public Sector Undertakings (PSU) and the private sector in the 10 major physical infrastructure sectors during the 12th Five-Year Plan.

(ii) To identify areas and activities to be financed by the government, PSUs and the private sector, respectively;

(iii) To suggest ways to enable the requisite flows of private investment in infrastructure including the creation of a supportive investor-friendly environment;

(iv) Make recommendations on the role government could play in developing the capital markets for intermediating long-term savings for investments in infrastructure projects, including the fostering of appropriate institutional arrangements;

(v) Examine the role of international capital flows in infrastructure financing and development, assess the nature of projects likely to receive such capital, and consider how such financing can be obtained, in a sustainable manner; and

(vi) Identify any regulatory/legal impediments constraining private investment in infrastructure, and make specific recommendations to facilitate their removal.

[19] http://infrafin.in/.

Highways

The National Highways Authority of India (NHAI) is the highest government body for implementing the National Highways Development Program (NHDP). All contracts it considers are awarded through competitive bidding. Under its authority several major highway projects have been undertaken in recent years, including:

- Four-laning of the Golden Quadrilateral and North South-East West Corridors (NHDP Phases I and II);
- Four-laning of 12,109 kms (NHDP- Phase III);
- Two laning of 20,000 km (NHDP- Phase IV);
- Six-laning of 6,500 kms (NHDP- Phase V);
- Development of 1000 km of expressways (NHDP- Phase VI);
- Other Highway Projects (NHDP- Phase VII); and
- Accelerated Road Development Program for the North East Region.

Railways

In order to address the strain on the Delhi-Mumbai and Delhi-Kolkata rail track, the government promoted the construction of dedicated freight corridors in the Western and Eastern high-density routes. The investment is expected to be about Rs. 22,000 crore (U.S. $5 billion).

Ports

While the government of India controlled port development in the past, it has increasingly turned to Build Operate Transfer. Several such arrangements are in process, including Danish shipping company Maersk Investment in Jawaharlal Nehru Port Terminal (JNPT) and Mumbai. JNPT handles over 60 percent of India's container port traffic. Other investments include those by port operators: P&O Ports; Dubai Ports International; and Singapore-based PSA.

Trade Facilitation

India currently has diverse trading relationships. Some of its largest trading partners currently are in the Middle East. One projection shows the United Arab Emirates (UAE) is forecast to be its largest trading partner by 2025, with trade values estimated at $103.6 billion, overtaking China which represents its largest trading partner in 2010.[20] Many of the corridors that have been spearheaded through concession and BOT agreements are designed primarily to satisfy domestic demand, given that overland transportation costs are quite high and, in some cases, the prohibitive cost of moving goods cross-country has inhibited

[20]http://www.deltaeconomics.com/wp-content/uploads/India-FINAL-04.10.11.pdf.

Indian producers from achieving efficient scale production. Until quite recently, India's international trade was modest. The total container volume handled by Indian ports in 2005 was lower than the JNPT's volume alone is today (see Table 2.2). The government is focusing attention on coordinated system improvements with its neighbors in the region to improve overall transportation efficiency.

Table 2.2 2005 Port Traffic in India

Port Name	Trade in Tonnage, MMT	Container Traffic (Million TEU)[a]
Cochin	14	0.19
Ennore	9.5	–
Haldia	36	0.13
JNPT	33	2.37
Kandla	42	0.18
Kolkata Dock System	10	0.16
Mormagao	31	0.01
Mumbai	35	0.22
New Mangalore	34	0.01
Paradip	30	–
Tuticorin	16	0.31
Vizag	50	0.05
Total (2005)	384.5	4.25
JNPT(2011)	*64.31*	*4.27*

Source: Indian Ports Association.

A trade deficiency with Russia and the other Commonwealth of Independent States (CIS) countries is a significant concern. For India's economy and trade balance, the lack of trade, which currently measures only around $10 billion a year, has been called the "most under-performing aspect of Indo-Russian bilateral relations." The completion of the North-South Transport Corridor, which can link Mumbai to St. Petersburg with a 40-percent cut in cost and time, is an important step in opening the country up for more trade. The development of the Astara sea port in Iran on the Caspian Sea is seen as a key component for the development of the North-South Corridor linking India not only to Azerbaijan and Iran, but also eventually to the other CIS countries.

The Eastern Dedicated Freight Corridor (DFC) project being implemented by the Indian Railways for faster movement of freight entails a 337 km double track line and 14 km of single track line between Bhaupur and Khurja in Uttar Pradesh.

Analysts predict that investment by railways in Dedicated Freight Corridors is projected to grow nearly five times by FY14.[21]

Delhi-Mumbai Industrial Corridor (DMIC), India

The Delhi-Mumbai Industrial Corridor is a mega-infrastructure project with an estimated total cost of $90 billion. The corridor has a length of 1,483 km between the political capital and the business capital of India. Mumbai is the host of the Jawaharlal Nehru Port which handles over 60% of India's container port traffic.

Challenges

Although in 2011 India committed to investing $12 billion in the highway system during the following year, the country has had difficulty in meeting road construction targets due to social conflict brought about by land acquisition. India has increasingly relied on toll concessions to finance road construction, offering 30-year concessions. As of November 2012, the National Highways Authority of India (NHAI) has awarded only 900 km of projects against its target of 8,300 km.[22]

One concessionaire, GMR infrastructure, recently terminated its concession to construct a new highway linking Rajasthan and Gujarat. This occurred following the NHAI's failure to secure the required environmental clearances and ROW. The project was to have been implemented through a design-build-finance-operate-and-transfer model.[23]

The lack of adequate modern ports, rail, and highway networks and supporting logistic infrastructure hinders the country's ability to position for being the sourcing destination of choice. The direction that India takes in its trade corridor development has significant implications for the United States. Despite the growth in trade traffic in recent years, there remains a significant gap between India's productive capacity and its current level of international trade. If additional foreign and private-sector investment allows India to accelerate trade corridor development, the role that merchandise trade with India will play in the U.S. total trade profile is likely to increase. Under current containership routing patterns, this development would primarily benefit U.S. East Coast ports.

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[21] http://www.thehindu.com/business/Industry/work-on-eastern-dedicated-freight-corridor-project-begins/article4491974.ece.

[22] PM to review status of all highway projects, The Times of India, November 13, 2012, http://articles.timesofindia.indiatimes.com/2012-11-13/india/35087493_1_highways-ministry-highway-projects-road-projects.

[23] GMR finally gives up on India's largest highway project, Business Standard, January 8, 2013, http://www.business-standard.com/article/companies/gmr-finally-gives-up-on-india-s-largest-highway-project-113010800086_1.html.

While India continues to make significant investments in its transportation infrastructure, the performance of the freight system continues to lag other key Asian trade partners.

Key take-a-ways include India's emphasis on trading partnerships with regional neighbors; an emphasis on increasing roadway capacity to facilitate trade and a separate rail system dedicated to freight. To accomplish this, India is expanding the use of public-private partnerships via concessionaires.

Given the inherent private-sector benefits accruing from freight network investments, the U.S. should also view the development of a national freight network as an enhanced opportunity for partnerships.

2.6 BRAZIL

Brazil is rapidly developing its trade infrastructure. With the long distances separating Brazil from many of its trading partners, efficiency is key to making Brazil's trade competitive, yet its logistics costs have been high for many years due to institutional inefficiencies. Maritime trade is particularly important given that much of Brazil's trade is primarily raw materials. Brazil also has one of the most extensive highway systems in the world and has made efforts to privatize many corridors. A key symbol of the Brazilian government's efforts to link with other trading partners is the completion of the Interoceanic Highway, which connects the Port of Santos on Brazil's East Coast with the West Coast of South America. This highway opens up previously inaccessible areas in the far western part of the country and fosters trade linkages between Brazil, Peru, and Bolivia. The project cost $2 billion to complete and has recently opened to traffic despite running through difficult terrain that presented many engineering challenges.

The Interoceanic Highway is only one of several major transportation corridors recently completed or currently under construction with many more under consideration. The Brazilian government has recently loosened the terms under which highway concessions can be issued to attract additional private investment.[24] In August 2012, the Brazilian government announced the issuance of R$42.5 billion in state-directed private investment to improve highway infrastructure. The money would be used to renovate 5,700 km of highways.[25]

[24] "Brazil unveils new highway concession terms", Xinhua, February 6, 2013, http://news.xinhuanet.com/english/world/2013-02/06/c_132154277.htm.

[25] "Brazil to Invest R$133B in Transport: Daily," The Rio Times August 17, http://riotimesonline.com/brazil-news/rio-politics/brazil-to-invest-r133b-in-transportation/.

Ports

Puerto Santos, which is the fastest growing maritime port in the country, is key to Brazil's ability to expand its overall trade linkages.

The Port's primary area of influence, which accounts for more than 50 percent of national GDP, includes the States of São Paulo, Minas Gerais, Goiás, Mato Grosso, and Mato Grosso do Sul. The secondary hinterland includes the States of Bahia, Tocantins, Espírito Santo, Rio de Janeiro, Paraná, Santa Catarina, and Rio Grande do Sul. The Santos Port Complex accounts for over one-quarter of Brazil's trade and includes principal cargoes, such as sugar, soy, container, coffee, corn, wheat, salt, citrus pulp, orange juice, paper, cars, alcohol, and other bulk liquids.[26] Table 2.3 displays Brazil's total waterborne trade by trade area in 2011.

Table 2.3 Brazil: Overseas Waterborne Trade By Trade Area
Metric Tons, 2011

Trading Area	Dry Bulk Tons	Liquid Bulk Tons	Breakbulk Tons	Containerized Tons	Total Tons
India/Far East	274,558,679	17,140,811	8,662,072	21,541,327	321,902,889
Northern Europe	81,121,971	5,844,245	5,822,874	13,182,340	105,971,430
Med/Black Sea	37,301,327	4,913,823	2,210,199	7,448,151	51,873,500
U.S. East/Can	24,488,215	11,118,852	5,289,984	8,706,605	49,603,656
Middle East	26,103,706	6,482,537	365,817	768,661	33,720,721
Carr/Gulf of Mexico	10,833,284	5,141,546	1,457,791	8,311,314	25,743,935
South Atlantic	11,880,158	3,803,265	1,814,900	3,761,240	21,259,563
West Africa	2,359,327	10,742,509	816,369	747,718	14,665,923
Unidentified	5,831,236	1,061,030	528,058	2,776,226	10,196,550
S. America W Coast	3,898,478	2,003,531	1,316,189	1,579,997	8,798,195
Northwest Africa	3,582,929	430,460	512,786	1,355,813	5,881,988
Cent Am W Coast	4,142,811	556,254	328,234	195,719	5,223,018
East Africa	1,532,577	184,230	125,177	1,404,094	3,246,078
Total	487,634,698	69,423,095	29,250,449	71,779,205	658,087,447

Source: AAPA via Agência Nacional de Transportes Aquaviários (ANTAQ), Anuário Estatístico Aquaviário 2011.

Evidence of Brazil's increasing connectivity to key trading partners is the increase in the volume of trade. Container traffic has grown markedly in the country from two million to over eight million TEU between 2000 and 2010 (see

[26] http://www.portodesantos.com.br/.

Figure 2.10). A related and widely cited metric of freight connectivity is the Liner Shipping Connectivity Index, which captures how well countries are connected to global shipping networks.[27] It has been computed annually by the United Nations Conference on Trade and Development (UNCTAD) since 2004 based on five components of the maritime transport sector: number of ships, their container-carrying capacity, maximum vessel size, number of services, and number of companies that deploy container ships in a country's ports.[28] The maximum index value was 100 when the index was started in 2004. Brazil's index value has increased from 25.83 in 2004 to 36.88 in 2013. This compares with an index value of 92.80 for the United States, 41.8 for Mexico, and 44.35 for India. China has the world's highest ranking at 157.51 in 2013.[29]

Table 2.4 Liner Shipping Connectivity Index, 2004 to 2013

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Brazil	25.83	31.49	31.61	31.64	30.87	31.08	31.65	34.62	38.53	36.88
Canada	39.67	39.81	36.32	34.40	34.28	41.34	42.39	38.41	38.29	38.44
China	100.00	108.29	113.1	127.85	137.38	132.47	143.57	152.06	156.19	157.51
India	34.14	36.88	42.9	40.47	42.18	40.97	41.40	41.52	41.29	44.35
Mexico	25.29	25.49	29.78	30.98	31.17	31.89	36.35	36.09	38.81	41.80
United States	83.30	87.62	85.8	83.68	82.45	82.43	83.80	81.63	91.70	92.80

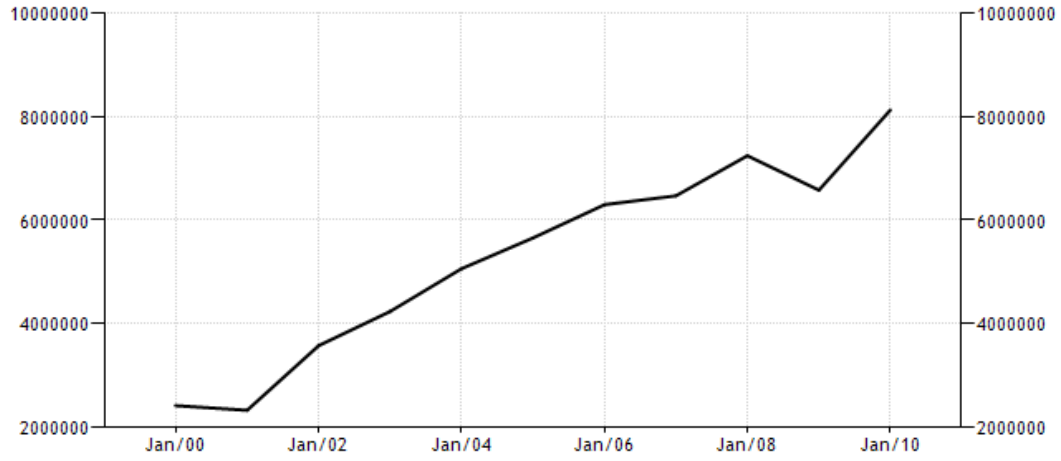
Source: United Nations Conference on Trade and Development.

[27] Hoffman, Jan, Corridors of the Sea: An Investigation into Liner Shipping Connectivity, http://www.ulpgc.es/hege/almacen/download/7099/7099518/hoffman_2_081012.pdf.

[28] "Liner shipping connectivity index," http://www.tradingeconomics.com/brazil/liner-shipping-connectivity-index-maximum-value-in-2004--100-wb-data.html.

[29] http://www.indexmundi.com/facts/indicators/IS.SHP.GCNW.XQ/rankings.

Figure 2.10 Container Port Traffic in Brazil, TEUs



Source: World Bank via www.tradingeconomics.com.

Freight Rail

The development of freight rail in Brazil has been impeded to some extent by the existence of multiple track gauges and other issues with interoperability. The government is only now beginning to address the lack of standardization in the rail system, pledging that common standards be adopted to ensure interoperability amongst the 10,000 km of new freight corridors that the Federal government plans to construct over the next 30 years.[30] Using a PPP model, the government will award concession contracts for the construction of new lines according to the following two groups.[31]

- **Group 1:**
  - São Paulo ring railway north, Jundiaí – Manuel Feio;
  - São Paulo ring railway south, Evangelista de Souza – Ouro Fino;
  - Access to the Port of Santos, Riberão Pires – Raiz da Serra – Cubatão/ Santos;
  - Lucas do Rio Verde – Uruaçu;
  - Estrela d'Oeste – Panorama – Marcaju; and
  - Açailândia – Vila do Conde (Belém).

[30] "Interoperability call on Brazil's new freight corridors," November 7, 2012, http://www.railwaygazette.com/news/single-view/view/interoperability-call-on-brazils-new-freight-corridors.html.

[31] http://www.railwaygazette.com/news/policy-legislation/single-view/view/brazil-to-develop-10-000-km-of-new-railway.html/

- **Group 2:**
  - Uruaçu – Brasília – Corinto – Campos;
  - Salvador – Aracajú – Maceió – Recife;
  - Rio de Janeiro – Campos – Vitória;
  - Belo Horizonte – Salvador;
  - Marcaju – Cascavel – Mafra; and
  - São Paulo – Mafra – Porto Alegre – Rio Grande.

In March 2013, the Brazilian land transport agency, Agência Nacional de Transportes Terrestres (ANTT), which regulates highways, railways, passenger and cargo transport and international transport in the country, published its first draft tender documentation for a 35-year concession to build operate and maintain a 477-km rail line from Açailândia in Maranhão state to the Port of Vila do Conde in Belém. This is the first of 12 PPP projects that the government is planning to implement. The finalized concession is expected to go out to tender in June 2013.[32]

Brazil has an aggressive transport investment program aimed at expanding the Country's role in global trade. While research revealed much information about the planned investments, there is little generally accessible information on the process by which the plan was developed or how it will be implemented.

The experience of Brazil is notable for its strategy of simultaneously building on its strengths, such as the expansion of Puerto Santos, while directing investment to the weak links in its overall transportation system that have limited the variety of commodities that can be efficiently exported and the countries with which it can efficiently trade. Some challenges that Brazil is currently facing, such as rail gauge interoperability, have long been resolved in the United States while other issues such as the use of PPPs to accelerate the improvement of rail corridors and connectivity with ports have close parallels in the United States and should be tracked closely.

2.7 CONSIDERATIONS FOR U.S. GATEWAY AND PLANNING EFFORTS

With the implementation of the Moving Ahead for Progress in the 21st Century Act (MAP-21), the U.S. is embarking on the development of a National Freight Plan, which will include a Gateways and Corridor component. The review of international examples of national freight investment programs and plans

[32] http://www.railwaygazette.com/news/freight/single-view/view/consultation-starts-on-first-railway-ppp.html.

reveals that significant focus on investments in freight systems are underway in many countries throughout the world. A variety of approaches ranging from a bottom-up to a top-down to ad-hoc approaches have been employed in the development of such plans.

However, the more successful and advanced programs represent a hybrid of top-down and bottom-up approaches. They are characterized by the central governing body or Federal government adopting and building upon an approach that originated at the regional level.

In Canada, the development of the National Gateways and Corridors Framework, as well as the three regional Gateway Strategies, is an important milestone. Some key considerations for the U.S. effort include:

- The National Gateway Framework is strategic, and helps align various regional strategies to serve towards the same purpose.
- Federal backing is essential. The National Gateway Framework has significant financial backing from Building Canada, the Federal infrastructure plan that essentially also acts as a transportation investment plan.
- It is not necessary for a top-down approach to initiate gateway strategies. Strategies that already exist at the regional level can be worked into, and help inform the national strategy in a bottom-up approach, as in the case of the Asian Pacific Gateway Strategy.
- In additional to Federal funding and other local funding, a great emphasis is placed on private funding. Attracting investment from the private sector is essential since public funding usually takes long to come by and may not be enough.
- Success in Gateway/Corridor strategies must be done in partnership with all relevant stakeholders, including all levels of government, as well as the private sector.
- Gateway Projects must be backed by rigorous analytical research that looks into all relevant topics affecting modal and intermodal transportation, and supply chain issues in the present and future.

The Mexico MCMP was developed with the idea that isolated improvements are not enough, and that a set of coordinated actions between the public and private sectors is needed to improve the performance of the Mexican Multimodal Transportation System. Other key takeaways include:

- Use of objective data combined with stakeholder input facilitated a more fact-based selection of priorities;
- Process focused on national priorities, but did not prohibit local participation in advancing any local or regional priorities; and
- Flexibility is essential to ensuring plan robustness and longevity.

The implications of the EU's TEN-T process to freight transportation gateway and corridor development in the United States include:

- A unifying vision linking transportation and the economy is a key foundational element of the TEN-T;
- Multijurisdictional transportation planning and implementation will require new management, funding, and coordination strategies;
- Awareness must evolve from an exclusively national and local understanding of freight movement to an international understanding of how freight movement connects to international markets;
- Any movement toward corridor-level thinking in the United States must be grounded in objective, transparent facts and market analysis;
- Benefit-cost analysis is a valuable tool in project selection and policy evaluation;
- Freight policy must align with related policies, such as economic, trade, environmental, and land use policies; and
- Stable multiyear funding provides continuity and minimizes delays, particularly on large-scale projects.

China is aggressively implementing measures to address lacking infrastructure and adverse operational practices in the freight transportation and logistics sectors. Key considerations include:

- Lower logistics costs to GDP ratio to be more in line with advanced economies;
- The designation of domestic logistics areas or industries; and
- The designation of nine logistics zones and ten corridors connecting twenty-one main cities, of which seventeen are identified as regional logistics hubs.

For example, the PRC through its five-year plan is calling for the formation of domestic logistics zones and corridors. The goal is to expand capacity across multiple modes and shift additional economic activity further inland in hopes of ensuring a more equitable distribution of the benefits arising from national investment.

While India continues to make significant investments in its transportation infrastructure, the performance of freight system continues to lag other key Asian trade partners.

Key take-a-ways include India's emphasis on trading partnerships with regional neighbors; an emphasis on increasing roadway capacity to facilitate trade and a separate rail system dedicated to freight. To accomplish this, India is expanding the use of public-private partnerships via concessionaires.

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3.0 Role of Gateways and Corridors

Gateways and corridors play an important role in the movement of all goods throughput the U.S. This section explores the role of gateways and corridors in supporting U.S. and North American competiveness by documenting the supply chains of key U.S. industry sectors and their reliance on multimodal corridors and gateways. The following presents case studies of selected industry supply chains for a closer examination of this relationship. The industries were selected based on their relative importance in terms of total import and/or export volumes, their strategic significance and their reliance on global trade lanes and infrastructure. The selected industry supply chains include:

- Agriculture,
- Energy,
- Consumer goods, and
- Automotive manufacturing.

3.1 AGRICULTURE

The surface transportation system in the U.S. is central to agriculture's ability to compete in domestic and world markets, a competition experiencing increased pressure from other world production regions. The agriculture production regions in the U.S. often are not located near the major urban centers or coastal export facilities, highlighting the critical need for freight transportation throughout the agriculture supply chain.

Agriculture includes a variety of commodities, from grains and processed food products to wood and wood products, to name a few, many of which have their own supply chain. The transportation needs of agricultural products is influenced by many factors, including changes in supply and/or demand, weather, seasonality of commodity cycles, and price fluctuations. These, and other factors, can affect the transportation system's efficiency by bringing about either shortages or surpluses in transportation capacity. For example, a bumper crop of corn one season may create shortages in rail car supplies that result in the need to transport with higher-cost trucks or product loss due to spoilage after no suitable transportation options became available. Table 3.1 shows some examples of typical harvest periods in the Eastern Corn Belt. The transportation

of grains in that region increases dramatically during the month of October each year. The 2010 USDA *Study of Rural Transportation Issues*[33] report points out that domestic demand of the major U.S. crops tends to be relatively stable, but that the crop production (supply) and export demand impact the freight transportation the most.

Table 3.1 Typical Harvest Periods for Agriculture Products in the Eastern Corn Belt

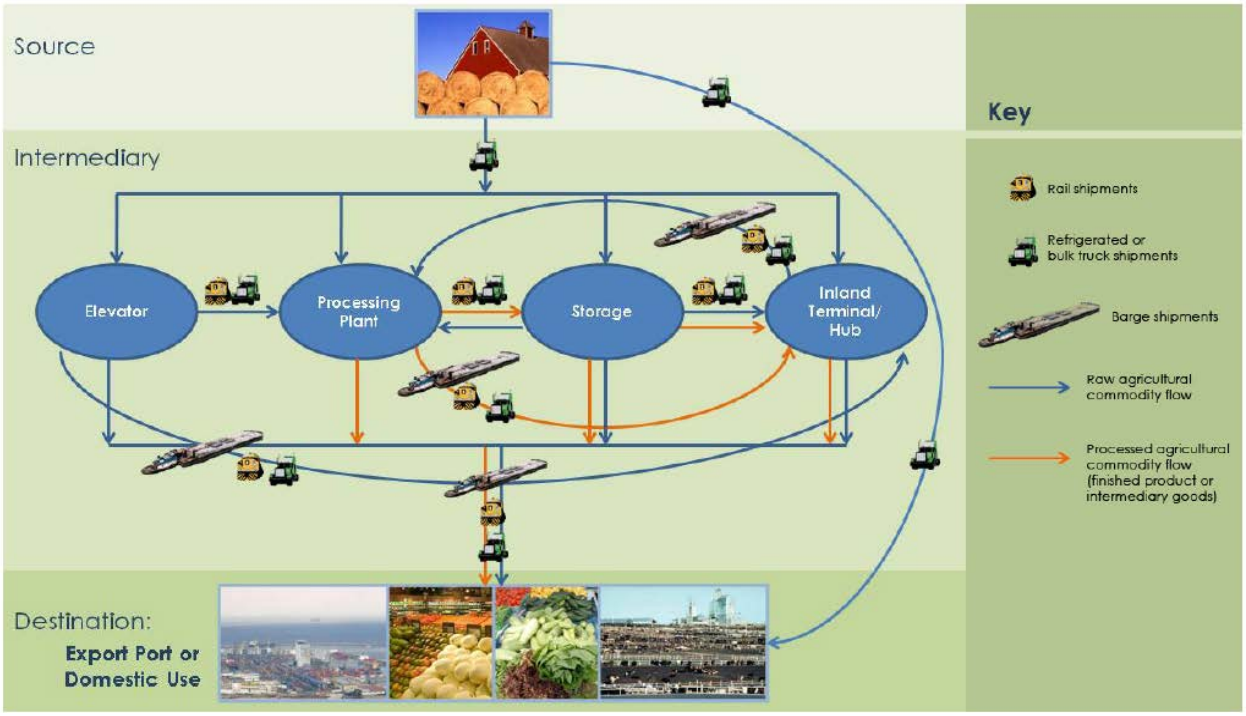
Crop	Typical Harvest Period
Corn – grain	October 7 to November 3
Corn – silage	September 1 to October 15
Soybeans	October 1 to October 20
Wheat (spring)	August 14 to September 1
Wheat (winter)	June 15 to July 15
Hay	Usually 3 cuttings from May 15 to Sept. 30

Source: EPA. "Crop Production." Ag 101. http://www.epa.gov/oecaagct/ag101/crop.html.

Figure 3.1 provides a representation of the supply chain for raw and processed products. Transportation of these, and other agriculture-related products, relies on all the surface transportation modes: truck, rail, and water. The figure shows that the initial freight movements utilize trucks from the source to the intermediary locations, listed as elevators, processing plants, storage, or inland terminal/hub, or directly to final destinations, such as cattle feed lots. Following the initial movement from the source, agriculture products are moved between intermediary locations or directly to final destinations, which include domestic markets and export port locations for shipment to foreign markets.

[33] Casavant, Ken, Marina Denicoff, Eric Jessup, April Taylor, Daniel Nibarger, David Sears, Hayk Khachatryan, Vicki McCracken, Eric Jessup, Marvin Prater, Jeanne O'Leary, Nick Marathon, Brian McGregor, and Surajudeen Olowolayemo, *Study of Rural Transportation Issues*, U.S. Department of Agriculture, Agricultural Marketing Service, April 2010, http://www.ams.usda.gov/AMSv1.0/RuralTransportationStudy, page 28.

Figure 3.1 U.S. Agriculture Supply Chain for Raw and Processed Products



Source: USDA, Study of Rural Transportation Issues, April 2010, http://www.ams.usda.gov/AMSv1.0/RuralTransportationStudy.

The U.S. Census Bureau *2007 Commodity Flow Survey*[34] reveals that agriculture represents 21 percent of all tons and 29 percent of all ton-miles moved by the transportation system in the U.S. (see Table 3.2). Using this data, the USDA states that agriculture is the largest user of the U.S. transportation system.

[34] DOT, Bureau of Transportation Statistics, U.S. Census Bureau, *2007 Commodity Flow Survey*. http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/commodity_flow_survey/index.html.

Table 3.2 Transportation Characteristics of Agricultural Commodities[a] *2007*

SCTG Code	Commodity Description	Value (Billion Dollars)	Tons (Millions)	Ton-Miles (Billions)
	All Commodities	11,685	12,543	3,345
01	Live animals and live fish	11	6	4
02	Cereal grains	85	514	203
03	Other agricultural products	144	212	88
04	Animal feed and products of animal origin, nec	90	246	76
05	Meat, fish, seafood, and their preparations	277	98	49
06	Milled grain products and preparations and bakery products	143	120	51
07	Other prepared foodstuffs and fats and oils	480	468	171
08	Alcoholic beverages	158	114	37
09	Tobacco products	71	3	0
22	Fertilizers	44	150	59
25	Logs and other wood in the rough	7	108	11
26	Wood products	184	324	101
27	Pulp, newsprint, paper, and paperboard	127	145	82
28	Paper or paperboard articles	118	82	29
	Agricultural Products Subtotal	1,938	2,592	962
	% of All Commodities	17%	21%	29%

Source: DOT, Bureau of Transportation Statistics, U.S. Census Bureau, 2007 Commodity Flow Survey. http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/commodity_flow_survey/index.html.

[a] Agricultural commodities identified in the USDA, *Study of Rural Transportation Issues* report.

Table 3.3 contains the modal characteristics of agricultural commodities. The total modal share for all commodities is 70.0 percent truck, 14.8 percent rail, 3.2 percent water, and 12 percent other. Agricultural commodities utilize truck at a higher rate than the overall levels, with 76.9 percent; rail moves 12.4 percent; and water transports 3.7 percent.

Table 3.3 Modal Characteristic of Agricultural Commodities by Tons, 2007

SCTG Code	Commodity Description	Trucks	Rail	Water	Other
	All Commodities	70.0	14.8	3.2	12.0
01	Live animals and live fish	98.4	0.0	0.0	1.6
02	Cereal grains	45.5	31.4	13.5	9.6
03	Other agricultural products	72.7	7.6	9.1	10.6
04	Animal feed and products of animal origin, nec	82.8	9.4	0.0	7.8
05	Meat, fish, seafood, and their preparations	95.8	1.0	0.3	2.9
06	Milled grain products and preparations and bakery products	85.3	7.8	0.0	6.9
07	Other prepared foodstuffs and fats and oils	89.9	5.7	0.5	3.9
08	Alcoholic beverages	89.2	6.0	0.0	4.8
09	Tobacco products	98.4	0.0	0.0	1.6
22	Fertilizers	64.7	19.2	1.7	14.4
25	Logs and other wood in the rough	95.0	3.1	0.0	1.9
26	Wood products	90.4	4.6	0.0	5.0
27	Pulp, newsprint, paper, and paperboard	70.7	19.3	0.1	9.9
28	Paper or paperboard articles	94.0	1.8	0.5	3.7
	Agricultural Products	76.9	12.4	3.7	7.1

Source: DOT, Bureau of Transportation Statistics, U.S. Census Bureau, 2007 Commodity Flow Survey, http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/commodity_flow_survey/index.html.

The USDA *Study of Rural Transportation Issues* provides the following discussion on modal shares for agricultural commodities:

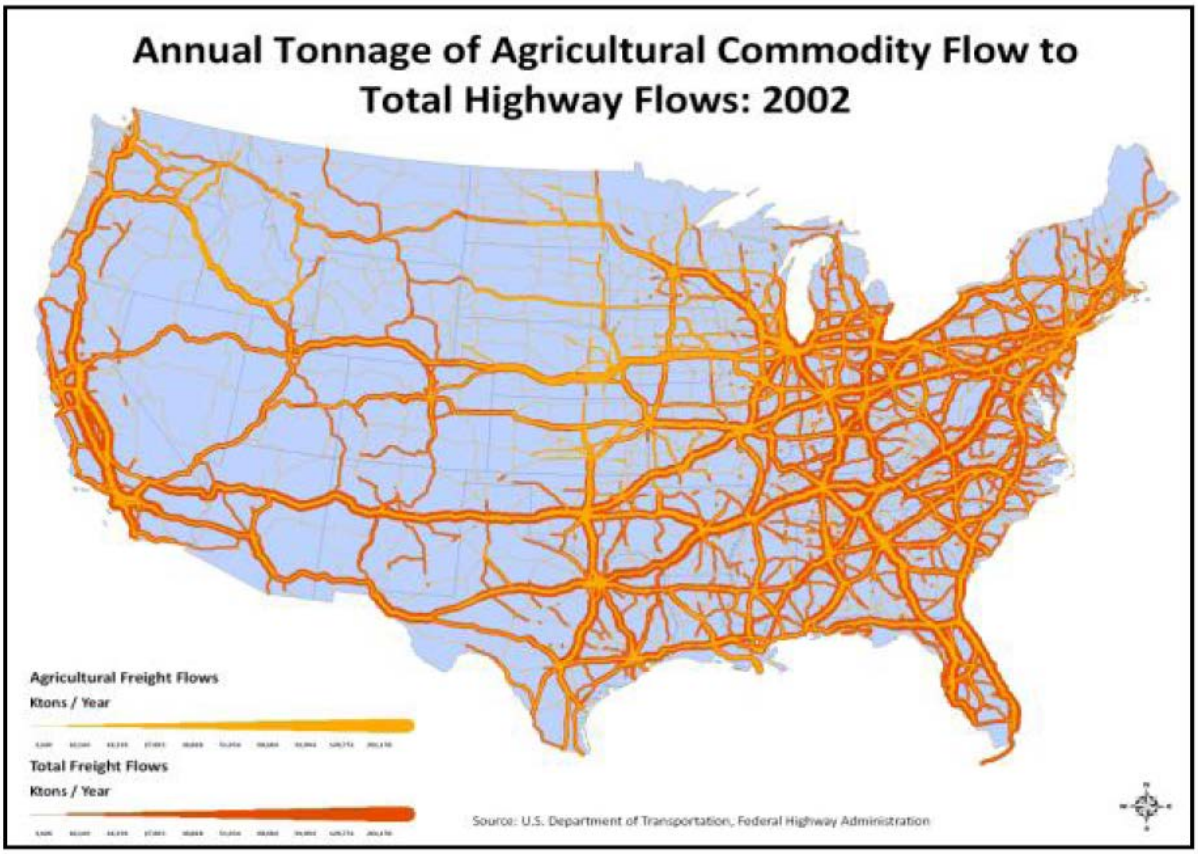
> "Modal shares vary by commodity based on the quality of service and other factors, such as rates, availability, and customer needs. Commodities high in value or susceptible to deterioration or spoilage are more sensitive to handling procedures and to speed of delivery than less perishable commodities. For example, fresh fruit and vegetables require speed and careful handling above all. Trucks dominate movements of fresh fruit and vegetables, livestock, meats and poultry, dairy products, and bakery and confectionary products. Rail and barges lend themselves to bulk and lower-value products such as wheat and soybeans. Many commodities depend heavily on railroads, particularly grain and oilseed, alcohols, and fertilizers. The higher ratio of ton-miles for rail and barge indicates their efficiency at moving commodities longer distances, such as

moving grains and oilseed to ports for export and to distant feedlot locations."[35]

Ocean shipping of export agricultural commodities is moved in either bulk vessels or in container ships. More than half of U.S. agricultural exports by value move in marine shipping containers, according to the USDA; a pattern created largely in order to reduce the number of empty containers shipped back overseas to refill with consumer goods.

As indicated above, transportation movements can heavily involve agricultural products movements. Figure 3.2 shows the annual tonnage of agricultural commodity flows to total highway freight flows. Agriculture makes most of the shipments on highways through some states including North and South Dakota, Nebraska, Idaho, and Washington. In other areas, agricultural shipments are competing for capacity against other truck movements along major routes.

Figure 3.2 Agriculture and Total Freight Moving on U.S. Interstate System *2002*

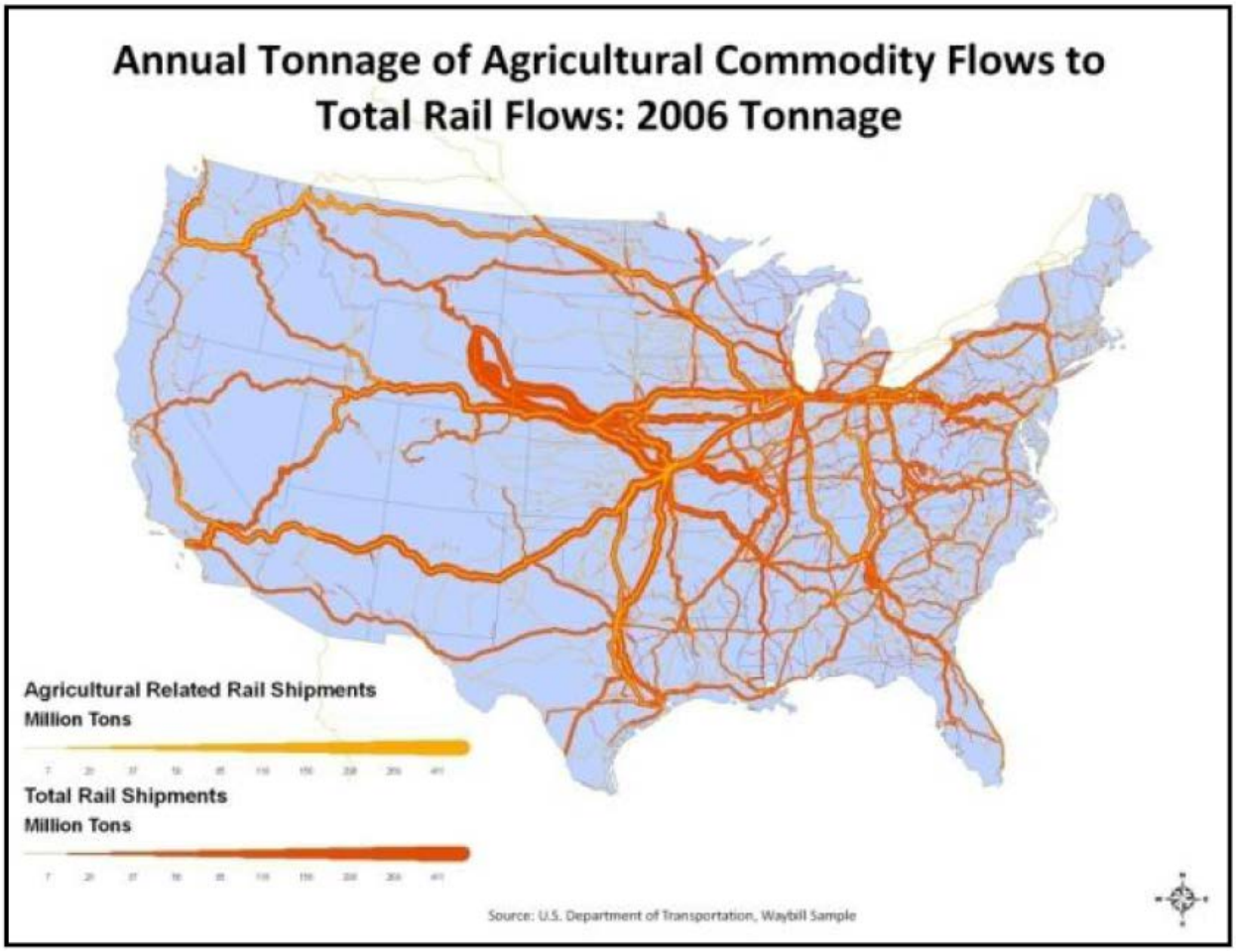


Source: USDA, *Study of Rural Transportation Issues*, April 2010, http://www.ams.usda.gov/AMSv1.0/RuralTransportationStudy.

[35] USDA, *Study of Rural Transportation Issues*, April 2010, http://www.ams.usda.gov/AMSv1.0/RuralTransportationStudy.

The railroads also play a major role in the shipment of agricultural commodities and products. Figure 3.3 shows the annual tonnage of agricultural commodity flows compared to total freight flows on the U.S. rail lines. Heavy concentrations of agricultural commodities occur on major corridors to the major West Coast and Gulf Coast ports for exports to foreign markets.

Figure 3.3 Agriculture and Total Freight Moving on U.S. Rail Lines
2006

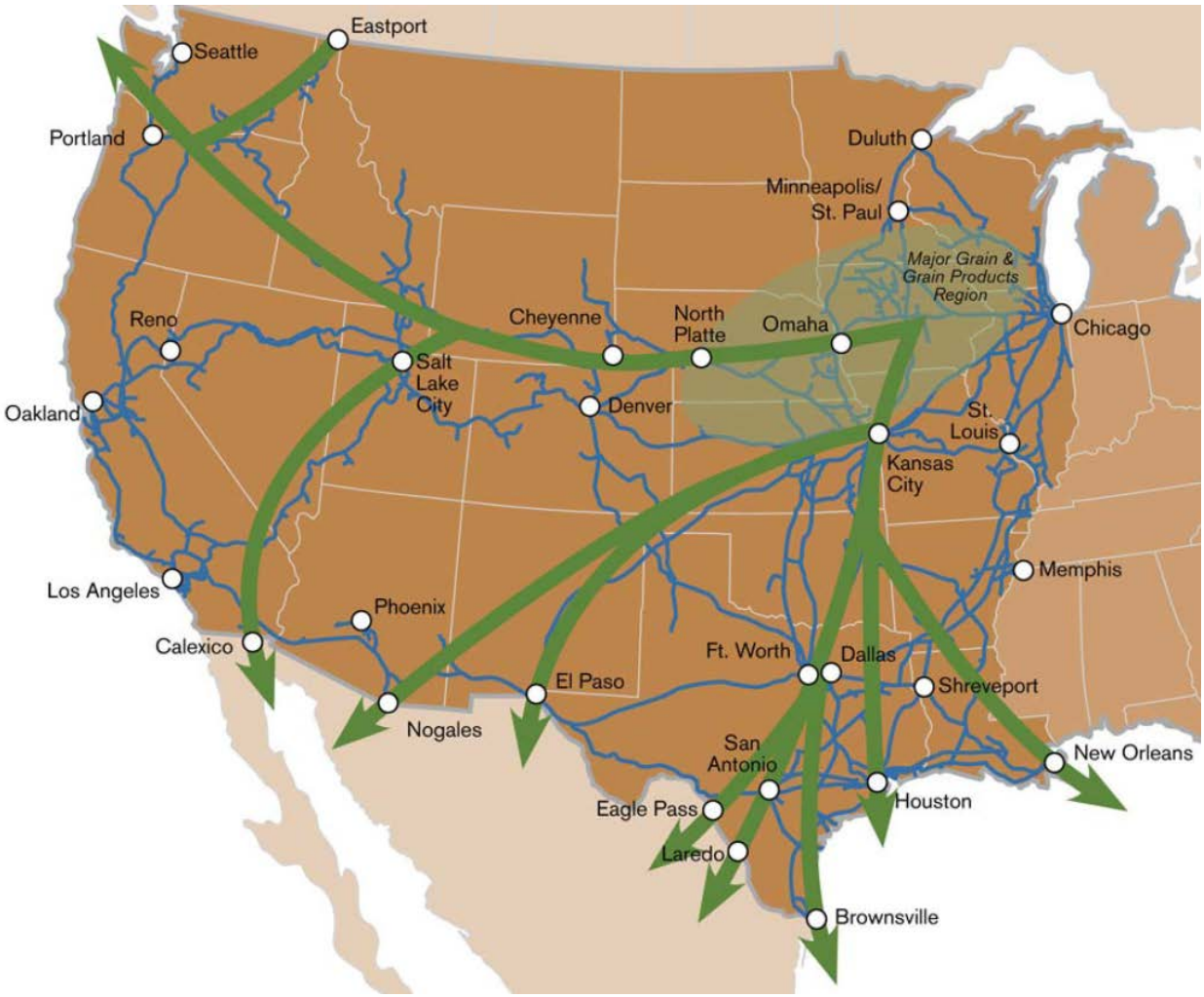


Source: USDA, Study of Rural Transportation Issues, April 2010, http://www.ams.usda.gov/AMSv1.0/RuralTransportationStudy.

Figure 3.4 shows how Union Pacific Railroad's export grain flows originate in the Midwest grain-producing areas and travel to ports along the Gulf Coast and West Coast, Mexico, and Canada. For both export and domestic shipments UP estimates that almost 40 percent of their agricultural shipments are shipped on

unit grain trains.[36] They highlight that unit trains transport a single commodity efficiently between producers and export terminals or domestic markets. UP characterizes their agricultural shipments as being 72 percent domestic, and 28 percent international traffic of which 13 percent are to Mexico. Whole grains represent 43 percent, grain products represent 34 percent, and food and refrigerated represents 23 percent of the agricultural shipments on the railroad.

Figure 3.4 UP Railroad Export Grain Flows



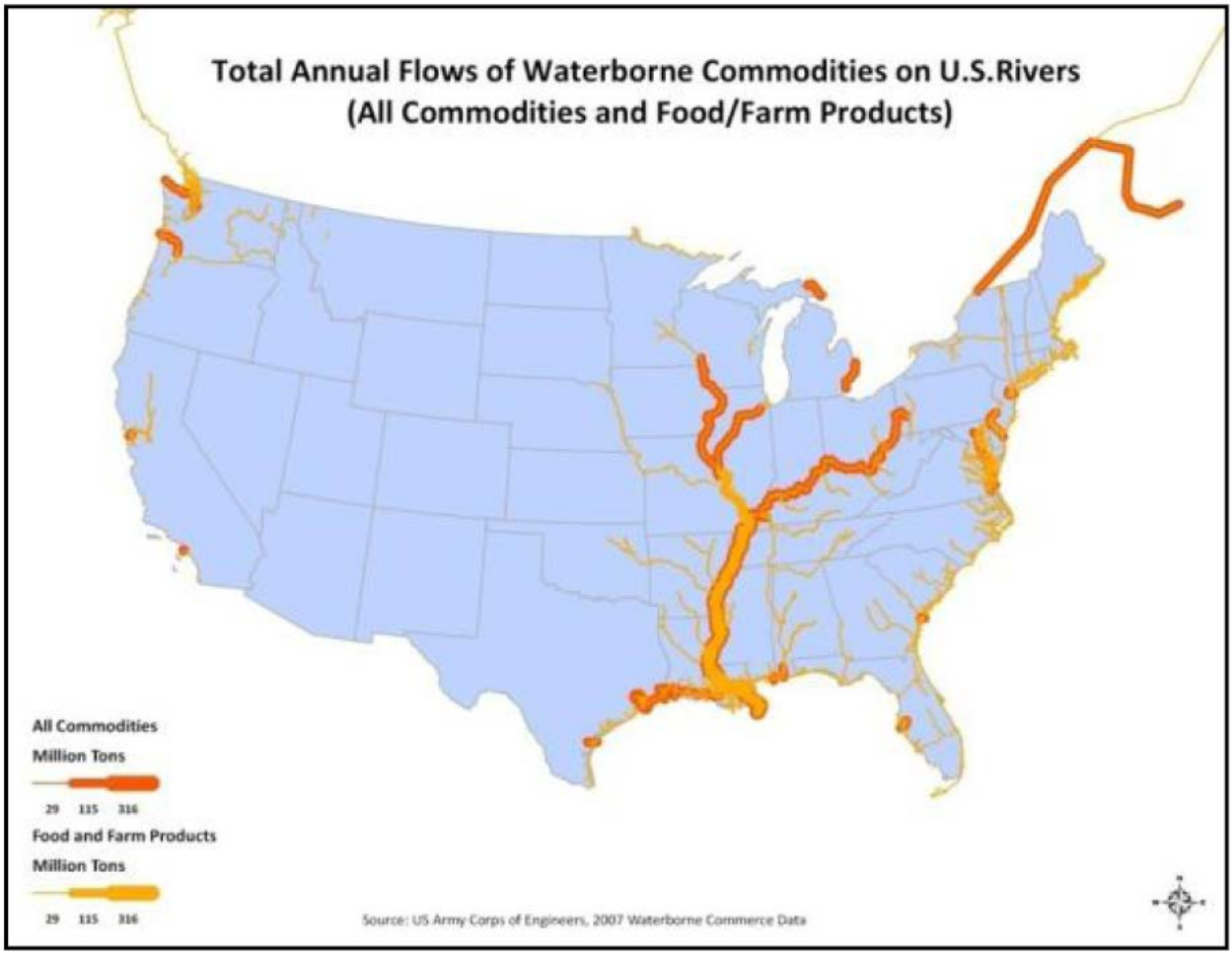
Source: Union Pacific Corporation, *2011 Fact Book*, http://www.up.com/investors/attachments/factbooks/2011/fact_book.pdf

The inland and coastal waterways are the third major surface transportation system involved in the transport of agriculture products. Figure 3.5 shows the annual tonnage of agricultural commodity flows compared to total freight flows

[36] Union Pacific Corporation, *2011 Fact Book*, http://www.up.com/investors/attachments/factbooks/2011/fact_book.pdf.

on the U.S. river system. The largest levels of barge activity are on the Mississippi River network, with many of the other rivers funneling barge shipments to the Mississippi River or to coastal port facilities.

Figure 3.5 Agriculture and Total Freight Moving on U.S. Waterways



Source: USDA, *Study of Rural Transportation Issues*, April 2010, http://www.ams.usda.gov/AMSv1.0/RuralTransportationStudy.

A report by the Texas A&M Transportation Institute (TTI) for the United Soybean Board examined the U.S. lock and dam infrastructure along the river systems. They indicate that a high percentage of the goods shipped by barge on the inland waterways pass through at least one lock. A disruption, such as a failure, would dramatically impact barge shipments. As demonstrated in Figure 3.5, the vast majority of barge shipments along the Mississippi River down to the Gulf Coast ports are agriculture commodities. The TTI report indicates that approximately 90 percent of all corn and soybean exports through

lower Mississippi ports arrive at the ports via barge.[37] The study points to the rapidly deteriorating condition of the nation's lock and dam infrastructure as hindering the ability of the waterborne transportation system to provide a service that will enable U.S. agricultural producers to continue to compete.

Corn Profile

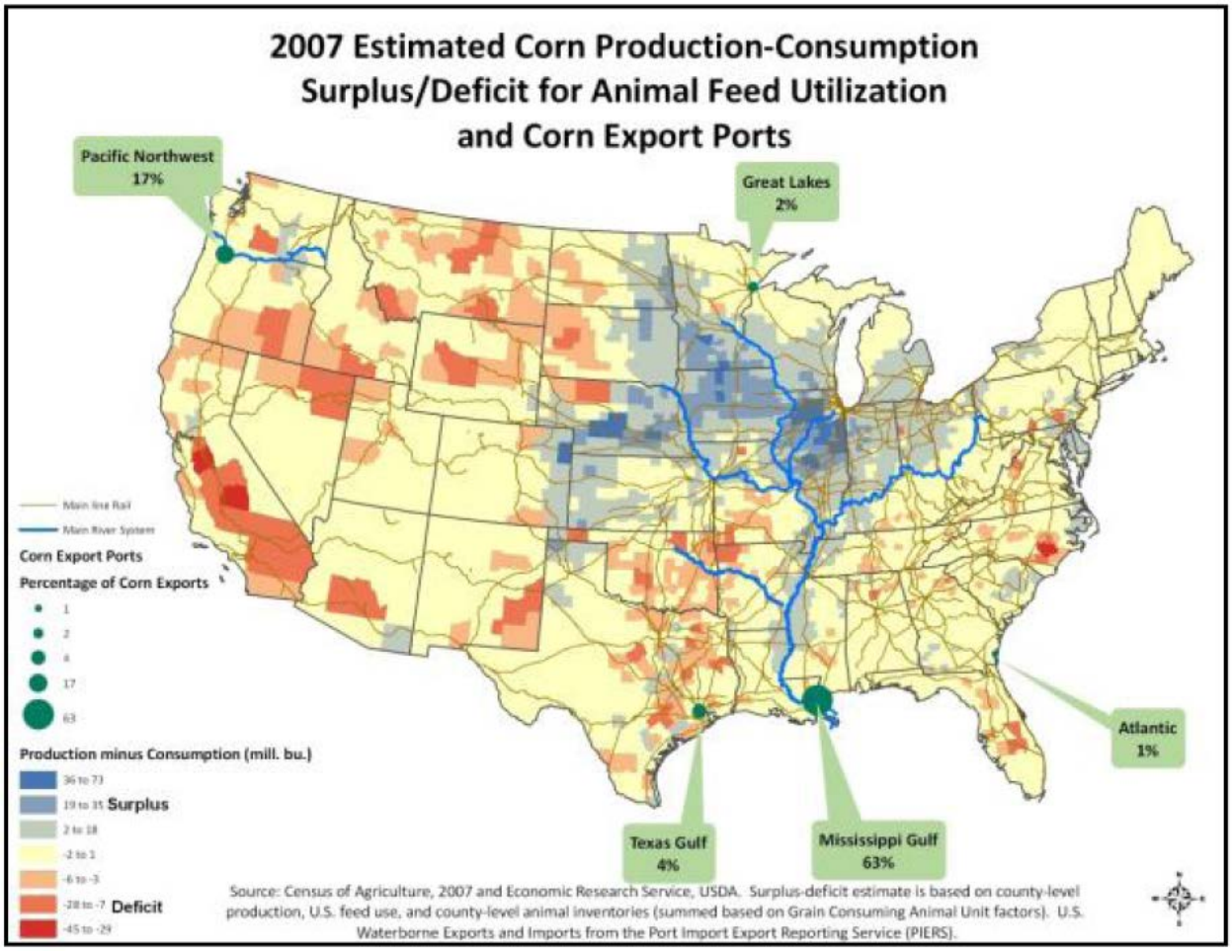
The USDA reports that in 2007 more than 60 percent of the U.S. corn was harvested in five states: Iowa, Illinois, Nebraska, Minnesota, and Indiana. Shown in Figure 3.6, these production areas (shown in a range of blue colors) are generally not located near the domestic consumption markets (shown in a range of red colors) located throughout the U.S. Corn produced in the U.S. for domestic purposes is mainly used as animal feed, human food, seed, or for ethanol. Recent legislative directives to increase the production of ethanol in the U.S. will shape future domestic corn transportation patterns. More than 90 percent of ethanol production capacity is located within a 50-mile radius of the corn producing areas, delegating trucks as the primary mode of transportation for those shipments, according to the USDA. It is noted in the *Study of Rural Transportation Issues* report that newer and larger biorefineries are able to receive corn shipments by rail. Modal share of the domestic corn transportation is 68 percent truck, 30 percent rail, and 2 percent barge.[38]

Figure 3.6 also highlights the ports utilized for the export of corn to foreign markets. Most of the corn exported occurs from the Mississippi Gulf ports with 63 percent, followed by Pacific Northwest ports (17 percent), Texas Gulf ports (4 percent), Great Lakes ports (2 percent), and Atlantic ports (1 percent). The USDA reports that 64 percent of corn exports are shipped via barge, 33 percent by rail, and 3 percent by truck.

[37] Kruse, C. J., A. Protopapas, Z. Ahmedov, B. McCarl, X. Wu, and J. Mjelde, America's Locks and Dams: "A Ticking Time Bomb for Agriculture?" prepared for United Soybean Board, December 2011, http://www.unitedsoybean.org/wp-content/uploads/Americas_Locks_And_Dams.pdf.

[38] Calculated averaged for years 2000 to 2006.

Figure 3.6 Corn Surplus/Deficit Map with the Transportation Systems



Source: USDA, *Study of Rural Transportation Issues*, April 2010, http://www.ams.usda.gov/AMSv1.0/RuralTransportationStudy.

3.2 ENERGY SUPPLY CHAINS

Americans consume 312 million BTU of energy per capita every year – more than four times the global average.[39] Each year the average American spends almost $4,000 on energy. Moving energy commodities to and within the United States requires all available modes of transportation from pipelines to rail, truck, barge, and ocean going vessels. A substantial share of total ton miles that are moved within the United States is tied directly or indirectly to the energy industry. The movement of the following five Standard Classification of Transported Goods Code (SCTG) commodity classes represents 39 percent of the total ton-miles for all commodity types. Furthermore, this total only measures the outputs or end

[39] Energy Information Administration (EIA), 2012.

products of the energy industry. It does not include the massive amount of cargo that must be moved to produce and distribute energy supplies. Table 3.4 shows the breakdown of modal share for 2011 ton-miles. As demonstrated by the FHWA's FAF data, rail is the single most important mode for coal, pipelines are essential in the movement of crude petroleum and natural gas, while the major movement of gasoline is split between trucks, water and pipeline shipments.

Table 3.4 National Ton-Mile Totals for Major Energy Commodities

	Coal	Crude Petroleum	Gasoline	Fuel Oils	Coal –n.e.c.[a] (Includes Natural Gas)
Truck	36,553	2,783	48,613	40,746	81,585
Rail	713,643	576	873	1,892	69,339
Water	13,825	67,335	11,087	18,877	77,303
Multiple modes & mail	35,049	1	5,236	20	18,732
Pipeline	0	208,699	41,010	9,828	738,518
Other and unknown	22,122	0	381	25,613	4,342

Source: FHWA, Freight Analysis Framework 3.

[a] n.e.c. – Not Elsewhere Classified.

Essential considerations in the movement of energy commodities include capacity, cost, and safety. Major infrastructure investments in rail, roads, inland waterways, and pipelines have consistently driven down the cost of delivering energy commodities. Nevertheless, in recent years due to fuel costs and taxing of existing infrastructure, the cost to deliver energy has been rising in certain quarters. For example, according to the Energy Information Administration (EIA), transportation costs account for approximately 40 percent of the average overall cost of coal delivered at electric power plants. The average cost of shipping coal by rail to power plants increased almost 50 percent from 2001 to 2010.[40] Energy supply chains are constantly evolving. The growth of biofuel as a component of U.S. energy supply has produced a degree of overlap between energy and agricultural supply chains. While other new energy sources that have come online in recent years, including wind and solar power, imported liquefied natural gas, shale oil, and shale gas, have all created new challenges for shippers in responding to changes in overall demand, consumer preferences, and new regulations. After experiencing a long period of relative stability, many energy supply chains today are in flux. The rate of change creates challenges for long-term planning in determining how future corridor investments should be

[40] "Cost of transporting coal to power plants rose almost 50 percent in decade," http://www.eia.gov/todayinenergy/detail.cfm?id=8830/.

prioritized. The following section discusses corridor planning considerations for each major energy commodity based upon recent developments and trends.

Coal

U.S. coal production is concentrated in three areas (see Figures 3.7 and 3.8). The Western Region (Northern Great Plains) accounts for over one-half of total U.S. coal production, with the largest share originating from the Powder River Basin concentrated in Wyoming. The Appalachian region accounts for roughly one-third of U.S. coal production, with West Virginia, Eastern Kentucky, and Pennsylvania being the largest sources of coal in this region. The remaining production comes from several interior states, such as Illinois, Indiana, western Kentucky, and Texas.[41] Different types of coal are used for different purposes with high grade anthracite used primarily in metallurgy to the more common forms of coal that are mostly used for power production.

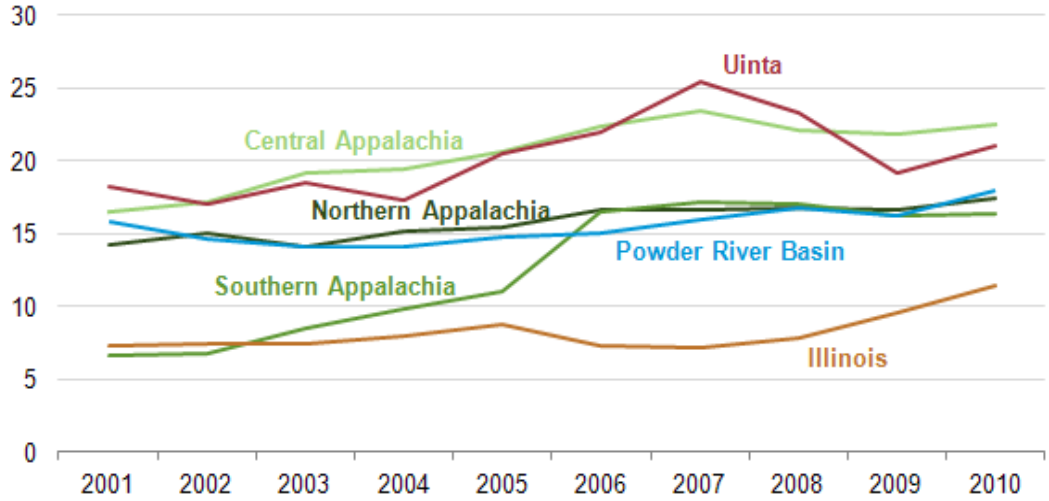
The U.S. rail system is essential to coal production and coal is equally essential to the success of the freight rail industry. Coal accounted for 43.3 percent of rail tonnage and 24.7 percent of rail gross revenue in 2011.[42] Almost 90 percent of coal ton-mileage is handled by rail.[43] Rail became even more essential to U.S. coal production with the discovery of low sulfur coal in the Powder River Basin, which could burn with lower environmental consequences. The establishment of new freight rail corridors linking Powder River Basin to distant population centers in the 1970s and 1980s represented a major shift in U.S. energy supply chains.

[41] EnvisionFreight.com

[42] https://www.aar.org/keyissues/Documents/Background-Papers/Railroads-and-Coal.pdf

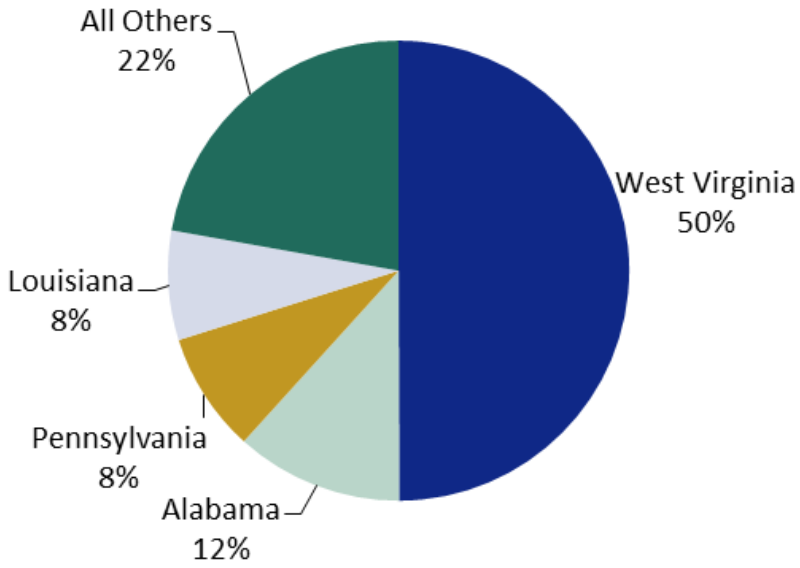
[43] FHWA, Freight Analysis Framework

Figure 3.7 Average Rail Transport Cost of Coal to the Power Sector by Major Coal Basin



Source: EIA.

Figure 3.8 U.S. Coal Exports By State



Source: Energy Information Administration, 2011.

Another major shift in the U.S. coal supply chains in recent years has been driven by exports. The United States has long been referred to as "the Saudi Arabia of Coal" due its large technically recoverable reserves, yet existing supply chains and corridors were established to satiate domestic demand and not to supply exports. Several simultaneous trends in the United States, including efforts to curb carbon emissions and new sources of natural gas, have driven down domestic demand for coal and opened up new opportunities for coal exports.

Coal exports have grown from $1.5 billion in 2003 to $14.9 billion in 2012.[44] Almost all of these exports are transported by ocean going and Great Lakes vessels. In 2012, maritime exports of coal totaled 108 million metric tons. While the Powder River basin is the greatest source of domestic supply, approximately one-half of U.S. coal exports in 2012 originated from West Virginia.[45] Due to environmental concerns and a shortage of available terminal capacity on the West Coast, the development of export corridors for Powder River Basin coal has been slower to occur, yet is poised to grow in the next few years as new West Coast terminals come on line.[46] The future development of coal supply chains is likely to continue to shift as the United States and its trading partners continue to institute new restrictions on carbon emissions.

Natural Gas

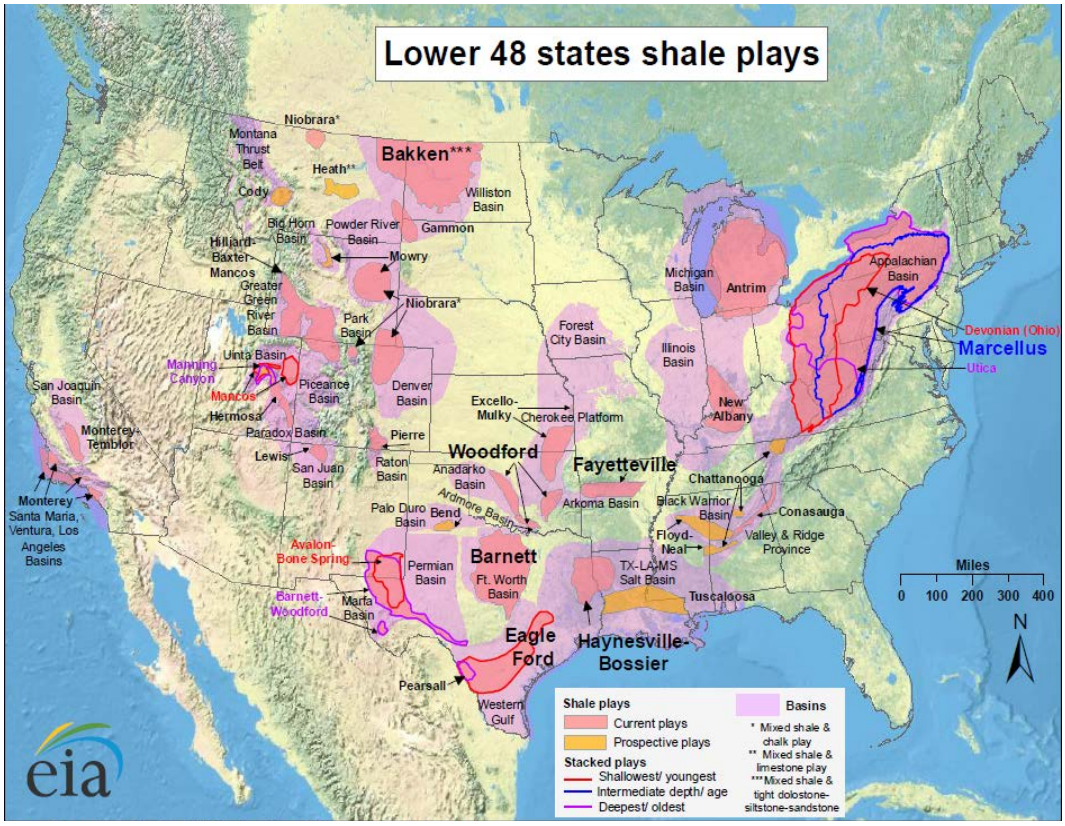
Natural gas supply chains have seen several shifts over the last decade. From 2003 to 2008, growing demand for natural gas as a home heating source and feedstock for electricity production outstripped U.S. production capacity, leading to sharp growth in pipeline imports from Canada, as well as new, strong growth from liquefied natural gas terminals. While LNG was costly, several ports aggressively pursued new LNG terminals on the assumption that the need for natural gas imports would continue to grow sharply. As illustrated by Figure 3.9, the falloff in energy prices and the recession severely undercut natural gas imports from both gaseous and liquefied sources. This trend was augmented by the success of major shale gas operations that began to grow precipitously in 2009 just as the economy was at its weakest point. In 2012, LNG imports, which had been seen as the wave of the future only a few years ago, were less than one-half of what they had been in 2003, while shale gas production continues to grow and expand geographically (see Figure 3.10).

[44] Source: USA Trade Online, (HS Category 2701).

[45] Source: USA Trade Online.

[46] "Wyoming mining company signs coal export deal," http://www.oregonlive.com/environment/index.ssf/2013/02/wyoming_mining_company_inks_co.html.

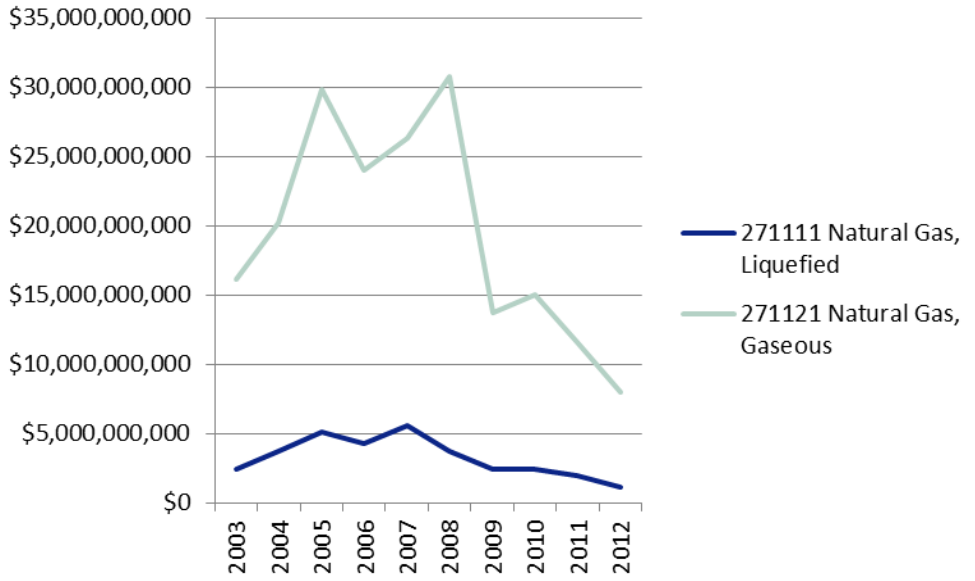
Figure 3.9 Current and Prospective Shale Gas and Shale Oil Developments



Source: Energy Information Administration, 2011.

The supply chains connected to shale gas production are different than those associated with traditional natural gas production. The production of gas by fracking requires substantial volumes of sand, water, and chemicals to be injected deep underground. These heavy inputs are most efficiently delivered by rail; however, rail lines do not generally extend to remote well sites – requiring numerous heavy truck trips to open and service well sites – often on rural roadways not designed or rated for such heavy traffic. The process also produces substantial volumes of waste water that must be shipped offsite. The rapid growth in fracking activity has revitalized certain rail corridors that had previously been underutilized. Pipelines could also be heavily utilized for the transport of products produced in these fields, but installations of pipelines often lag other modes.

Figure 3.10 U.S. Natural Gas Imports



Source: https://www.aar.org/keyissues/Documents/Background-Papers/Railroads-and-Coal.pdf.

Petroleum

The supply chains for petroleum have seen less significant transformation in recent years than natural gas and coal, yet like natural gas the emergence of nontraditional petroleum sources from states, such as North Dakota, is beginning to shift the corridors used for moving petroleum. Increases in oil output in North Dakota, Texas, and the Gulf of Mexico are currently driving total U.S. oil production higher.[47] Yet, the corridors and physical infrastructure for supplying oil from new sources, such as North Dakota, to consumption points is less well developed than it is from more established production sites. In addition to the well-publicized Keystone pipeline, there are several other pipelines currently under construction or in the planning stages that are expected to improve the efficiency and capacity of oil production in the upper Midwest. At present, due to the shortage of available pipeline capacity, oil producers are relying on rail to supplement pipeline capacity for delivering product. This shift in production locations will both alter and diversify the corridors used for petroleum.

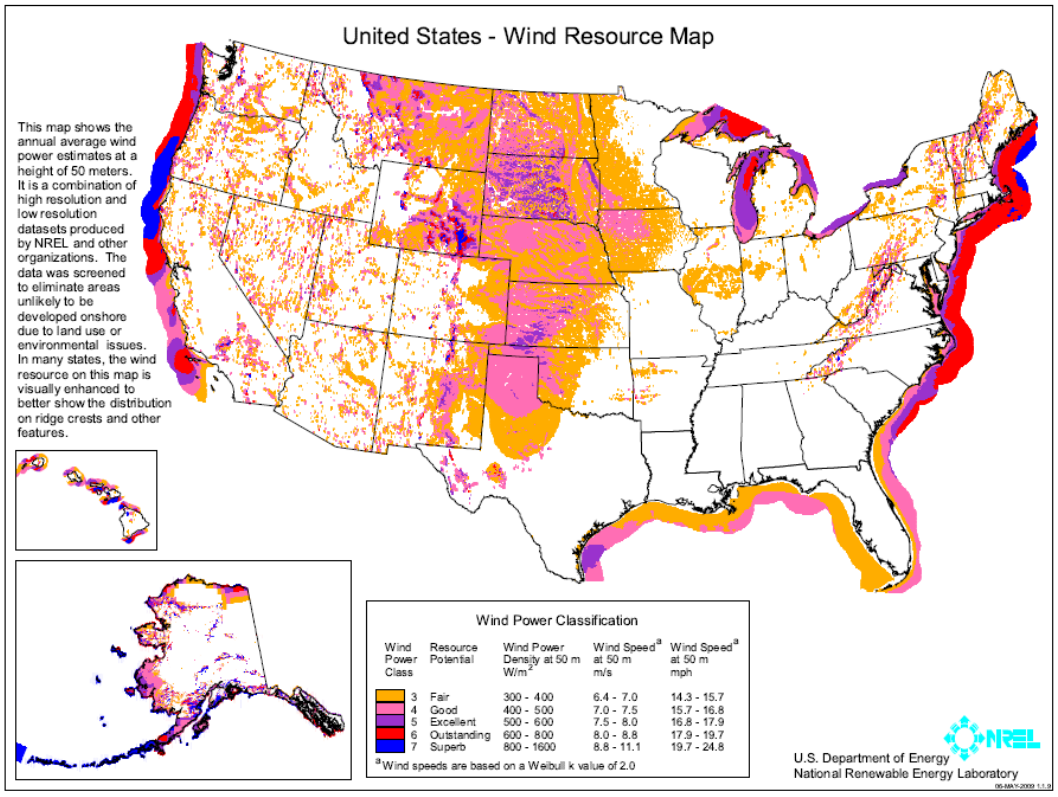
Renewable Energy

A different set of considerations comes into play when producing renewable energy. As wind energy farms have spread across the U.S. (see Figure 3.11), the movement of turbines, blades, and other components for wind farms has led to the establishment of renewable energy corridors. The corridors used for

[47] http://www.eia.gov/todayinenergy/detail.cfm?id=6610

supplying wind farms require roads that are capable of handling overweight and oversize loads. Furthermore, since many wind energy components are imported, they also require efficient connections to marine ports. Biofuels are another form of renewable energy that has sometimes revealed weaknesses in the existing freight corridor network. Pure ethanol, for example, is corrosive to pipelines and in most cases must be handled by rail or trucks, a factor which can increase its delivery cost vis-à-vis petroleum-based alternatives, The first pipeline designed specifically to handle ethanol was put into service in 2008 and several others are in the planning stage, yet the long-term modal balance of ethanol distribution is unclear.[48] Another challenge in delivering biofuels is the relatively small production scale and geographic dispersion of producers.

Figure 3.11 U.S. Wind Resources Map



Source: U.S. Department of Energy, National Renewable Energy Lab

[48] http://www.pipelineandgasjournal.com/nation%E2%80%99s-first-ethanol-unit-train-pipeline-distribution-system-planned.

3.3 CONTAINERIZED CONSUMER GOODS

The supply chains used for delivering consumer goods rely on a careful balance between versatility, responsiveness and efficiency. Trucks are the indispensable mode for the delivery of consumer goods as no other mode that is currently operational can provide comparable access to thousands of consumption points around the country. Nevertheless, as the U.S. economy has grown more trade dependent, other modes played a growing role in the delivery of U.S. consumer goods at different stages of the supply chain.

Consumer goods are spread over many different commodity types within the Standard Classification of Transported Goods, which is the classification system used by the Commodity Flow Survey and Freight Analysis Framework. Table 3.5 shows a breakdown of Commodity Class 43 "Mixed Freight," which includes deliveries to destinations such as grocery stores, convenience stores, and restaurants. The pattern that is revealed for this commodity classification is common for many consumer deliveries in which the vast majority of tons and ton miles are truck based within the borders of the United States.

Table 3.5 Modal Distribution of SCTG Commodity Code 43 "Mixed Freight"

Mode of Transportation	Value 2007 (Million Dollars)	Percent	2007 (Thousands)	Percent of Total	2007 (Millions)	Percent of Total
All modes	932,353	100	300,922	100	56,137	100
Truck	866,591	92.9	292,751	97.3	49,838	88.8
Rail	1,860	0.2	971	0.3	1,160	2.1
Water	318	-	81	-	S	S
Air (includes truck and air)	1,723	0.2	97	-	133	0.2
Parcel, U.S.P.S. or courier	45,205	4.8	2,253	0.7	1,505	2.7
Truck and rail	4,808	0.5	1,457	0.5	1,919	3.4
Truck and water	1,115	0.1	281	0.1	601	1.1
Rail and water	218	-	58	-	132	0.2
Other multiple modes	161	-	42	-	114	0.2
Other and unknown modes	10,347	1.1	2,930	1.0	594	1.1

Source: http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/commodity_flow_survey/final_tables_december_2009/index.html.

Importation of Containerized Consumer Goods

In 2012, maritime containerized imports represented 30 percent of total U.S. imports by value. Since the 1990s, the United States has experienced strong growth in imported consumer goods, particularly from Asia, that has substantially reoriented the consumer goods supply chain. The vast majority of

containerized consumer goods, outside of imports from Canada and Mexico, enter the country through maritime ports. Not all goods that are containerized are consumer goods, yet the overwhelming majority of imported finished goods that are destined for consumers enter the country in containerized form. Table 3.6 shows a breakdown of maritime imports and the percent containerized by value. In 2012, 70 percent of the commodity types imported into the United States were primarily containerized (i.e., containers constituted at least 90 percent of the total value of the import commodity).

Table 3.6 Containerized Value of Maritime Imports by Commodity, 2012

Commodity	Vessel Value (Thousand Dollars)	Containerized Vessel Value (Thousand Dollars)	Percent Containerized
2709 Crude Oil From Petroleum and Bituminous Minerals	248,422,508	307,602	0.1%
8703 Motor Cars & Vehicles for Transporting Persons	86,595,105	8,868,264	10.2%
2710 Oil (not Crude) from Petrol & Bitum Mineral etc.	86,427,490	3,406,854	3.9%
8708 Parts & Access For Motor Vehicles (head 8701-8705)	26,618,594	24,946,945	93.7%
8443 Print Mach Incl Ink-jet Mach Ancil T Prnt Pt Nesoi	15,215,031	14,901,342	97.9%
8471 Automatic Data Process Machines; Magn Reader etc.	14,414,785	14,113,778	97.9%
8528 TV Recvrs, Incl Video Monitors & Projectors	12,625,738	12,368,985	98.0%
9403 Furniture Nesoi And Parts thereof	12,371,625	12,235,037	98.9%
6110 Sweaters, Pullovers, Vests etc., Knit or Crocheted	11,810,684	11,614,168	98.3%
3004 Medicaments Nesoi, Mixed or not, In Dosage etc. Fm	11,230,570	11,006,660	98.0%
4011 New Pneumatic Tires, of Rubber	10,443,997	10,294,168	98.6%
6403 Footwear, Outer Sole Rub, Plast or Lea & Upper Lea	9,648,520	9,562,510	99.1%
9503 Toys Nesoi; Scale Models Etc.; Puzzles; Parts etc.	9,645,122	9,538,813	98.9%
9401 Seats (except Barber, Dental, etc.), and Parts	9,168,252	9,072,522	99.0%
6204 Women's Or Girls' Suits, Ensemb etc., Not Knit etc.	8,216,833	8,015,286	97.5%

Commodity	Vessel Value (Thousand Dollars)	Containerized Vessel Value (Thousand Dollars)	Percent Containerized
8481 Taps, Cocks, Valves etc. for Pipes, Tanks etc., Pts	7,655,279	6,695,916	87.5%
4202 Travel Goods, Handbags, Wallets, Jewelry Cases, etc.	7,459,277	7,198,864	96.5%
8517 Electric Apparatus for Line Telephony etc., Parts	7,365,570	7,059,998	95.9%
6402 Footwear, Outer Sole & Upper Rubber or Plast Nesoi	6,446,114	6,407,615	99.4%
8429 Self-Propelled Bulldozers, Graders, Scrapers, etc.	6,383,290	2,646,386	41.5%
8504 Elec Trans, Static Conv & Induct, Adp Pwr Supp, Pt	6,370,904	5,235,342	82.2%

Source: U.S. Census Foreign Trade Statistics

Due to their proximity to Asia, the most significant beneficiaries of the growth in maritime containerized trade have been West Coast ports.

Low cost imports from Asia have shifted American patterns of consumption by lowering the real cost of a multitude of items. As an illustration, expenditures on Chinese-made goods still make up only 1.2 percent of U.S. household expenditures, despite playing a much more visible role in daily life. In 2010, imports from all countries accounted for 16 percent of the U.S. GDP.[49] Despite the fact that the U.S. economy is more trade reliant than it has been in the past, most consumer spending is on services, as illustrated in Figure 3.12.

The high cost of services and housing in the United States must be counterbalanced by affordable consumer goods to maintain a high quality of life. Low freight transportation costs are important in holding down U.S. expenditures on imported goods, in particular, East Asian goods, which are primarily nonluxury everyday items.

[49]Hale, Galina, and Bart Hobijn, The U.S. Content of "Made in China," http://www.frbsf.org/publications/economics/letter/2011/el2011-25.html/.

Figure 3.12 Share of Consumer Expenditures by Expenditure Type

		Share spent on		Import content: Directly sold to final demand		Import content: Total	
	Expenditure share	"Made in USA"	"Made in China"	Total	Chinese goods	Total	Chinese goods
Total	100.0	88.5	2.7	7.3	1.2	13.9	1.9
Less food and energy	86.1	88.0	3.1	7.7	1.4	13.0	2.0
Durables	9.9	66.6	12.0	18.7	6.2	26.3	7.3
Motor vehicles	3.4	74.9	1.2	17.5	0.6	27.4	1.9
Furniture/ household equip.	4.7	59.6	20.0	21.4	10.6	27.8	11.6
Other durables	1.8	69.0	11.8	14.2	5.3	20.5	6.2
Nondurables	23.2	76.2	6.4	12.1	2.6	22.1	3.3
Food	8.0	90.8	0.4	5.2	0.2	13.9	1.1
Clothing/shoes	3.4	24.9	35.6	29.5	13.8	33.6	14.7
Gasoline/fuel oil/other energy goods	3.6	88.4	0.1	7.4	0.0	34.1	0.5
Other nondurables	8.4	77.7	3.1	13.8	1.4	20.1	2.0
Services	66.9	96.0	0.0	4.0	0.0	9.2	0.6
Housing	16.6	100.0	0.0	0.0	0.0	2.5	0.4
Household operations	7.2	99.7	0.0	0.3	0.0	10.6	0.6
Transportation	1.6	90.4	0.0	9.6	0.0	20.8	0.4
Medical care	18.4	99.3	0.0	0.7	0.0	6.0	0.6
Recreation	8.2	99.6	0.0	0.3	0.0	6.6	0.8
Other services	14.9	84.3	0.0	15.7	0.0	20.2	0.5

Source: Authors' calculations based on 2008 input/output matrix from Bureau of Labor Statistics (2010) and 2010 trade statistics, from Census Bureau (2011), and national accounts data.

Source: http://www.frbsf.org/economic-research/publications/economic-letter/2011/august/us-made-in-china/.

Distribution of Containerized Consumer Goods

The United States' extensive network of highways and truck-based distribution centers is an essential factor in enhancing the low cost of shipments to consumers. The system is further enhanced by investment by Class I railroads in transcontinental corridors that are capable of transporting double-stack containers at low cost and high reliability to national load centers, such as Chicago and Dallas/Fort Worth, for distribution to the rest of the country. Los Angeles and Long Beach still account for 40 percent of all U.S. containerized imports from Asia.[50]

In recent years, ports in the Gulf and Southeast have increased their share of Asian trade shipments through both the Panama and Suez Canals. The utilization of the Suez to send cargo from Asia to the U.S. East Coast is increasing as Asian manufacturing shifts south and as an increasing number of very large

[50] "LA-LB Volume Climbs," February 14, 2013, http://www.joc.com/port-news/us-ports/port-los-angeles/la-lb-container-volume-climbs_20130214.html.

container ships are deployed between Europe and Asia (those ships might also stop at U.S. ports in a pendulum-type service).

Asian containerized imports through the Port of Savannah, for example, grew from $2.8 billion to $11.5 billion between 2003 and 2012, making it the third largest recipient of Asian containerized imports behind Los Angeles and Long Beach.

Imports are moved from the dockside through customs clearance to distribution centers. The distribution centers may be located near the port or they may be located in another state. At this stage, the maritime steel containers are typically unloaded so they can be returned to the port while imported goods are sorted and often share space with other goods that are domestic in origin. Deliveries to stores are typically performed by truckload and less-than-truckload (LTL) carriers.

3.4 AUTOMOTIVE MANUFACTURING

The supply chain for the U.S. automotive industry is very complex with networks of thousands of companies around the world interchanging the 10,000 to 15,000 parts and accessories required to make up an automobile in the most efficient manner possible in order to produce complete automobiles at the lowest cost possible. Schwartz (2008) points out that "a superior supply chain is one critical element to helping automakers differentiate themselves from the competition."[51]

Motorized vehicles ranked third by value in 2011 amongst all commodities shipped in the U.S., accounting for 7 percent of the total value of goods moved. The Bureau of Transportation Statistics indicates that Motor vehicles and parts (HTS Code 87) comprised 8.7 percent of the total U.S. trade in 2011 by value. Imports were higher than exports with 9.2 percent and 8.1 percent, respectively.[52]

NAFTA trade involves significant amounts of automotive-related activity between Canada, Mexico, and the U.S. Total U.S. NAFTA trade with Canada and Mexico totaled $918 billion in 2010, with exports totaling $412 billion and

[51] Schwarz, Michael. "Trends in the Automotive Industry: Implications on Supply Chain Management," White Paper, CISCO Systems Inc., 2008, http://www.ict-partner.net/web/about/ac79/docs/wp/ctd/Auto_Trends_WP_FINAL.pdf.

[52] U.S. Department of Transportation, Research and Innovative Technology Administration, Bureau of Transportation Statistics, 2013 Pocket Guide to Transportation, January 2013, http://www.rita.dot.gov/bts/publications/pocket_guide_to_transportation/2013.

imports totaling $506 billion.[53] The U.S. Department of Commerce Office of Transportation and Machinery (OTM) provides U.S. automotive industry vehicle and parts imports and exports. Combined trade between the U.S. and Canada and Mexico exceeded $196.4 billion in 2011. Table 3.7 contains the U.S. automobile trade between the NAFTA partners.

Table 3.7 U.S. Automotive Trade, 2011

	Canada	Mexico
Vehicle Exports	$23.9 billion	$3.8 billion
Vehicle Imports	$39.7 billion	$30.7 billion
Total Vehicle Trade	$63.6 billion	$34.5 billion
Parts Exports	$28.2 billion	$21.1 billion
Parts Imports	$15.3 billion	$33.7 billion
Total Parts Trade	$43.5 billion	$54.8 billion
Total Trade	$107.1 billion	$89.3 billion

Source: Compiled from U.S. Department of Commerce Office of Transportation and Machinery (OTM), "U.S. Automotive Trade Data and Data Links," http://www.trade.gov/mas/manufacturing/OAAI/tg_oaai_003649.asp.

The auto industry was one of the first in this country to adopt "lean manufacturing" or "just-in-time" logistics and supply chain principles, according to the Envision Freight web site.[54] A key to this approach is to keep inventory levels as low as possible for anticipated levels of production, with suppliers providing their inputs "just in time." An efficient and reliable transportation system is a critical component in the success of this approach. A miscalculation or disruption in the supply chain flow could result in the stopping of vehicle production, which costs a manufacturer hundreds of thousands of dollars per hour. The manufacturers also require flexibility of using different modes depending on current conditions, such as using air to ship a component when that component inventory becomes very low at the manufacturing plant. A 2005 survey of motor vehicle manufacturers found that on-time performance was the most important variable for mode choice, followed by total logistics costs.[55]

[53] Office of the United States Trade Representative, "North American Free Trade Agreement (NAFTA)," http://www.ustr.gov/trade-agreements/free-trade-agreements/north-american-free-trade-agreement-nafta.

[54] *Envision Freight*, "The Role of Transportation in Commodity Supply Chains – Some Examples," http://www.envisionfreight.com/value/pdf/Commodity_Studies.pdf.

[55] Tatineni, V. C., and M. J. Demetsky, *Supply Chain Models for Freight Transportation Planning, Center for Transportation Studies*, University of Virginia, August 2005, http://cts.virginia.edu/docs/UVACTS-14-0-85.pdf.

The 2011 earthquake and tsunami in Japan provide an example of how the supply chain can be negatively disrupted. A March 2012 CNN article documents Renesas Electronics, whose factory in the city of Naka was severely damaged as a result of the natural disaster. The article indicates that 70 percent of all cars utilized the microchip produced at that facility. With the drastic reduction in vehicle production, new auto sales plummeted 37 percent after the disaster.[56]

Figure 3.13 generally illustrates the linkages between a number of different parts and subcomponent suppliers and auto manufacturers. Several sources indicate a fully assembled vehicle consists of between 10,000 and 15,000 separate components.

Figure 3.14 depicts the automotive value chain, from raw materials to finished vehicles at dealerships. The Original Equipment Manufacturer (OEM) only manufactures a fraction of the total components required to assemble a complete vehicle. They acquire the remaining parts from Tier 1 suppliers, who often outsource to subtier suppliers. A 2004 report highlights that a company's position in the supply chain may differ depending on the part and the customer. "Thus, a company that is a first-tier supplier of transmissions to one OEM may be a subtier supplier of other parts to the same or other OEMs."[57]

Transportation related to the first link in the supply chain, consisting of raw materials to the suppliers, involves the movement of bulk materials, such as steel and plastic. Value of time and trip time reliability is not critical for this link, so these items are often moved via water over long distances.

Transportation efficiency and trip time reliability is a critical element in the movement of items between different part manufacturers and part manufacturers and assembly plants as a result of the lean manufacturing practices.

The final link is the distribution of finished vehicles to the dealerships to be sold. Travel time reliability and value of time are not as critical in this link, as usually finished vehicles are transported to regional "mixing centers", where vehicles are prepared for the final leg of the trip. Vehicles are then sent to dealerships based on demand.

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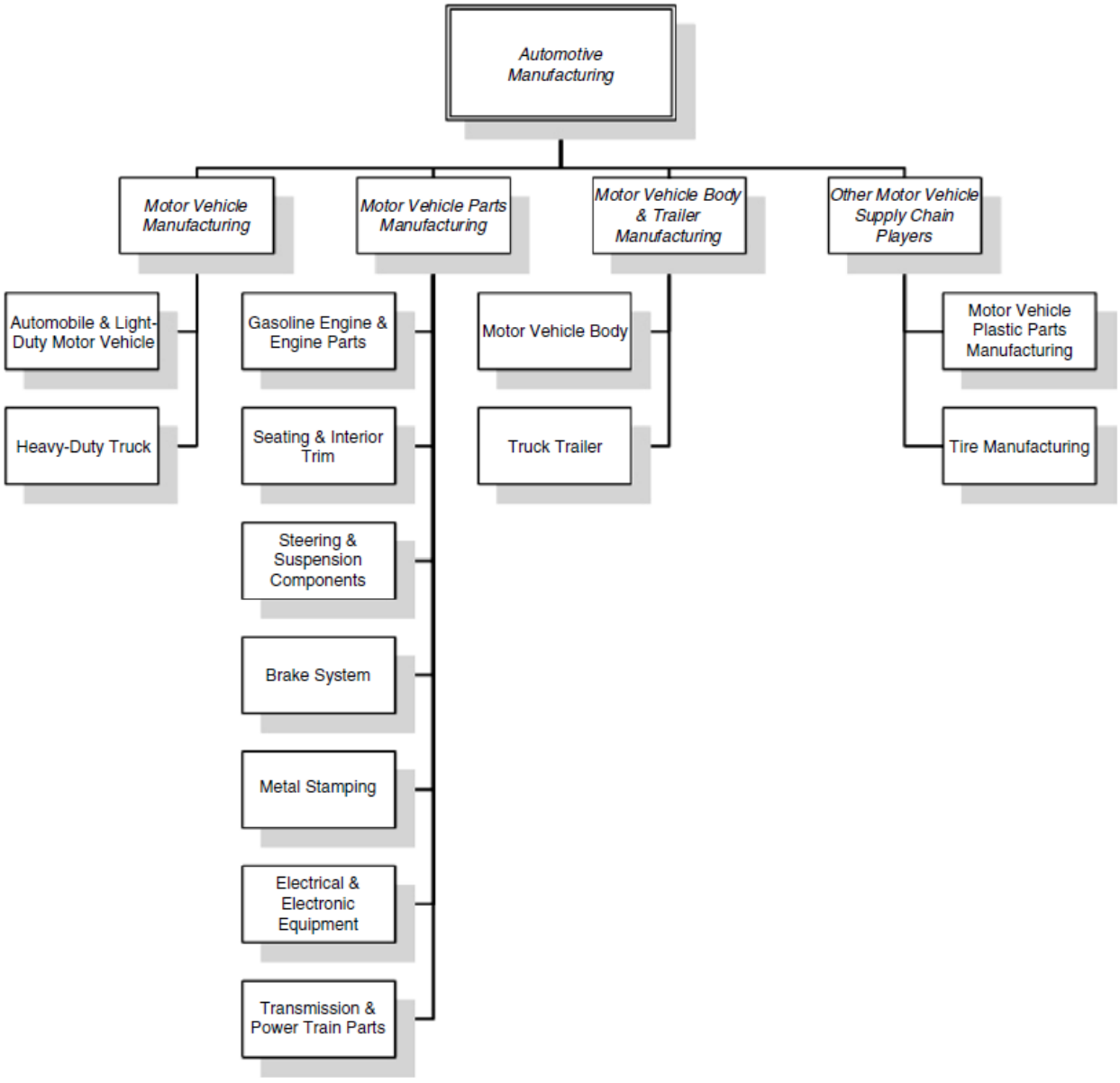
[56] Lah, Kyung, "Rebuilding Auto Industry's 'Brain' Supplier After Tsunami," CNN, Tuesday March 6, 2012, http://www.cnn.com/2012/03/06/world/asia/rebuilding-japan-lah-suppliers.

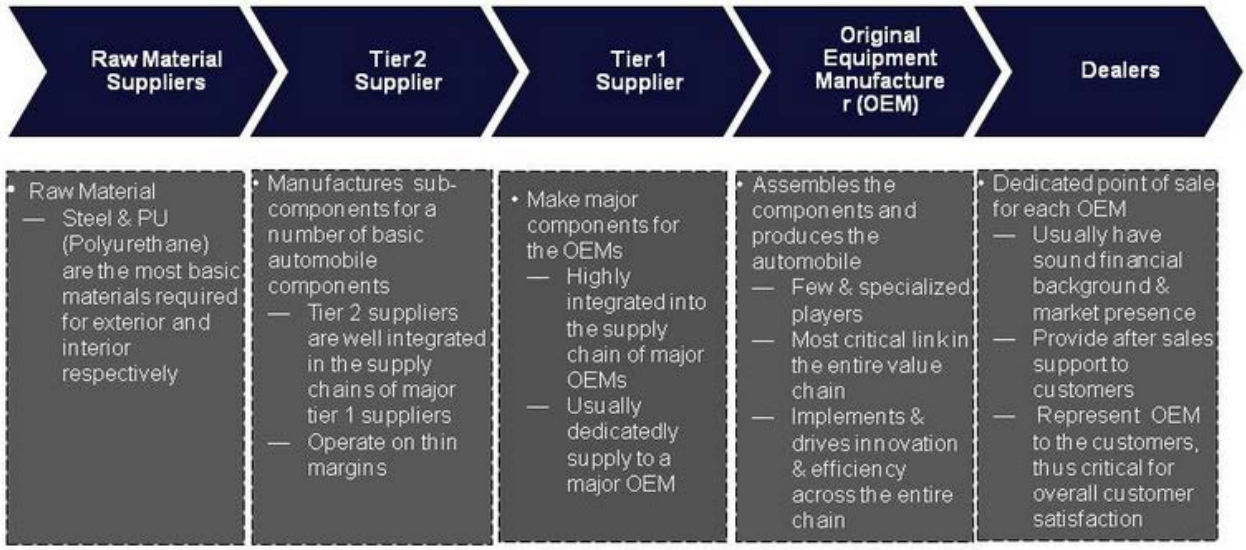
[57] White, W. J., A. C. O'Connor, and B. R. Rowe, *Economic Impact of Inadequate Infrastructure for Supply Chain Integration*, U.S. Department of Commerce, National Institute of Standards and Technology, June 2004, http://www.nist.gov/director/planning/upload/report04-2.pdf.

Figure 3.13 Linkage between Automotive Manufacturing Supply Chain Components



Source: Logistics and Supply Chain Management (SCM) Key Performance Indicators (KPI) Analysis: A Canada/United Stations Automotive Sector Supply Chain Perspective, Industry Canada, October 2006, page 12.

Figure 3.14 Automobile Industry Value Chain

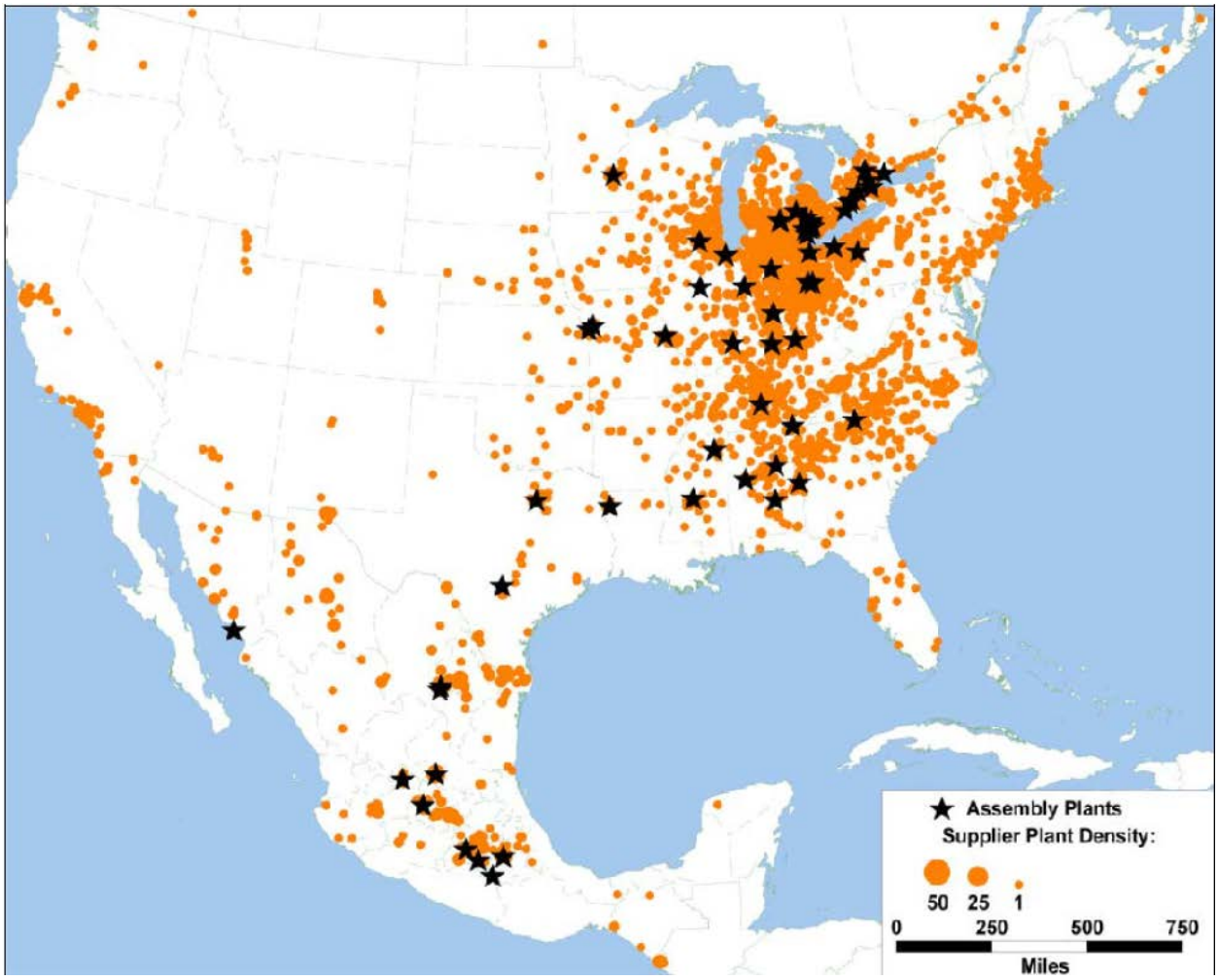


Source: Noealt, Automobile "Industry-Value Chain Analysis," http://www.noealtcorporateservices.com/apps/photos/photo?photoid=40766854.

Figure 3.15 pinpoints the North American assembly plants and part manufacturing facilities. Assembly plants (stars on the map) largely stretch along an axis between Ontario to central Mexico. The dots on the map represent thousands of part suppliers that serve the assembly plants. The North American Free Trade Agreement freely allows the flow of parts and finished vehicles between Canada, Mexico, and the U.S. without tariffs or other restrictions. A report by the Congressional Research Service indicates that most modern assembly plants have "supplier parks" nearby, which are largely a result of the Just-in-Time part deliveries.[58]

[58] Canis, Bill, *The Motor Vehicle Supply Chain: Effects of the Japanese Earthquake and Tsunami*. R41831, Congressional Research Service, May 23, 2011, http://www.fas.org/sgp/crs/misc/R41831.pdf.

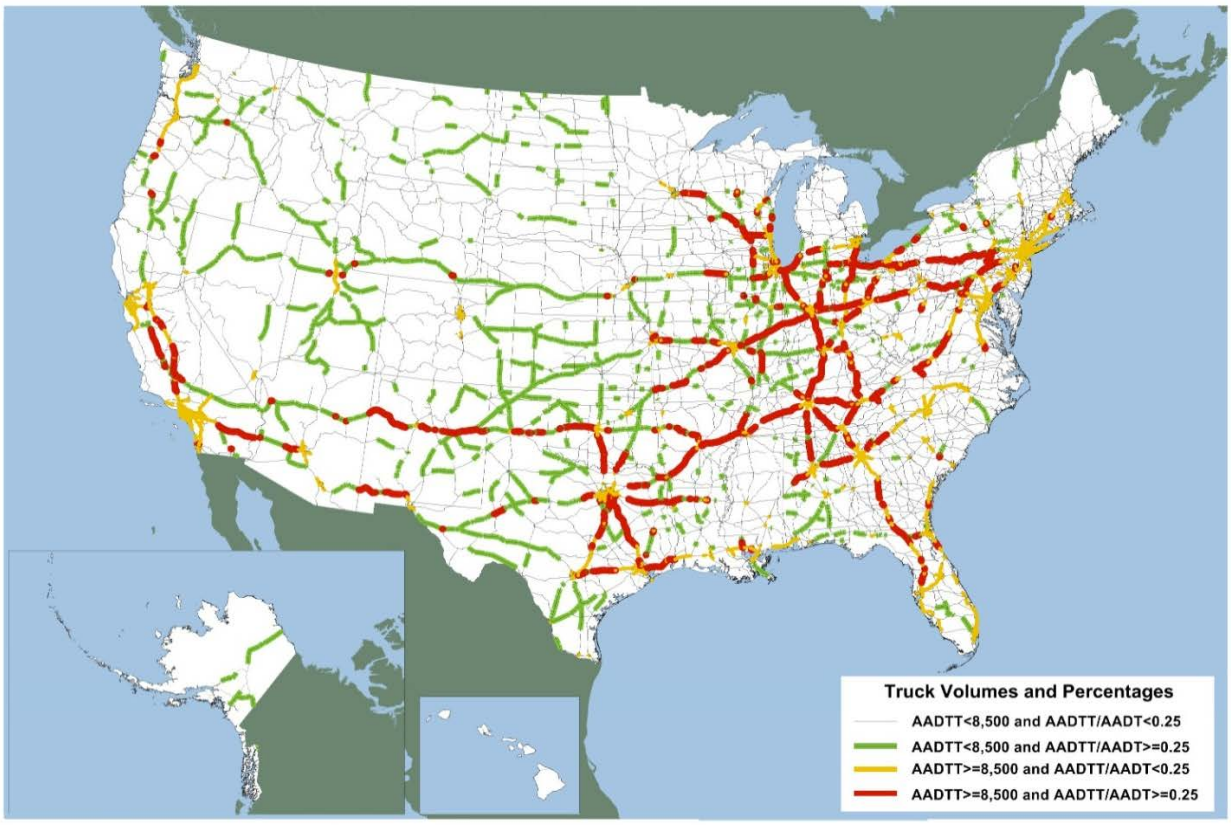
Figure 3.15 North American Major Auto Assembly and Parts Manufacturing Facilities



Source: Thomas Klier, Senior Economist, Federal Reserve Bank of Chicago, April 2011.

The major transportation corridors in the country correlate to automotive industry axis between the Eastern Great Lakes and Mexico. Figure 3.16 demonstrates the major truck routes in the U.S. using 2007 data. Most of the major corridors, represented in the red, are long this axis.

Figure 3.16 Major Truck Routes on the National Highway System
2007



Notes: AADTT is average annual daily truck traffic and includes all freight-hauling and other trucks with six or more tires. AADT is average annual daily traffic and includes all motor vehicles.

Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework, Version 3.4, 2012, http://www.ops.fhwa.dot.gov/freight/freight_analysis/nat_freight_stats/nhsmajortrkrts2007.htm.

The North American railroads are also very active in the transport of automotive products. Norfolk Southern Railway Company (NS) serves 24 auto assembly plants, 31 auto distribution terminals, 3 Just-in-Time (JIT) Rail Centers, and 4 vehicle mixing centers, according to their web site.[59] Figure 3.17 shows the railroad's connections to the automotive facilities.

[59]http://www.nscorp.com/nscportal/nscorp/Customers/Automotive/.

Figure 3.17 Norfolk Southern Railway Company's System with Automotive Vehicle Distribution Facilities

Source: Map developed for FHWA by Norfolk Southern, December 2013.

The major railroads in the U.S. are largely segregated by the western and eastern lines, which require them to collaborate on services that stretch beyond their individual service areas. An example of this is Union Pacific Railroad's (UP) auto parts network, shown in Figure 3.18, provides seamless service through

collaborative agreements with all Class I railroads in North America. UP claims their express network to and from Mexico handles over 200,000 shipments per year.[60]

Figure 3.18 Union Pacific Railroad's Auto Parts Network

Source: http://www.uprr.com/customers/autos/svcs/prem_net.shtml.

Air cargo is also an important player in the automotive supply chain. With Just-in-Time manufacturing, a delay resulting from not having the necessary components on-hand can result in the loss of hundreds of thousands of dollars every hour. A report focusing on the air cargo activities in the 10-state Mid-America Freight Coalition (MAFC) region points to the importance of the automotive industry to the region and the role air cargo plays. The analysis of 2009 automotive employment indicated that 61 percent of the total U.S. automotive employment resides within the MAFC region, employed amongst the 2,361 manufacturing establishments. With 59 percent of the total automotive

[60]http://www.uprr.com/customers/autos/svcs/index.shtml.

manufacturing establishments employing less than 50 people, the authors surmised that there is a significant presence of Tier II and Tier III small auto parts manufacturers throughout the region.

SCTG commodity code 37 – Transportation Equipment ranked as the fifth most significant commodity in terms of value for the region, according to the report's Freight Analysis Framework analysis. The air cargo shipments of transportation equipment (SCTG 37) moved primarily domestically with 78 percent followed by export movements with 16 percent.[61]

Another air cargo study performed by some of the authors investigated the air cargo activities at Texas airports. The Freight Analysis Framework analysis performed in that study found that SCTG Commodity Code 37 – Transportation Equipment and SCTG Commodity Code 36 – Motorized Vehicles ranked second and third, respectively, in overall domestic air cargo shipments.[62] One finding of that research project was the significant transport of automotive parts manufactured in Mexico across the border by truck to airports on the U.S.-side before shipping via air for the trip up to the Midwest states where auto assembly plants reside.

3.5 CONSIDERATIONS FOR A NATIONAL GATEWAYS AND CORRIDORS CONCEPTS

Agriculture Commodities

Examination of key agricultural crop exports in the U.S. provides insights into the critical role that the nation's multimodal transportation system and policies play in the global competitiveness of U.S. agricultural goods. The research points to concerns regarding adequate port infrastructure to handle export levels at the ports closest to the point of production or those that can be reached in the most efficient manner. There is also concern regarding the adequacy of rail infrastructure and service into key export ports and between production areas and ports. However, perhaps one of the largest infrastructure concerns for this industry is the deteriorating condition of lock and dam infrastructure.

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[61] Adams, T. M., S. Janowiak, J. Bittner, B. R. Sperry, J. E. Warner, and J. D. Borowiec, *Air Cargo in the Mid-America Freight Coalition Region*, CFIRE ID Number 04-11, National Center for Freight and Infrastructure Research and Education (CFIRE), University of Wisconsin-Madison, August 2012, http://www.wistrans.org/cfire/documents/FR_CFIRE0411.pdf.

[62] Sperry, B. R., J. E. Warner, and J. D. Borowiec, *Evaluation of the Role and Needs of Air Cargo in Texas*, Report No. SWUTC/08/473700-00037-1, Southwest University Transportation Center, Texas Transportation Institute, College Station, Texas, March 2008.

Non-infrastructure issues that deserve consideration include the impact of climate change and extreme weather recently experienced in the U.S. This has led to a reduction of U.S. production which, if sustained, could result in increased imports and decreased exports. In addition, portions of primary inland waterway routes were compromised, either preventing the passage of barges or allowing only barges carrying reduced loads. This can lead to mode shift away from water routes to rail and truck, driving up the prices and reducing global competitiveness.

Energy Commodities

The demand and preference for different energy types can change more rapidly than the infrastructure that is responsible for producing and supplying energy commodities. The corridors that currently exist were largely constructed to serve the energy demands that existed decades ago, yet many new energy sources such as LNG, shale gas, shale oil and renewable sources require different handling characteristics and impose different costs on the system. The low price of natural gas and the increased cost of transporting coal cross country have upended the traditional assumption that coal will always be more inexpensive than natural gas as a fuel source. Furthermore, as power plants and vehicles have grown more adept at using different energy sources, it appears that supply chains will continue to grow more diverse and will increasingly be called upon to serve exports as well as imports.

Intermodal/Containerized Goods

U.S. containerized trade is steered by global economic trends and steamship routing decisions made far from U.S. shores. For this reason, any master plan for routing of international container trade should include substantial contingencies to accommodate changes in routing and sourcing trends and unforeseen macroeconomic and political shifts. Despite uncertainty in global trade trends, factors such as proximity to U.S. population centers, private-sector investment in rail facilities and distribution hubs, and terminal/ship liner relationships will continue to influence the domestic end of international trade flow patterns.

Automotive

The U.S. automotive industry continues its evolution, resulting in changes in sourcing locations by both domestic and international manufacturers. The trend of U.S.-based manufacturers migrating to the Southeastern states has continued and expanded as more Asian and European-based manufacturers have recently located significant facilities in the southeast. In addition, Mexico has become increasingly important as a sourcing location for both component parts and assembly plants. Thus, the need for seamless North-South freight transportation networks spanning from Canada to Mexico has continued to grow and become even more critical for the North American automotive industry.

Another key factor impacting the national transportation needs of the automotive sector is the need for import and export facilities for finished products, as well as multiple cross border movements of component parts. The majority of automotive manufacturers produce goods for both the domestic and export markets. The export of autos requires very specific infrastructure and handling and hence, not all gateways are equipped to meet these needs. In addition, all of the U.S.-based manufacturers import a portion of the components required in assembly. Many of these may be sourced in facilities throughout North America and it is not uncommon for parts to cross the border two or more times before being completed and shipped to the assembly plant. This, combined with the just-in-time manufacturing process, places considerable emphasis on the reliability and resiliency of the border crossings and freight transportation network.

Summary

Examination of the role of gateways and corridors in supporting strategic industry supply chains reveals very diverse requirements, needs and concerns. However, there are also common themes deserving consideration in the development of a National Gateways and Corridors Plan including:

- Reliance on a multimodal network that offers options to mitigate the impact of unexpected disruptions and changes in modal costs and/or services;
- The need for focus on the movement of bulk goods as well as intermodal goods especially for port and gateway investments; and
- Increased diversification of sourcing and distribution networks to mitigate impact of disruptions leads to need to access gateways and trade corridors.

4.0 Private Sector Input and Observations with Public Sector Reflection

4.1 APPROACH TO PRIVATE SECTOR INPUT

Scenario planning is a technique that, when combined with the traditional planning process, overcomes challenges associated with long-range planning of complex, uncertain projects with diverse stakeholders. Rather than trying to predict the state of the world 30 or more years in the future, scenario planning allows plans and planners to accommodate a range of plausible futures. Combining traditional planning and scenario planning results in a robust and flexible plan that supports an equally robust investment program.

The current effort used scenario planning as a way to engage private sector freight stakeholders. In addition to research on current trends and factors impacting freight gateway and corridor volumes, a series of private sector focus groups and forums was conducted. The purpose of these events was to solicit input from shippers, carriers, operators and other freight stakeholders on how national investment needs and priorities change under alternative future scenarios. The sessions employed a modified version of the Future Freight Flows scenario planning workshop developed by the Massachusetts Institute of Technology's Center for Transportation and Logistics for the National Cooperative Highway Research Program (NCHRP), Project 20-83(1).

Through employing scenario planning, elements of a national gateway and corridor concept can be categorized as:

- **No-brainer elements –** found to be favorable investments in all alternative futures;
- **No-gainer elements –** unfavorable investments in one or more alternative future and not found to be favorable in any;
- **No-regret elements –** favorable in some, but not all alternative future, and are not unfavorable in any scenario; and
- **Contingent elements –** favorable in some alternative future(s) and unfavorable in some others.

Elements falling in one of the first three categories are robust, meaning that the need to invest in them is the same regardless of the future state of the world (i.e., the uncertainty associated with the forecast of future demand has little bearing

on the purpose and need for the investment). Any segments falling into the fourth category are contingent upon which scenario comes to fruition in the world (i.e., uncertainty about future conditions is a factor in establishing purpose and need). The findings from the scenario forums results can be useful for informing, refining and reinforcing the outcome of the traditional public sector planning process for determining national gateway and corridor investment plans.

In order to gather a representative cross section of freight users to provide input into future national gateways and corridor needs, the project team conducted a series of freight stakeholder outreach events throughout the U.S. This section provides an overview of those events and a discussion of the findings.

4.2 OVERVIEW OF PRIVATE-SECTOR FORUMS

The events consisted of focus groups and forums. Each event was two to four hours in duration intended to gather a diverse amount of information from the unique perspectives of the participants. Participants were solicited through coordination with local and national industry groups and local, regional and state departments of transportation and planning organizations. The private sector outreach events were held between June and November 2012 in Newark, New Jersey; Indianapolis, Indiana; Houston, Texas; and Anaheim, California. Two additional forums consisting of public sector stakeholders, academia, consultants, multijurisdictional coalitions and other industry leaders were held in Washington, D.C. prior to and after the private sector events to allow for commentary on and reaction to the private sector outreach events.

Table 4.1 lists the businesses and organizations represented at each of the private-sector events.

Table 4.1 Businesses and Organizations Represented at the Outreach Events

Newark	Indianapolis	Houston	Anaheim
Canadian Pacific	Koch Fertilizer, LLC	BNSF	Port of Tacoma
New Jersey DOT	TPG Marine	Greater Houston Port Bureau	Hawks Logistics, Inc.
CSXT	Indiana DOT	Port of Houston Authority	Container Port Group
PANYNJ	Purdue University	Air Liquide	ABL Logistics – 3PL
NYC DOT	Indianapolis Airport Authority	Lyondell Basell Industries	Port of Long Beach
Norfolk Southern	TTX Company	M&G Polymers	Container Ports Group
Oakland Transportation	MD Logistics	Couch Lines	Plum Creek Marketing
A&P NYA Railway	Norgren	HR Green	True Value Company
DVRPC	Canadian National Railway	Weatherford International	Quality Transportation Services
SJPC/GCIA	Indianapolis MPO	Union Pacific	ABF Freight
East of the Hudson Development	Conexus Indiana	Port of Galveston	Presto Geosystems
HCIA	Integrated Distribution Services, Inc.	Gulf Coast Rail District	Bison Transport
NJTPA		Transport Handling Specialist	SNX Advance
		Railserv Inc	MOL America
		Mediterranean Shipping	Port of Virginia
			Florida East Coast Railway
			NS Thoroughbred Direct Intermodal
			Alliance Shippers
			US Transportation Command
			World Trade 100
			Port of San Diego
			Port of San Diego
			RailPro

Format of Outreach Events

The private sector forums were intended to gather a diverse amount of information from the unique perspectives of private sector participants. Due to distinctions in context, the structure of the meetings was modified as needed, yet all were built around a consistent set of goals. In the course of the exercise, each focus group or forum participant was asked to direct their comments around four central questions:

1. What are the current national freight gateway and corridor investment needs?
2. Given current trends, how is the relative importance of gateways and corridors likely to change and why?

3. What will national investment needs be under alternative futures?
4. How should national gateways and corridor priorities be determined?

In order to convey the scale of uncertainty regarding the needs in the future for Question 3, the project team utilized four alternative scenarios developed by the Massachusetts Institute of Technology (MIT) Center for Transportation and Logistics as part of NCHRP 20-83(01) project[63]. Participants were asked to set aside opinions as to which future scenario was likely to be most accurate and instead operate under the assumption that the world described in their assigned scenario had come to pass. The scenarios, entitled "Naftastique", "One World Order", "Global Marketplace", and "Millions of Markets"(see text box to right) envisioned future conditions in which the importance of changes in our understandings of technology, economic and political relations, and resource availability have superseded the linear growth projection assumptions that typically dominate future planning exercises. Table 4.2 summarizes the key attributes for each alternative future scenario.

Future Freight Flows Scenarios

Global Marketplace is a highly competitive and volatile world. Open, vigorous trade between virtually all nations has led to market-based approaches to most contemporary challenges. It is like Thomas Freidman's Flat World on steroids.

One World Order is a highly regulated and managed world. Facing global scarcity of key resources, nations establish international rules to ensure their fair and sustainable use. Global trade thrives, but its course is shaped by the very visible hand of regulation, at times an iron fist in a velvet glove.

Millions of Markets is a world where advanced technological breakthroughs have enabled the United States (and other countries) to become highly self-reliant in terms of energy, agriculture, manufacturing, and other needs. There is increased migration towards smaller urban areas that are supported by nearby regional innovation hubs that can manufacture highly customized goods.

Naftástique! is a world where trade has moved away from a single global market towards a number of emerging regional trading blocs. China, Europe and South America form their own clusters. The United States leads an effort to make North America a self-sufficient economic community.

The commentary and feedback received during these breakout sessions was carefully documented. In addition to providing oral comments during each session, participants were asked to provide input on criteria score sheets provided by the project team. Detailed

63 More information on the outcomes of this project is included in Appendix A.

proceedings were developed for each forum. A summary of the key findings and collective results is provided in the next section.

Table 4.2 Summary of Attributes for the Alternative Futures Used to Access Future Freight Flows

Scenario Attribute	Natastique	One World Order	Global Marketplace	Millions of Market
Global Trade	Low	High	High	Low (physical)
Resource Availability	Low	Low	High	High
Energy Cost Level	High	High	Low	Low
Energy Cost Variability	Low	High	High	Low
Level of Environmental Awareness	Same as Today	High	Low	High
Population Dispersion	Growth in Southwest	Growth in Biggest Cities	Growth in Biggest Cities	Rise in Mid Tiered Cities
Energy Sources	Majority North American	Mix Foreign & Domestic	Majority Foreign	Majority Domestic
Level of Migration	High w/in Bloc, Low between	High	High	Low
Migration Policy	High	High	Low	Low
Currency Fluctuations	Low w/in Bloc	High	Moderate	Low

Source: NCHRP 20-83(1), Future Freight Flows.

4.3 PRIVATE-SECTOR INPUT

While opinions varied significantly both within and between forums, a number of common themes emerged. Importantly, some of the recommendations were held to be essentially valid regardless of which future scenario emerged.

Major Themes

1. While there was significant discussion as to the role of the Federal government in future freight transportation planning, the vast majority of participants expressed the view that the Federal government will continue to have an important role in coordinating activities between states and localities to avoid redundant activities and to help the transportation system to overcome important national challenges.
2. The inability to prioritize investments and carry major infrastructure projects to completion was repeatedly expressed as a challenge that was tied in part to uncertainty in funding and in part to a lack of a well-defined national freight plan. Additionally, a concerted effort to include more public private partnership activities to tackle this issue was proposed to propel closing the funding gap for priority infrastructure projects.
3. In each meeting, the participants represented multiple modes. One of the insights of the workshop is that modal representatives readily recognize the types of services that are better performed by another mode as opposed to

their own. Support for increased multimodalism was nearly universal. Thus, one need is for the Federal government to have a realistic and comprehensive understanding of the strengths and weaknesses of each mode.

Following is a summary of the findings specific to each of the four questions addressed in the outreach events.

What are the current national freight gateway and corridor investment needs?

The private sector participants thought broadly about corridor investments and emphasized that corridor needs included not only traditional infrastructure but also labor constraints such as shortages in truck drivers and logistics professionals, as well as the need for improved technology for tracking freight within the supply chain. It was noted that deficiencies in these areas lead to increased costs and risk. Various comments focused on the need for increasing redundancy within the freight system and improving access for a greater number of current and potential shippers. Many policy ideas were aimed at improving communication between modes and between the public and private sector. With respect to gateways, many participants wanted to look beyond the immediate border crossings to increased international collaboration that evaluates the entire supply chain from point of origin to point of destination. Participants suggested that the government track patterns of private investment in infrastructure in order to better understand emerging trends.

Given current trends, how is the relative importance of gateways and corridors likely to change and why?

Frequent mention was made of the National Export Initiative and the need for supply chains to be modified to better accommodate exports. While there was significant distinction of opinion, the majority of participants saw a future in which infrastructure oriented toward international trade was more spread out geographically, yet the lines separating primary and secondary gateways would become more distinct. As an example, participants suggested that the current race of East Coast ports to accommodate post-Panamax traffic is an instance in which numerous ports hope to serve as a first port of call yet only a few will succeed with the others serving a supporting role such as a feeder port.

What will national investment needs be under alternative futures?

The responses to this question reinforced the idea that assumptions about future conditions greatly impact the direction of investments to be undertaken, yet investments aimed at improving communication between Federal agencies(such as Customs and Border Patrol, TSA and DOT) and with the private sector as well as the ability of agencies to react were desirable under almost any scenario. An interesting feature of the audience, most of whose occupations involved some sort of problem solving activity, is that they generally seemed more comfortable

in evaluating future scenarios in which resources were constrained and/or conditions required short-term reactions.

Observations on specific scenarios include:

- **Naftastique!.** Participant input on infrastructure impact under this scenario includes increased importance of land ports of entry, investment in inland waterways, investment in rail infrastructure at land borders, increased importance of north-south corridors, investment in Gulf Coast ports and increased potential for short sea shipping (see Figure 4.1). Participants also indicated that east and west coast seaports would become relatively less important. Social and economic implications include growth in the Southwest and a resurgence of manufacturing in the U.S., especially in the South. The participants indicated that the most significant regulatory implications of this scenario would be the need for harmonization of truck regulations in North America, resulting in the expansion of Mexican trucking operations in the U.S. The participants also generally felt that there would be a need for a relatively strong Federal role in ensuring adequate gateway and corridor freight infrastructure.

Figure 4.1 Private-Sector Input on National Infrastructure Needs under Naftatisque! Scenario

National Infrastructure Needs	High	Medium	Low
Rail Infrastructure	■		
Sea Ports		■	
Border Ports of Entry	■		
Inland Waterways	■		
North South Highway Corridors	■		
Federal Role	■		
East West Highway Corridors		■	

Source: Cambridge Systematics Private Sector Forums

- **One World Order**. Private sector input on infrastructure needs under the One World Order scenario is summarized in Figure 4.2. Key points made by participants on the implications of this scenario include the need to take advantage of existing infrastructure and larger ports coupled with a reduced need for significant highway expansions and an increased dependence on inland waterways and rail (both passenger and freight). Additionally, there was agreement that Pacific Northwest and Southern U.S. ports would become relatively more important, resulting in a shifting away from southern west coast ports. This will be due primarily to the substitution of all water routes over the land bridge movement as energy costs and environmental regulations make all water routes more competitive.

Figure 4.2 Private-Sector Input on National Infrastructure Needs under the One World Order Scenario

Source: Cambridge Systematics Private Sector Forums

- **Global Marketplace.** Forum participants indicated that Southeast and Gulf ports, air cargo facilities, landside investments at key ports and east-west corridors will be the primary national infrastructure needs under the Global Marketplace scenario (see Figure 4.3). The participants also felt that this scenario will lead to a greater dependence on border crossings, especially those in the northwest. From a regulatory perspective, the consensus was that there would be a greater need for redundancy in the system and regulations that give rise to productivity gains such as increased truck size and weight limits.

Figure 4.3 Private-Sector Input on National Infrastructure Needs under the Global Marketplace Scenario

Source: Cambridge Systematics Private Sector Forums

- **Millions of Markets:** Given the co-location of production and consumption characterized in the Millions of Markets scenario, forum participants pointed to last mile connectors and secondary roads, short-line railroads and inland waterways as being relatively more important than major seaports and land bridge corridors (see Figure 4.4). The participants had differing opinions regarding the Federal role in this scenario given the focus on infrastructure that has traditionally been under local and state responsibility.

Figure 4.4 Private Sector Input on National Infrastructure Needs in the Millions of Markets Scenario

National Infrastructure Needs	High	Medium	Low
Rail Infrastructure	■		
Sea Ports		■	
Border Ports of Entry (Southern)	■		
Highway Corridors	■		
Federal Role		■	
Intermodal Connectors	■		

Source: Cambridge Systematics Private Sector Forums

How should national gateways and corridor priorities be determined?

Participants repeatedly stated that correcting known deficits in the freight infrastructure system should be the top priority given the uncertainty of future conditions. Many comments were tied to the need of an agreed upon and, to the extent possible, standardized benefit-cost analysis structure that would not bias any mode or region of the country. Participants also focused in on the need to ensure competitiveness for strategic commodities and industries such as energy and agriculture.

4.4 SUMMARY OF PRIVATE SECTOR INPUT

A criteria score sheet offered participants an opportunity to rank, in order of importance, those criteria to be included for consideration in prioritizing infrastructure investments. Table 4.3 and Figure 4.5 provide a summary of the score sheets from all of the events.

In general, the following criteria were highly-rated by participants as those that should receive the most attention in national freight planning:

- Volume of freight,
- Growth in volume,
- Emerging trade gateways and corridors, and
- Accommodation of strategic goods such as energy and agriculture commodities.

Lower scoring criteria included:

- Value of freight for both imports and exports, and
- Redundancy in the system.

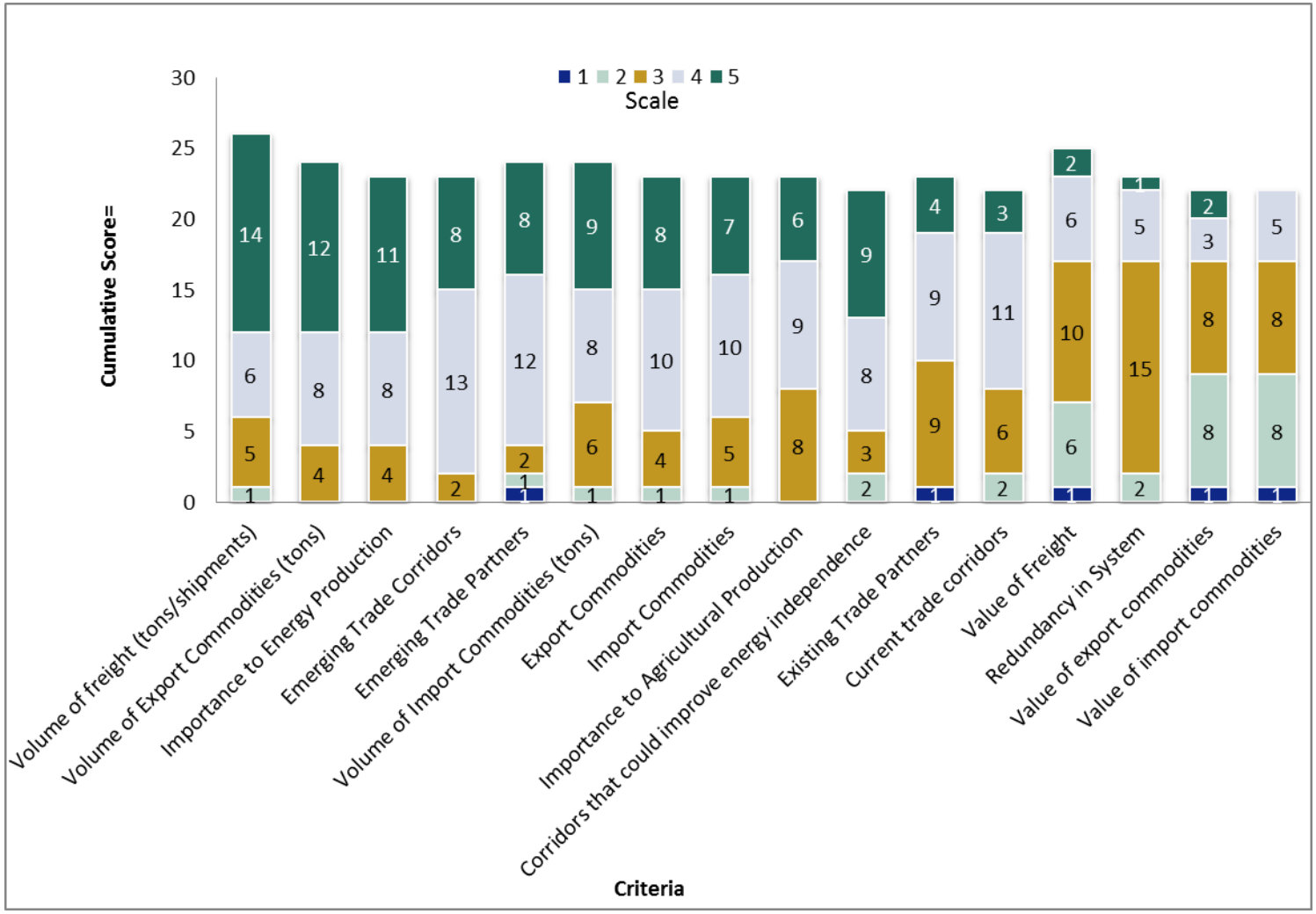
Although these criteria scored lower, they still received high rating from a few participants.

It should be noted that no criteria received a rating of 1 or not important. Participants were also asked for any criteria not listed that they deemed important. Table 4.4 provides a listing of participant suggested criteria for consideration.

Table 4.3 Private-Sector Input on Criteria for Prioritizing National Gateways and Corridors Priorities

Criteria	Explanation	Score – from Not Important to Very Important					Total Value
		1	2	3	4	5	
Volume of freight (tons/shipments)	Corridor and gateway investments based on the volume of freight tonnage being transported.		1	5	6	14	111
Volume of Export Commodities (tons)	Corridor and gateway investments based on the volume in tonnage of export commodities being transported.			4	8	12	104
Importance to Energy Production	Corridor and gateway investments to ensure that existing energy supply chains are preserved and new supply chains are developed.			4	8	11	99
Emerging Trade Corridors	Corridor and gateway investments to facilitate trade along trade corridors with faster growing freight volumes.			2	13	8	98
Emerging Trade Partners	Corridor and gateway investments to facilitate trade with trading partners with which the United States has the potential for future growth in trade.	1	1	2	12	8	97
Volume of Import Commodities (tons)	Corridor and gateway investments based on the volume in tonnage of import commodities being transported.		1	6	8	9	97
Future Export Commodities	Corridor and gateway investments around those commodities that the United States is likely to export in substantial quantities in the future.		1	4	10	8	94
Future Import Commodities	Corridor and gateway investments focused on commodities that the United States is likely to import in substantial quantities in the future.		1	5	10	7	92
Importance to Agricultural Production	Corridor and gateway investments to ensure existing agricultural supply chains are preserved and new supply chains are developed.			8	9	6	90
Corridors that could improve energy independence	Corridor and gateway investments that move the United States closer to energy independence.		2	3	8	9	90
Existing Trade Partners	Corridor and gateway investments to facilitate trade with trading partners with which the United States has a strong preexisting trade relationship.	1		9	9	4	84
Current trade corridors	Corridor and gateway investments that connect current major gateways and markets.		2	6	11	3	81
Value of Freight	Corridor and gateway investments based on values of freight being transported.	1	6	10	6	2	77
Redundancy in System	Corridor and gateway investments to ensure that all major supply chains have adequate redundancy in case of an unexpected disruption (natural or man-made) in one part of the network.		2	15	5	1	74
Value of export commodities	Corridor and gateway investments based on the value of export commodities being transported.	1	8	8	3	2	63
Value of import commodities	Corridor and gateway investments based on the value of import commodities being transported.	1	8	8	5		61

Figure 4.5 Summary of Private Sector Input on Prioritization Criteria for National Gateways and Corridors Investments



Source: Cambridge Systematics Private Sector Forums

Table 4.4 Forum Participants Suggested Considerations for National Gateways and Corridors

Participant Suggestions
Freight/Commuter conflicts
Alignment with overall network
Access to inland networks
Supply or sourcing markets
Economic impact
Included in a National Freight Plan that connects multimodal gateways and corridors
Complimentary corridors
Efficient/Smart corridors
Federal involvement
Private involvement
Effective funding for project
Highway system connectivity

Through the use of scenario planning, insight into the robustness and contingent nature of investment options was gained. Despite the challenge of uncertainty and risk, the input received through this effort suggests there are investments that could be undertaken with relatively low risk. The study also suggests that there are investments with significant associated risks, hence their need depends upon on the future state of the U.S. and the world. Figure 4.6 summarizes the scenario findings

Figure 4.6 Summary of Private Sector Scenario Planning Input

Source: Cambridge Systematics Private Sector Forums

Analyzing the input across scenarios across all of the private sector events reveals patterns regarding the robustness or contingent nature of investment

decisions. Robust implications are those strategies or approaches that have similar outcomes across all of the scenarios. Contingent implications are those strategies or approaches that make sense in some scenarios – but not in all.

Robust implications can be categorized as:

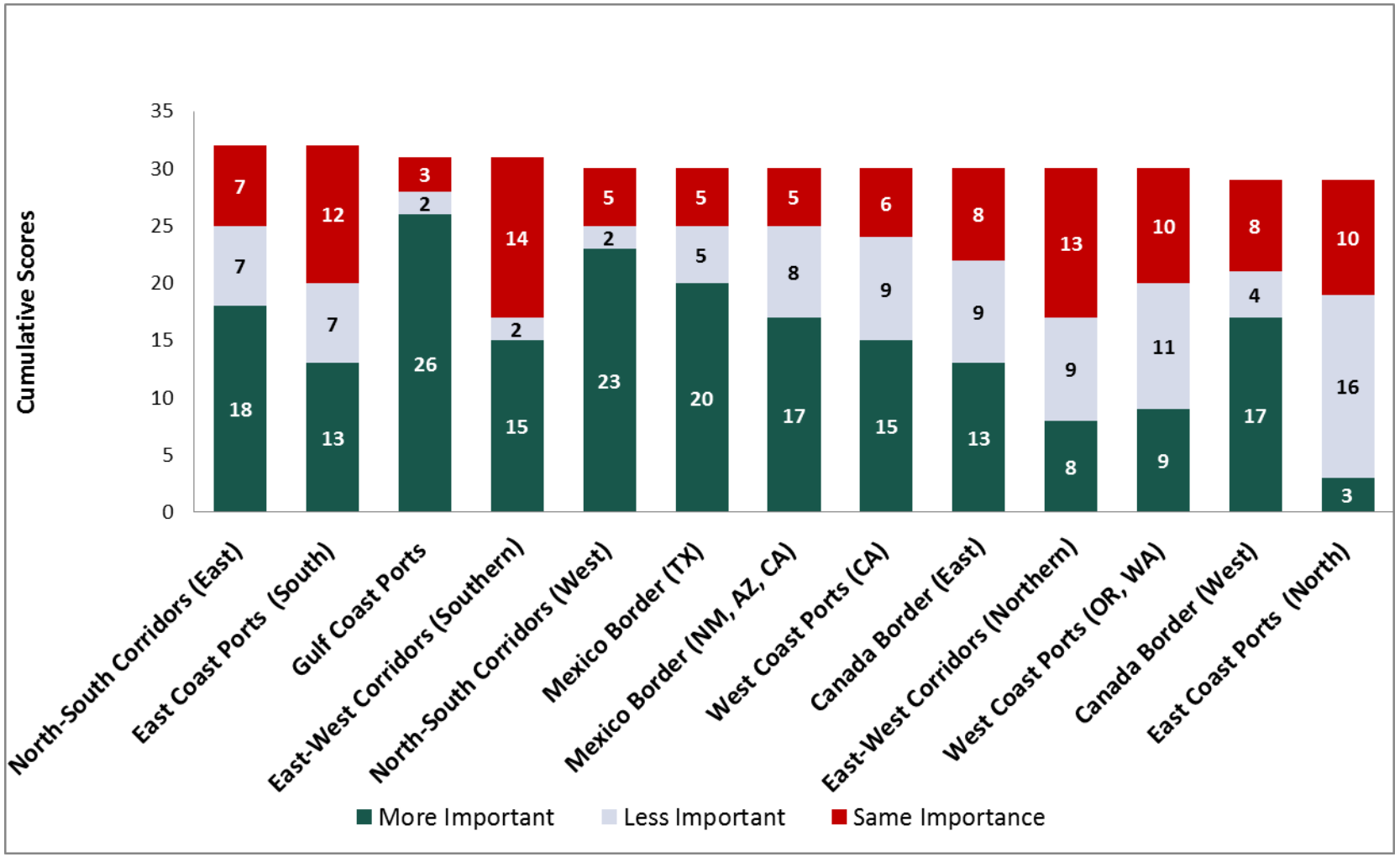
- **No Brainers are those that make sense (good ratings) in all scenarios.** These should be pursued further;
- **No Regrets.** These are ones that make sense in some but are indifferent in the others; and
- **No Gainers.** These are not desirable in any scenario – do not pursue them.

For contingent implications, more in-depth examination is warranted to understand:

- Why it is contingent?
- What aspects of the segment/option specifically make it contingent?

As part of the private sector forum, participants completed and submitted individual score sheets for national priorities under their respective scenario. The results of that exercise are summarized in Figure 4.9. The results indicate that No Brainer priorities include Gulf Coast Ports, north-south corridors and southeastern border crossings. No Regret investment priorities include southeastern ports, east-west corridors in the southern portion of the country and north and southwestern border crossings. Finally, investment priorities that are contingent on the state of the future include northeastern ports and border crossings, west coast ports and east-west corridors in the northern portion of the U.S.

Figure 4.7 Summary of Cross Scenario Comparison



Source: Cambridge Systematics Private Sector Forums

4.5 PUBLIC SECTOR REACTION TO PRIVATE SECTOR INPUT

The final forum of the project was conducted in January 2013 and the purpose of the final forum was to report out on the private sector. The participants included a range of public and private sector experts, researchers and planners in the fields of freight transportation, economics, international trade, and trade and transportation policy.

The forum was organized into two main portions. The first part of the forum was a presentation and discussion of findings from the private sector outreach events, and the second was an open discussion on key considerations to be integrated into the national gateway and corridor plan. This forum provided an opportunity for public sector participants to provide reactions to the findings from the private sector forums and offer input on a framework for developing the National Gateways and Corridors Concepts.

The general public sector reaction to the private sector forum findings included:

- **Options rather than redundancies.** The term redundancy is used in an engineering context to refer to improved reliability of the transportation system, yet the term can carry a negative context in suggesting wasteful investments. When referring to shipper or other private sector needs, the word "option(s)" should be used rather than redundancy since this term better captures what the private sector is looking for when speaking about redundancies in the transportation system.
- **Export focused.** Significant focus was placed on exports rather than imports with a spotlight on bulk goods as containerized cargo. This sentiment was consistent with findings by the Department of Commerce's work with the private sector with a similar focus on export supply chains. This export focus can partially be attributed to the major export initiative policies put forth by President Obama's Administration in addition to the private sector view on potential markets, especially Mexico.
- **Pipelines.** Pipelines were lightly discussed during the private sector focus groups mainly when discussing domestic energy production and future trends given the recent demand for shale gas. Generally, pipelines were found to be an important mode that is almost entirely owned and operated by the private sector.
- **Consistent, mode-neutral communication.** Both sides (public and private sectors) agreed that funding mechanisms today are not suitable for the future. Freight and goods movement are a vital part of the economy, and investment must be made in the freight infrastructure. Notable differences between groups included the public agencies focus on local issues and domestic needs whereas the private sector generally focused on international

trade and infrastructure necessary to facilitate trade with existing and emerging trade partners. Addressing these issues requires active dialogue between public sector planners and policymakers on the requirements of a multimodal network. The discussion should focus on how to react to shifts in both domestic supply chains and international trade lanes.

- **Timing.** A consistent message brought forth by the private sector regards the lack of urgency on the part of the public sector in reacting to infrastructure needs. This lack of perceived urgency was also cited as a bottleneck to trade especially at border crossings where time to get through the "red tape" is a major hindrance for the private sector.
- **Rail importance.** A significant importance on rail today and in the future was somewhat confusing for the public sector participants but was explained that given the high energy costs of future state scenarios led to the private sector's push for additional investments in rail infrastructure. It was noted that there was significant representation from Class I railroads at all forums conducted which likely influenced the expressed importance of rail.
- **Current events.** Given the private sector is typically looking at most five years out, it was perceived that perhaps current events are shaping the reactions as well as input provided by the private sector conflicting with the longer range planning horizon of the public sector. Examples include how the private sector plans around shutdowns or specific events rather than a future environment.
- **Scenario Planning.** Questions regarding how infrastructure might change to U.S. coasts, whether the Panama Canal or the rise of the African economies will influence infrastructure needs are addressed through scenario planning activities. When trade lanes shift significantly, the public sector can better adapt to these changes and find common areas to focus on when scenario planning is used to inform decisions and thereby investments. The difficulty with these exercises for the private sector is the long-term nature of scenarios. Public sector does 'planning' but the private sector is more concerned with 'doing' things which often leads to a disconnect.
- **Potential markets.** Participants raised concern that there seems to be a gap in the understanding of the relative size of a market by the private sector. For example, Mexico cannot replace the market that China and Southeast Asia currently hold. Therefore, determining the appropriate evaluation criteria becomes imperative for public sector planners and policymakers. It was also noted that the private sector, however, did not advocate disinvestment in any existing gateways or corridors such as southern California or New York/ New Jersey but rather indicated a need to focus more investment in still emerging gateways in the Gulf Coast and southeast regions.
- **Public Private Partnerships.** "Follow the private money" was suggested several times throughout the private sector forums suggesting that there is increased willingness for Public Private Partnerships. However, it was stated

that many private sector participants would not provide investment analyses to the public sector in order to determine the feasibility of these partnerships. The data needs were not discussed during the forums but the take away is the desire on behalf of the private sector to partner with public sector in investing in needed infrastructure.

Summary of the discussion on developing a National Gateways and Corridors Plan included:

- **Regional versus Federal.** There was not a unified stance by the public sector on whether to focus on domestic or international trade. The divided view between regionally focused public sector participants and those focused more federally reflect that trade routes and therefore the gateways or corridors used are not homogenous throughout the U.S. For example, in Washington state trade occurs mostly east-west with the Ohio Valley but one of the major Federal trade corridors runs north-south. Thus, there are differences regionally versus federally, in terms of needed infrastructure and these differences need to be addressed to avoid unintended consequences when developing a national plan.
- **Physical and regulatory constraints.** Many of the recommendations presented by private sector participants did not necessarily consider the physical limitations to building additional infrastructure over the next several years. It is understood that the northeast region would remain important and serve as a major population center but wasn't going to be a growth center in the future given the region is already built out. Given this, the northeast region and the Los Angeles/ Long Beach areas should not be abandoned in terms of improvements. Rather investments should be focused more on high growth potential. In addition to physical limitations, community and regulatory constraints were brought forth as an issue by both the private and public sectors.

After providing their reactions and feedback from the private sector findings, the public sector participants were then asked to provide specific input on elements of the Gateways and Corridors Concepts. The following summarizes the discussion and inputs provided by the forum participants.

- **Evaluation Criteria Discussion:**
  - Volume versus value. The private sector ranked volume as a more important prioritization criteria relative to value, which concerned many of the public sector participants. It was noted that value returned and investments for high value goods would be more economically impactful, whereas volume is important to ship the largest number of 'boxes'. To develop a national framework, it is believed that value should be the focus over volume as value is captured by the national and regional areas whereas prioritizing by volume could create congestion, making congestion the overriding concern. It was noted that if one were to rank all the gateways and corridors using both volume and value, the

priorities would remain relatively the same. Hence, the divergence of public and private sector perspectives may not be as significant as initially portrayed.

- Delay. Key issues at border crossings related to delay include congestion and regulatory requirements. The private sector again states that when looking at the global economy, the trends tie in more closely with volume than value. The private sector views moving goods, thus volume, benefits the economy through private sector activities. Additionally, inventory costs must also be considered.
- Value by commodity. Value should be broken out by critical commodities when prioritizing investments as not all commodities are created equally. From a policy consideration, value does matter.
- Societal benefits. The DOTs and public organizations need to capture the societal benefits; therefore, development and equity impacts need to be considered when evaluating investment needs.
- Congestion. Not every city or region is overly concerned with congestion. Some locations are more focused on stimulating their economy through exports, which are highly dependent upon gateways and corridors to access export markets.

- **Gateways and Corridors Concepts Elements Discussion:**
  - Goals and objectives. First and foremost, one of the primary goals should be to make the U.S. more competitive. Another key goal and objective for the Gateways and Corridors Concepts is to implement performance-based evaluations informed through increased cooperation and communication with the private sector. Not to ignore the importance of domestic trade, it is clear that exports are the only way to grow the national economy, so improving access to major trade borders/access points should be a priority. It was also noted that environmentally sustainable routes and improved safety should be taken into consideration.
  - Evaluation of resources/assets and performance. In addition to the evaluation criteria discussed previously, several additional resource and performance criteria were proposed. Consistent with the private sector, the group agreed that productivity of both human and physical assets is vital to addressing throughput and cost issues. There should not be a focus on industries individually, but rather allow the market to adjust using strategic corridors, such as intra-regional movements that link regions in the U.S. This will require a need for flexible risk systems as part of the evaluation. Financial bottlenecks are another form of bottleneck that needs to be addressed.
  - Risk assessment and management. Redundancy or options in a national plan are about risk assessment and management. There should be

options within the network but not necessarily redundant corridors. Redundancy was rated very low by public sector participants, however, there was a recognition of a need to consider network risks. There exists a potential conflict between public private partnerships and redundancy. For example, shippers surveyed for a recent study in Latin America rated redundancy in corridors very high but indicated that they were unwilling to pay for it. It was noted by participants that the air cargo system provides redundancy and can serve to mitigate risk in a more cost effective manner. Thus, the public sector should examine flexible strategies that are more affordable than providing the investment in redundant corridors.

During the open discussion period of the forums, participants provided suggestions and potential solutions to issues as well as providing proposed solutions to achieving the goals and objectives of the National Gateways and Corridors Concepts.

First, it was suggested that planners and policymakers "think outside the box" in terms of developing strategies, such as focusing on developing strategies or projects to promote a national economy rather than just on an individual region or state. The example of the Prince Rupert on-dock rail structure was mentioned given the project's innovative style by Canadian planners and policymakers to boost their national economy. Even though it is a port example, the premise of expanding economic development through a national focus away from traditionally regionally focused projects is something to consider. In addition to innovative ideas, the complexity of a project should also be taken into account when determining strategies or projects. For example, urban congestion is a major issue given that, when corridors run through major urban areas, the scale of problems encountered is far greater.

Rather than simply focusing on volume or value separately, there should be a broader focus on supply chains and the economic importance of where the value is retained in the supply chain. Developing strategic supply chains allows the focus to fall on where the value added is absorbed into the economy, thus, allocating benefits without predetermined geographical borders so as to focus not only on imports or exports but also domestic movements. Additionally, evaluating strategic supply chains provides options to promote competitiveness between modes to obtain the optimal balance between modal redundancy and competiveness. This will also promote more partnerships.

The public sector forum participants, mostly from state or regional organizations, noted that the Federal government maintains a longer-term strategic view globally and should leverage how other countries are investing so as to provide better coordinated strategies given the global nature of the economy. Therefore, instead of evaluating specific projects, the Federal government is suggested to focus on strategic plans without too broad a focus where the goals are lost and allow the states/regions to focus on specific projects necessary to meet national goals and objectives.

The difficult question regarding spending was simply presented by tackling the division of investment funds among current and future issues so as not to choose one or the other. Rather, spending should be divided, for example, two-thirds to fixing current issues and the remaining one-third to future issues. This allows both current issues to be addressed while planning for future trends in transportation needs without committing a significant amount of funds to either.

Coordination between modes was discussed both by private sector and public sector participants as an area to promote for the National Gateways and Corridors Plan. Since at the Federal level the plan only considers freight, and does not address labor or other inputs into the economy, the plan should coordinate with the other agencies such as commerce, labor, and land. Additionally, a review of regulations with a goal of improving communication between Federal agencies to achieve national transportation goals is needed.

To continue the additional need for more coordination, a national plan should also promote more coordination between states especially regarding intra-regional movements. An obstacle, however, to improved state-to-state coordination is the constant changeover in administrations at the state level. This institutional bottleneck makes it nearly impossible to get multiple states to move in the same direction over a long period of time.

Finally, with regards to transportation policy and spending, there exists a first mover issue which can lead to security and mobility conflicts. Many Federal agencies retain a "bottom-up" orientation and are reluctant to take the lead in building infrastructure with the possibility that it will later prove to be unneeded. Improved dialogue with the private sector and utilization of more Public Private Partnerships may address part of this issue.

5.0 Conclusion

With the implementation of the Moving Ahead for Progress in the 21st Century Act (MAP-21), the U.S. is embarking on the development of a National Freight Plan which will include a Gateways and Corridors component. The focus of the National Gateways and Corridors Concepts project is to identify and document multimodal corridor and gateway needs, trends and opportunities to ensure U.S. and North American competitiveness for consideration in the development of future national infrastructure plans.

The project workplan consisted of three primary elements case studies of international freight system planning efforts (Chapter 2), documentation of freight transportation needs of strategic U.S. supply chains (Chapter 3) and private sector stakeholder input (Chapter 4). The common backgrounds emerging throughout all three phases were the recognized need for a national freight infrastructure plan and the challenge of developing such a plan as a result of uncertainty regarding future freight transportation needs.

The research conducted for the National Gateways and Corridors Concepts study provides numerous factors for consideration as the MAP-21 implementation moves forward. Key findings and considerations include the following (additional specific recommendations from specific areas of research effort follow in Section 5.1):

- A combination of "top-down" and "bottom-up" approaches have characterized many of the most advanced national plans;
- Public private partnerships are used extensively in developing and implementing national plans;
- National plans often focus on "game-changer" megaprojects that would not happen in the absence of Federal funding and support;
- The freight network must be flexible and robust to respond to unanticipated disruptions and changes in global trade and logistics patterns;
- The national freight system must accommodate the efficient movement of bulk goods as well as containerized goods;
- Gateway and modal options are significant factors influencing private sector sourcing and distribution locations;
- Based on private sector input, top considerations in developing a national Gateways and Corridors Plan should include current and future freight volumes, accommodation of strategic commodities such as energy and agricultural goods, and recognition of emerging gateways and corridors;

- Priority investment areas under most alternative futures include Gulf Coast ports, north-south corridors and Southeastern border crossings;
- The National Plan should focus on fewer, nationally significant projects, be centrally organized but locally implemented, and be action oriented; and
- The National Plan should be developed using fact-based quantification of investment tradeoffs and recognize the need for potential mitigation strategies to address the distribution of benefits and costs.

5.1 SUMMARY OF KNOWLEDGE GAINED AND KEY TAKE-A-WAYS

Case Studies of International Freight System Planning

From the case studies of international freight system planning efforts, we learned that significant focus on investments in freight systems is underway in many countries throughout the world. A variety of approaches ranging from a bottom-up to top-down to ad-hoc approaches have been employed in the development of such plans.

However, the more successful and advanced programs represent a hybrid of top-down and bottom-up approaches. They are characterized by the central governing body or federal government adopting and building upon an approach that originated at the regional level.

In Canada, the development of the National Gateways and Corridors Framework, as well as the three regional Gateway Strategies, is an important milestone. Some key considerations for the U.S. effort include:

- The National Gateway Framework is strategic, and helps align various regional strategies to serve towards the same purpose.
- Federal backing is essential - The National Gateway Framework has significant financial backing from Building Canada, the federal infrastructure plan that essentially also acts as a transportation investment plan.
- It is not necessary for a top-down approach to initiate gateway strategies. Strategies that already exist at the regional level can be worked into, and help inform, the national strategy in a bottom-up approach, as in the case of the Asian Pacific Gateway Strategy.
- In addition to federal funding and other local funding, a great emphasis is placed on private funding. Attracting investment from the private sector is essential since public funding usually takes long to come by and may not be enough.
- Success in Gateway/Corridor strategies must be done in partnership with all relevant stakeholders, including all levels of government as well as the private sector.

- Gateway Projects must be backed by rigorous analytical research that looks into all relevant topics affecting modal and intermodal transportation, and supply chain in the present and future.

The Mexico MCMP was developed with the idea that isolated improvements are not enough and that a set of coordinated actions between the public and private sectors is needed to improve the performance of the Mexican Multimodal Transportation System. Other key takeaways include:

- Use of objective data combined with stakeholder input facilitated a more fact based selection of priorities;
- Process focused on national priorities but did not prohibit local participation in advancing any local or regional priorities; and
- Flexibility is essential to ensuring plan robustness and longevity.

The implication of the EU's TEN-T process to freight transportation gateway and corridor development in the United States include:

- A unifying vision linking transportation and the economy is a key foundational element of the TEN-T.
- Multijurisdictional transportation planning and implementation will require new management, funding, and coordination strategies.
- Awareness must evolve from an exclusively national and local understanding of freight movement to an international understanding of how freight movement connects to international markets.
- Any movement toward corridor-level thinking in the United States must be grounded in objective, transparent facts and market analysis.
- Benefit-cost analysis is a valuable tool in project selection and policy evaluation.
- Freight policy must align with related policies, such as economic, trade, environmental, and land use policies.
- Stable multiyear funding provides continuity and minimizes delays, particularly on large-scale projects.

China is aggressively implementing measures to address lacking infrastructure and adverse operational practices in the freight transportation and logistics sectors. Key considerations include:

- Lower logistic costs to GDP ratio to be more in line with more developed mature markets,
- The designation of domestic logistics areas or industries,
- The designation of nine logistic zones and 10 corridors connecting 21 main cities and identifying 17 of the cities as regional logistic hubs.

For example, the PRC through its five year plan is calling for the formation of domestic logistics zones and corridors. The goal is to expand capacity across multiple modes and shift additional economic activity further inland in hopes of ensuring a more even distribution of the benefits arising from national investment.

While India continues to make significant investments in its transportation infrastructure, the performance of the freight system continues to lag other key Asian trade partners.

Key take-a-ways include India's emphasis on trading partnerships with regional neighbors; an emphasis on increasing roadway capacity to facilitate trade and a separate railway system dedicated to freight. India is expanding the use of public private partnerships via concessionaires.

The government of India controlled port development in the past; it has increasingly turned to Build Operate Transfer for ports.

Given the inherent private sector benefits accruing from freight network investments, the U.S. should also view the development of a national freight network in India as an enhanced opportunity for partnerships.

Brazil has an aggressive transport investment program aimed at expanding the Country's role in global trade. While research revealed much information about the planned investments, there is little generally accessible information on the process by which the plan was developed or how it will be implemented.

The experience of Brazil is notable for its strategy of simultaneously building on its strengths, such as the expansion of Puerto Santos, while directing investment to the weak links in its overall transportation system that have limited the variety of commodities that can be efficiently exported and the countries with which it can efficiently trade. Some challenges that Brazil is currently facing such as rail gauge interoperability have long been resolved in the United States, while other issues, such as the use of PPPs to accelerate the improvement of rail corridors and connectivity with ports, have close parallels in the United States and should be tracked closely.

Industry Supply Chains

Agriculture

Our examination of key agricultural crop exports in the U.S. provides insights into the critical role that the nation's multimodal transportation system and policies play in the global competitiveness of U.S. agricultural goods. The research points to concerns regarding adequate port infrastructure to handle export levels at the ports closest to the point of production or those that can be reached in the most efficient manner. There is also concern regarding the adequacy of rail infrastructure and service into key export ports and between

production areas and ports. However, perhaps one of the largest infrastructure concerns for this industry is the deteriorating condition of lock and dam infrastructure.

Non-infrastructure issues that deserve consideration include the impact of climate change and extreme weather recently experienced in the U.S. This has led to a reduction of U.S. production which, if sustained, could result in increased imports and decreased exports. In addition, portions of primary inland waterway routes were compromised, either preventing the passage of barges or allowing only barges carrying reduced loads. This can lead to mode shift away from water routes to rail and truck, driving up the prices and reducing global competitiveness.

Energy Commodities

The demand and preference for different energy types can change more rapidly than the infrastructure that is responsible for producing and supplying energy commodities. The corridors that currently exist were largely constructed to serve the energy demands that existed decades ago, yet many new energy sources such as LNG, shale gas, shale oil and renewable sources require different handling characteristics and impose different costs on the system. The low price of natural gas and the increased cost of transporting coal cross country has upended the traditional assumption that coal will always be more inexpensive than natural gas as a fuel source. Furthermore, as powerplants and vehicles have grown more adept at using different energy sources, it appears that supply chains will continue to grow more diverse and will increasingly be called upon to serve exports as well as imports.

Intermodal/Containerized Goods

U.S. containerized trade is steered by global economic trends and steamship routing decisions made far from U.S. shores. For this reason, any master plan for routing of international container trade should include substantial contingencies to accommodate changes in routing and sourcing trends and unforeseen macroeconomic and political shifts. Despite uncertainty in global trade trends, factors such as proximity to U.S. population centers, private sector investment in rail facilities and distribution hubs, and terminal/ship liner relationships will continue to influence the domestic end of international trade flow patterns.

Automotive

The U.S. automotive industry continues its evolution resulting in changes in sourcing locations by both domestic and international manufacturers. The trend of U.S. based manufacturers migrating to the Southeastern states has continued and expanded as more Asian and European based manufacturers have recently located significant facilities in the southeast. In addition, Mexico has become increasingly important as a sourcing location for both component parts and assembly plants. Thus, the need for seamless North-South freight transportation

networks spanning from Canada to Mexico has continued to grow and become even more critical for the North American automotive industry.

Another key factor impacting the national transportation needs of the automotive sector is the need for import and export facilities for finished products, as well as multiple cross border movements of component parts. The majority of automotive manufacturers produces goods for both the domestic and export markets. The export of autos requires very specific infrastructure and handling and hence, not all gateways are equipped to meet these needs. In addition, all of the U.S. based manufacturers import a portion of the components required in assembly. Many of these may be sourced in facilities throughout North America and it is not uncommon for parts to cross the border two or more times before being completed and shipped to the assembly plant. This, combined with the just-in-time manufacturing process, places considerable emphasis on the reliability and resiliency of the border crossings and freight transportation network.

Summary of supply chain findings

Examination of the role of gateways and corridors in supporting strategic industry supply chains reveals very diverse requirements, needs and concerns. However, there are also common themes deserving consideration in the development of a National Gateways and Corridors Plan including:

- Reliance on a multimodal network that offers options to mitigate the impact of unexpected disruptions and changes in modal costs and/or services;
- The need for focus on the movement of bulk goods as well as intermodal goods especially for port and gateway investments; and
- Increased diversification of sourcing and distribution networks to mitigate impact of disruptions leads to need to access gateways and trade corridors.

Summary of Private Sector Input

In general, the following criteria were highly-rated by participants as those that should receive the most attention in national freight planning:

- Volume of freight,
- Growth in volume,
- Emerging trade gateways and corridors, and
- Accommodation of strategic goods such as energy and agriculture commodities.

Lower scoring criteria included:

- Value of freight for both imports and exports, and
- Redundancy in the system.

Additional suggested criteria included:

- Freight/Commuter conflicts,
- Alignment with overall network,
- Access to inland networks,
- Supply or sourcing markets,
- Economic impact,
- Inclusion in a national freight plan that connects multimodal gateways and corridors,
- Complimentary corridors,
- Efficient/Smart corridors,
- Federal Involvement,
- Private involvement,
- Effective funding for project, and
- Highway system connectivity.

Through the use of scenario planning, insight into the robustness and contingent nature of investment options was gained. Despite the challenge of uncertainty and risk, the input received through this effort suggests there are investments that could be undertaken with relatively low risk. The study also suggests that there are investments with significant associated risks, hence their need depends upon the future state of the U.S. and the world. Figure 5.1 (see also figure 4.6) summarizes the scenario findings.

Figure 5.1 Summary of Private Sector Scenario Planning Input

Source: Cambridge Systematics Private Sector Forums

Public sector

The public sector, when examining the private sector input, suggested that the following themes be taken into account when creating a national freight system (these are discussed in greater detail in Chapter 4):

- Options rather than redundancies,
- Export focused,
- Pipelines,
- Consistent, mode-neutral communication,
- Timing,
- Rail importance,
- Current events,
- Scenario Planning,
- Potential markets, and
- Public Private Partnerships.

Additional discussion by the public sector on developing a National Gateways and Corridors Plan included:

- Regional versus federal – There was not a unified stance by the public sector on whether to focus on domestic or international trade; the gateways or corridors used are not homogenous throughout the U.S.
- Physical and regulatory constraints – Many of the recommendations presented by private sector participants did not necessarily consider the physical limitations to building additional infrastructure, and regulatory constraints were brought forth as an issue by both the private and public sectors.
- Volume versus value –To develop a national framework, the public sector believed that value should be the focus over volume, as value is captured by the national and regional areas whereas prioritizing by volume could create congestion.
- Delay - Key issues at border crossings relate to delay, and include congestion and regulatory requirements.
- Value by commodity - Value should be broken out by critical commodities when prioritizing investments as not all commodities are created equally.
- Societal benefits - The DOTs and public organizations need to capture the societal benefits therefore development and equity impacts need to be considered when evaluating investment needs.
- Congestion - Not every city or region is overly concerned with congestion.

Additional Public sector Gateways and Corridors Concepts Elements conclusions included:

Goals and objectives –

- Make the U.S. more competitive.
- Implement performance based evaluations.
- Environmentally sustainable routes.
- Improved safety.
- Allow the market to adjust using strategic corridors, such as intra-regional movements that link regions in U.S.
- Redundancy or options in a national plan should be options within the network but not necessarily redundant corridors.

First, it was suggested that planners and policymakers "think outside the box" in terms of developing strategies, such as focusing on developing strategies or projects to promote a national economy rather than just on an individual region or state. Rather than simply focusing on volume or value separately, there should be a broader focus on supply chains and the economic importance of where the value is retained in the supply chain.

It is suggested to focus on strategic plans and allow the states/regions to focus on specific projects necessary to meet national goals and objectives.

Spending should be divided, some to fixing current issues and the remaining to anticipate future issues. This allows both current issues to be addressed while planning for future trends in transportation.

To address labor or other inputs into the economy, the plan should coordinate with the other agencies such as commerce, labor, and land. Additionally, a review of regulations with a goal of improving communication between federal agencies to achieve national transportation goals, is needed.

To continue the additional need for more coordination, a national plan should also promote more coordination between states especially regarding intra-regional movements.

Finally, with regards to transportation policy and spending, there exists a first mover issue which can lead to security and mobility conflicts. Many federal agencies retain a "bottom-up" orientation and are reluctant to take the lead in building infrastructure with the possibility that it will later prove to be unneeded. Improved dialogue with the private sector and utilization of more Public Private Partnerships may address part of this issue.

Appendix A. **Factors Impacting Future Freight Flows**

As part of the first phase of the NCHRP 20-83 (1) project on Future Freight Flows, driving forces and critical uncertainties that will impact freight flows in the United States over the next 30 years were identified, categorized, and ranked. The results were used to develop the set of future scenarios which were used for the current effort.

The process started with the Future Freight Flows Symposium where thought leaders from five primary dimensions (Social, Technology, Environment, Economic, and Political) presented potential future trends to a hand selected group of expert practitioners. This led to a brainstorming session where the attendees generated potential driving forces and critical uncertainties that were analyzed, harmonized, and consolidated into twelve representative "Snapshot Scenarios". These Snapshot Scenarios were presented back to the practitioners in an interactive setting where they developed estimates of each force's influence over time, its impact on freight flows, and how it would stress the existing U.S. infrastructure. The results of these twelve analyses were analyzed and translated into twenty more detailed "Driving Forces."[64]

Table A.1 summarizes the findings from MIT's efforts. The table includes the driving factors, their definition and information on the category of impact, as well as the manner in which freight flows are most likely to be impacted. The driving forces were categorized as social, technology, economic, environmental or political, with some factors fitting into more than one category. Impacts on freight flows were divided into five components including sourcing, destinations, routing, volume and value density.

The uncertainty and risk associated with the primary factors driving future freight flows formed the basis for the development of scenarios depicting alternative states of the world. The resulting scenarios were used in the current planning effort in the private sector forums.

[64] NCHRP Web Only Report 195, Driving Forces Influencing Future Freight Flows, April 2010.

Table A.1 Summary of Driving Forces Impacting Future Freight Flows in the U.S.

Driving force	Description	Social	Technology	Economic	Environmental	Political	Sourcing	Destinations	Routing	Volume	Value Density
Redomestication of manufacturing	Substantial redomestication of manufacturing back to the United States			X			X	X	X		X
Reduction in global trade	Sustained reduction in global trade volume (both imports and exports) possibly due to rise of protectionism, pandemics, etc.			X			X			X	
Increased security threats	Large increase in both the number and magnitude of security threats (domestic and abroad)	X					X		X	X	
Green regulations	Stringent environmental and sustainability regulations adopted and strictly enforced by the United States and most other countries					X			X	X	X
High and volatile fuel prices	Dramatic increase in price and volatility of all oil-based fuels			X			X	X	X	X	X
Rise of BRIC markets	Ascendancy of consumer markets in Brazil, Russia, India, China, and other countries leading to increased demand for products manufactured in the United States			X				X		X	X
Low-cost batch manufacturing	Widespread adoption of technologies enabling efficient and low-cost small batch manufacturing for most consumer goods		X				X			X	X
Online retailing	Dramatic shift towards online purchase and point-of-use delivery leading to reduction of physical retail stores		X	X				X	X	X	X
Sensible network	Widespread ability to capture and monetize real-time sensing data on all products, vehicles, and facilities across a supply chain at essentially no cost		X						X		
Recycling regulations	Omnipresent enforcement of regulations and rules requiring recycling and reuse of all manufactured products				X	X			X	X	
Average age of 100	Average life expectancy reaching 100 years in the United States	X						X			X
East coast ports	Shifting point of entry for a majority of imports to the East Coast (e.g., due to rise in manufacturing in Africa, more ships using the Panama Canal, etc.)			X			X		X	X	

Driving force	Description	Social	Technology	Economic	Environmental	Political	Sourcing	Destinations	Routing	Volume	Value Density
New agriculture powerhouses	New countries (such as Russia or India) emerging as agricultural powerhouses supplanting the United States in some food commodities			X				X	X	X	X
Water scarcity	Pervasive water scarcity in some regions leading to a reduction in exporting products that either contain water (e.g., fruit) or require a water intensive manufacturing process (e.g., soda, electronic chips)				X		X		X		X
Green customer demand	The sustainability and environmental "friendliness" of a product becoming the dominant factor for consumer demand for most products supplanting cost	X			X		X	X	X		
Mega cities	Over 90% of the United States consumers living and working in mega-region cities and built up urban areas	X						X	X		X
Zero immigration	Immigration into the United States reduced essentially to zero					X		X	X		
Battery vehicles	New battery technologies dramatically reducing the cost and increasing the efficiency and range of electronic vehicles		X					X	X		X
Commodity price volatility	Shifting geo-politics and other factors leading to tremendous price volatility for almost all commodities such as wheat, copper, and lithium			X			X		X	X	
Increased value density	Advancements in manufacturing, materials, and other technologies increasing the average value per ton moved in the United States from ~$700 per ton (in 2008) to over $2000 per ton		X						X	X	X

Source: NCHRP Web Only Report 195, Factors Impacting Future Freight Flows, May 2010.

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