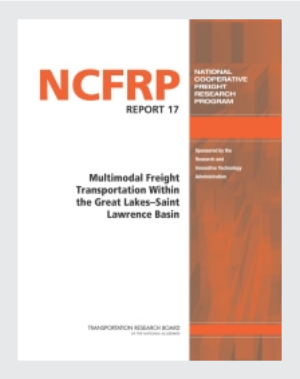

Multimodal Freight Transportation Within the Great Lakes--Saint Lawrence Basin

DETAILS

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NATIONAL COOPERATIVE FREIGHT RESEARCH PROGRAM

NCFRP REPORT 17

Multimodal Freight Transportation Within the Great Lakes–Saint Lawrence Basin

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NATIONAL COOPERATIVE FREIGHT RESEARCH PROGRAM

America's freight transportation system makes critical contributions to the nation's economy, security, and quality of life. The freight transportation system in the United States is a complex, decentralized, and dynamic network of private and public entities, involving all modes of transportation—trucking, rail, waterways, air, and pipelines. In recent years, the demand for freight transportation service has been increasing fueled by growth in international trade; however, bottlenecks or congestion points in the system are exposing the inadequacies of current infrastructure and operations to meet the growing demand for freight. Strategic operational and investment decisions by governments at all levels will be necessary to maintain freight system performance, and will in turn require sound technical guidance based on research.

The National Cooperative Freight Research Program (NCFRP) is a cooperative research program sponsored by the Research and Innovative Technology Administration (RITA) under Grant No. DTOS59-06-G-00039 and administered by the Transportation Research Board (TRB). The program was authorized in 2005 with the passage of the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU). On September 6, 2006, a contract to begin work was executed between RITA and The National Academies. The NCFRP will carry out applied research on problems facing the freight industry that are not being adequately addressed by existing research programs.

Program guidance is provided by an Oversight Committee comprised of a representative cross section of freight stakeholders appointed by the National Research Council of The National Academies. The NCFRP Oversight Committee meets annually to formulate the research program by identifying the highest priority projects and defining funding levels and expected products. Research problem statements recommending research needs for consideration by the Oversight Committee are solicited annually, but may be submitted to TRB at any time. Each selected project is assigned to a panel, appointed by TRB, which provides technical guidance and counsel throughout the life of the project. Heavy emphasis is placed on including members representing the intended users of the research products.

The NCFRP will produce a series of research reports and other products such as guidebooks for practitioners. Primary emphasis will be placed on disseminating NCFRP results to the intended end-users of the research: freight shippers and carriers, service providers, suppliers, and public officials.

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FOREWORD

By William C. Rogers
Staff Officer
Transportation Research Board

NCFRP Report 17: Multimodal Freight Transportation Within the Great Lakes–Saint Lawrence Basin describes the current multimodal freight transportation system within this binational region (i.e., Minnesota, Wisconsin, Michigan, Illinois, Indiana, Ohio, Pennsylvania, New York, Ontario, and Quebec) and its importance to regional, U.S., and Canadian economies. The report also analyzes the system's overall performance and related opportunities and constraints to improving performance and to meeting projected freight flows. The multimodal freight transportation system in the Basin is complex. It spans numerous modes, geographies, and jurisdictions, and serves a wide variety of commodity and supply chains. The Basin generates 30% of the combined gross domestic product of the U.S. and Canada and is home to 31% of the two countries' populations combined.

The report includes an analysis of each mode's capacity and the major commodities each of them moves; the barriers and constraints that impact each mode's ability to move cargo; the performance implications in terms of major commodity supply chains (coal, automotive parts and machinery, containerized consumer goods, grains, and iron ore); and a strategic freight planning process for multimodal transport chain performance going forward.

The Great Lakes–Saint Lawrence Basin of the United States contains a unique transportation system with the nation's largest rail hub in Chicago; the border with our largest trading partner, Canada; a robust ports and waterways system; and an extensive highway infrastructure that serves the major industrial and agricultural heart of the nation, as well as provides vital transportation connections to the rest of North America and the world.

Under NCFRP Project 35, CPCS Transcom Limited was asked to (1) define the existing multimodal freight transportation system in the Great Lakes–Saint Lawrence Basin; (2) describe the economic impacts by mode and major industry sector for each state and province as well as the Basin as a whole; (3) identify and describe the common recommendations, strategies, and policies in the existing freight plans for the states, provinces, and metropolitan planning organizations in the Basin; (4) identify opportunities and constraints to improving regional freight transportation performance and development within the Basin, with emphasis on commercial navigation and port operations and the impact of the Harbor Maintenance Tax; and (5) develop a communication plan, including target audience, and tools and products (and their upkeep), to inform the public, decision makers, and private sectors of the relationship of the Great Lakes–Saint Lawrence Basin multimodal freight transportation system to the economic vitality of the region and the nation, as well as potential improvements for meeting projected freight flows.

CONTENTS

Note: Many of the photographs, figures, and tables in this report have been converted from color to grayscale for printing. The electronic version of the report (posted on the Web at www.trb.org) retains the color versions.

SUMMARY

Multimodal Freight Transportation Within the Great Lakes–Saint Lawrence Basin

The Great Lakes–St. Lawrence Basin (GLSLB) is a bi-national region (United States, Canada) comprising eight states (Minnesota, Wisconsin, Michigan, Illinois, Indiana, Ohio, Pennsylvania, New York), two provinces (Ontario, Quebec), and hundreds of municipalities, large (e.g., Chicago, Toronto) and small. The GLSLB region generates 30% of U.S. and Canadian gross domestic product (GDP) and is home to 31% of the two countries' population.

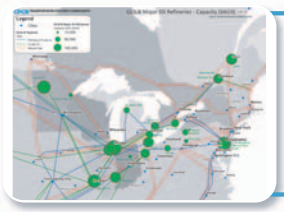
The multimodal freight transportation system within the GLSLB is extensive and comprises:

Marine Transportation: 15 large international marine ports and 50 regional marine ports, the Great Lakes–St. Lawrence Seaway System (GLSLSS) and its 19 locks, and a network of inland waterways, including, in particular, the Mississippi River with its major tributaries of the Ohio and Illinois Rivers.

Rail Transportation: Seven Class 1 railways, totalling 30,778 miles of track and 68 intermodal terminals, several short lines, and rail border crossings.

Road Transportation: Extensive highway system and several border crossings. In the U.S., key north-south highways include I-35, I-55, I-65, I-75, and I-95 and on the east-west axis, I-70, I-80, and I-90. In Canada, key freight highways are east-west along the St. Lawrence River and northern edge of the Great Lakes.

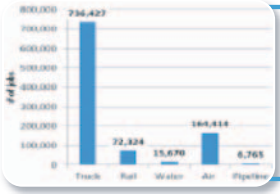
Air Transportation: The GLSLB serves as one of North America's major air cargo hubs and includes 36 of North America's 156 airports that handle over 10,000 tons of cargo per year. The GLSLB's 20 largest airports make up 95.2% of the regional air cargo traffic. Major freight airports include Chicago O'Hare and Toronto Pearson.



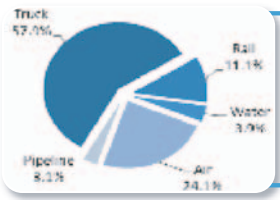
Pipeline Transportation: A network of pipelines in the GLSLB moves a range of fuels and petroleum products including crude, gasoline, and natural gas. These pipelines are privately owned and operated by energy companies.

Economic Importance of the GLSLB Multimodal Freight Transportation System

The GLSLB transportation system has a primary role in supporting local, regional, and international trade and economic activity. The following highlights the economic importance of the GLSLB freight industries and supply chains:

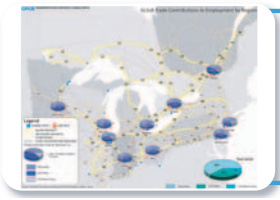


In 2007, freight transportation industries in the GLSLB directly employed over one million individuals. Including indirect and induced impacts, they accounted for 3.8 million jobs, $627 billion in gross output, $311 billion in gross domestic product, $200 billion in personal income, and $87 billion in taxes.



Trucking accounted for 58% of the economic impact, air freight for 24%, rail transportation for 11%, water transportation for 4%, and pipelines for 3% (based on the average for all five metrics).

Of the economic impact of the GLSLB transportation system, 58% accrued to the eight GLSLB states, 13% to the two GLSLB provinces, and 29% to other U.S. states and Canadian provinces.



60% of the total employment created by transportation can be attributed to regional commodity flows (mostly intra-state and intra-provincial flows) relying primarily on trucking, 32% to national trade, which relies mainly on trucking, air, and rail, and 8% to international trade.

Even though U.S.–Canada trade within the region represents only 6% of the value of regional trade, it accounts for 25% and 29% of the supply-chain impacts on employment and output of this trade.

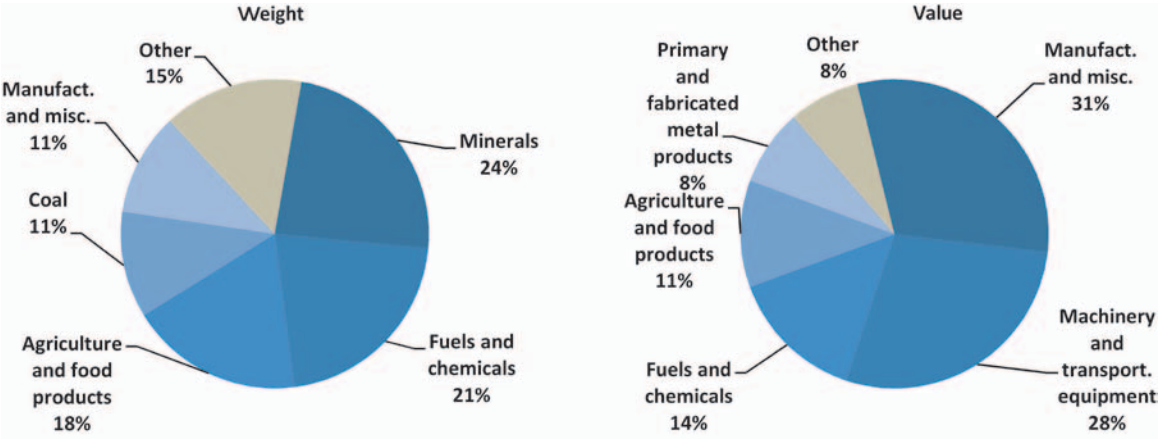
The most significant regional trans-border trading pair is between Ontario and Michigan, which alone accounts for over 1.4 million jobs, $513 billion in output, $139 billion in value-added, and $103 billion in personal income.

Key Commodities Flows in the GLSLB

The multimodal freight transportation system in the GLSLB handles a diverse range of freight, serving a wide range of industries. The major commodities moving to, from, or within the GLSLB include coal (largely for regional power production), iron ore (for regional steel production and export), grain and other agricultural products (local consumption and export), automotive and machinery (supporting local manufacturing base), and other manufactured goods (including containerized imports for regional distribution and consumption and exports).

The importance of these commodities varies significantly when it is measured in weight or value.

Top 5 Commodities Groups with an Origin or Destination in the GLSLB



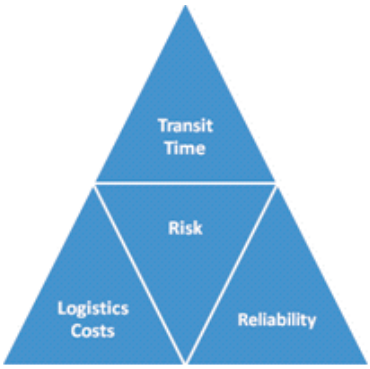
The transportation needs of these commodities depend both on their intrinsic characteristics (e.g., weight, value, volume, perishability) and their market characteristics (e.g., origin, destinations, cost of alternative transportation). The following table summarizes the interaction between modes and commodities for flows moving to, from, or within the GLSLB.

Mode	Million tons	% (weight)	$ per ton	% (value)	Top Three Commodities by Mode By weight		Top Three Commodities by Mode By value	
Air	8.3	0.1%	$116,020	12.8%	Manufacturing and misc.	55.1%	Manufacturing and misc.	68.7%
					Machinery and transport. equip.	21.8%	Machinery and transport. equip.	24.9%
					Pulp and paper products	5.9%	Primary and fabric. metal products	1.9%
Marine	1,152.2	15.3%	$270	4.1%	Minerals	30.2%	Machinery and transport. equip.	38.2%
					Coal	22.4%	Fuels and chemicals	17.0%
					Fuels and chemicals	22.4%	Minerals	9.0%
Truck	4,742.8	63.0%	$1,160	72.8%	Minerals	25.8%	Machinery and transport. equip.	28.6%
					Agriculture and food products	23.3%	Manufacturing and misc.	26.1%
					Fuels and chemicals	17.2%	Agriculture and food products	14.1%
Rail	1,169.5	15.5%	$490	7.6%	Coal	49.2%	Manufacturing and misc.	33.1%
					Minerals	17.2%	Machinery and transport. equip.	32.3%
					Agriculture and food products	11.2%	Primary and fabric. metal products	9.4%
Pipeline	456.4	6.1%	$440	2.7%	Fuels and chemicals	100.0%	Fuels and chemicals	100.0%
					-	-	-	-
					-	-	-	-
All Modes	**7,529**	**100%**	**$1,003**	**100%**	**Minerals**	**23.5%**	**Manufacturing and misc.**	**30.6%**
					Fuels and chemicals	**21.3%**	**Machinery and transp. equip.**	**28.1%**
					Agriculture and food prod.	**18.1%**	**Fuels and chemicals**	**14.3%**

GLSLB Multimodal Freight Transportation System Performance

The "performance" of the GLSLB multimodal freight transportation systems is complex, particularly when assessed from a multimodal, multijurisdictional, and multicommodities perspective. Complicating matters is the reality that the GLSLB is a region within a larger continental and global transportation network, serving regional and international supply chains.

While performance is assessed differently by different stakeholders (carriers, policy makers, regional planners, etc.), the most salient perspective in considering freight transportation



performance is, albeit arguably, that of the freight (shippers). By and large, shippers assess freight transportation performance on the basis of total logistics cost, transit time and reliability, and related risks thereto. Thus, transportation decisions, including routing, mode selection, and other supply-chain decisions, including location decisions and inventory planning, are primarily made on the basis of appropriate tradeoffs between these factors as well as the characteristics of the freight, including origin and destination.

Transportation characteristics and "performance" needs can differ significantly by commodity and supply chain, as do the pressures these different commodities exert on the GLSLB multimodal freight transportation system.

For instance, coal, one of the most significant commodities in terms of volume transported in the GLSLB, is largely captive to its transport chain, moving between three coal-producing regions (largely outside the GLSLB) to regional coal-fired power plants in the GLSLB, and to a lesser degree regional industries. Coal supply chains are less time sensitive than higher-value commodities and are moving in bulk by rail and marine/barge transportation. Coal movements generally don't move by long-distance truck, nor does related traffic interact significantly with urban transportation systems.

In terms of freight values, automotive parts and machinery transportation are most significant in the GLSLB. Michigan, Ontario, Ohio, and Indiana are major players in the region's automotive industry. Most of the industry inputs (e.g., parts) are regionally produced. U.S. trade with Canada is central to the region's industry, with nearly 20 million tons of automotive inputs and related freight crossing the border each year, mostly at the Detroit/Windsor land-border crossing. Given the time-sensitive automotive production process (just-in-time), truck is often the mode of choice for intermediate inputs.

Consumer goods and general cargo moving in intermodal containers also represent a significant share of regional freight traffic. Chicago is the region's undisputed intermodal and regional distribution hub with nearly 20 intermodal facilities served by six Class 1 railways, providing linkages to West Coast ports (Vancouver, Los Angeles/Long Beach, Seattle and Tacoma, Prince Rupert) and East Coast ports (including Montreal, New York, and Philadelphia). Most intermodal traffic moves by rail between coasts and the GLSLB. Truck transport moves intermodal freight the last/first mile, contributing to urban congestion, which in turn increases logistics costs, reduces reliability, and lengthens transit times for the movement/distribution of intermodal traffic.

Other major GLSLB commodities flows (grain, iron ore, petroleum products, etc.) likewise have different supply-chain characteristics, performance drivers, and different pressures exerted on the GLSLB multimodal freight transportation system.

This creates a significant challenge for policy makers, transport planners, and researchers interested in understanding and improving the performance of the GLSLB multimodal freight transportation system, as barriers and constraints to improving freight transportation performance are often commodity supply-chain specific, as are the opportunities and initiatives to promote improved performance.

Barriers and Constraints to Multimodal Freight Transportation System Performance in the GLSLB

Modal constraints and barriers—both hard infrastructure capacity constraints or bottlenecks and soft regulatory or operational constraints—are fairly well understood in the GLSLB. Commodity supply-chain–specific multimodal and multijurisdictional constraints and

barriers and related potential solutions are less well understood. The following are some of the most significant barriers and constraints to multimodal freight transportation performance in the GLSLB.

Capacity constraints and bottlenecks: Road and rail infrastructure around major markets and freight transportation hubs in the GLSLB is capacity constrained. The performance implications are most significant for the movement of general cargo and manufactured products, including intermodal container traffic, which is most dependent on rail and truck linkages to/from major population centers and markets.

Capacity constraints and congestion are most significant around Chicago, the GLSLB's most important transportation hub. Capacity constraints around Chicago and other major urban centers in the GLSLB, including Minneapolis, Detroit, Toronto, and Montreal, are resulting in increased transit time and cost with reduced reliability, particularly for general cargo, which critically depends on rail intermodal and truck transportation to/from major centers. Air pollution, carbon dioxide (CO_2) emissions, congestion, and increased wear and tear on regional roads are some of the negative externalities that also result from intensive freight transportation. This issue is expected to worsen with time and economic growth, creating new and more significant capacity constraints in the regional surface transportation system. This could have important implications for the competitiveness of the region for manufacturing and exports, among other segments of the regional economy.

Unlike the regional road and rail system, the region's waterways and airports generally have excess capacity to handle freight. However these other modes are not necessarily conducive to absorbing freight currently moving on congested segments of the rail and road network for a host of reasons, not least of which is compatibility with the way existing supply chains have been organized and the specific transit time, cost, and reliability requirements. The challenges in encouraging modal shift of containerized traffic from rail or truck to marine transportation within the GLSLB is a case in point. This not to say that modal shift does not have potential, with the right enabling conditions.

Modal integration challenges: Modal integration was cited frequently as a major barrier to the improvement of the multimodal freight transportation system in the GLSLB. Modal integration issues range from poor physical modal connections, inefficiencies in the transfer of freight, and transportation-chain coordination problems. Other coordination problems are the delays and variable wait times at land-border crossings, which reduce reliability and lead to increased inventory requirements (and, in turn, total logistics costs). As a result of these and similar modal integration issues, many noted that it was difficult to optimize or plan for performance improvements to the multimodal freight transportation in the GLSLB.

Lack of jurisdictional coordination: Poor harmonization across state boundaries, including regulations about road size and weight limits, was often cited as a major barrier. From a freight transportation planning perspective, most state departments of transportation (DOTs) and provinces are focused within their jurisdictional boundaries, as evidenced by the number of state-level freight and modal plans recently completed or currently under way in the GLSLB. There are few overarching multimodal and multijurisdictional freight plans considered for the broader GLSLB region. Some notable exceptions include the I-70 corridor initiative in the U.S. and Canada's Ontario-Quebec Continental Gateway and Corridors Strategy initiative.

Lack of multimodal funding mechanisms: Several stakeholders noted that very little exists by way of multimodal funding mechanisms in the GLSLB at present, particularly in the U.S.

Modal inequality: Several stakeholders consulted spoke directly or indirectly to issues of modal inequality, particularly with respect to the marine mode. From a multimodal

perspective, modal inequality could be seen as preventing an optimal allocation of freight in the GLSLB multimodal transportation system. Of course, policy makers cannot directly compel modal shift. Mode selection will remain a decision of shippers. However, policy makers can take steps to internalize external costs of transportation (externalities) including emissions, road wear and tear, etc., and in doing so, promote modal switch, in line with the incentives of shippers.

Insufficiency of data and performance metrics: A major perceived gap in improving the performance of the GLSLB multimodal freight transportation system relates to the public availability of transport-chain performance measures. This hinders a full appreciation of the issues limiting transport-chain performance in the GLSLB and where measures to address performance are most warranted.

Lack of awareness of importance and role of freight transportation system: Many consulted noted a lack of awareness about the importance of multimodal freight transportation in the GLSLB, and related planning issues, particularly among elected officials (since freight does not vote). There is also a concern with the "silo" approach to transportation planning (mode or jurisdiction specific) where those involved in the policy process tend to have limited understanding of freight supply chains beyond their respective areas of focus.

Labor constraints: The current workforce in the transportation sector in the GLSLB, and indeed elsewhere in North America, is aging. This is particularly true for the trucking and marine modes, where the average age has been increasing for some time, and there is a lack of new entrants into the industry. Labor shortages and related challenges could have the effect of increasing transportation costs in the GLSLB in the longer term.

Opportunities and Initiatives to Improve the Performance of the GLSLB Multimodal Freight Transportation System

One of the key messages to emerge from this study and from consultations with stakeholders in the GLSLB is the need for a well-informed, coordinated, and strategic approach to planning for improving the performance of the GLSLB multimodal freight transportation system. Some of the key opportunities and initiatives for moving forward include the following.

Opportunity for better freight transportation performance data and performance measures: What gets measured gets managed. At present few public organizations in the GLSLB use or track metrics on the performance of the regional multimodal freight transportation system. This is in part due to limitations in data, which are often commercially sensitive. There is an opportunity to define regional and perhaps even continental freight data needs and develop an integrated set of available data, in a consistent format, for use by transportation planners and policy makers. Some initial work has been done by Transport Canada (TC) to collect and analyze end-to-end "fluidity" indicators to define transit times, costs, and reliability issues. This represents a significant area of future research.

Opportunity for gateway and corridor- or supply-chain–specific performance analysis: More work could be done to develop and measure the performance of key regional supply chains (e.g., coal, iron ore, grain, and other agricultural products, automotive and machinery, general cargo, including intermodal traffic, etc.) and related gateways and corridors. This would facilitate an understanding of supply-chain–specific issues and provide greater insight on how to address related performance issues, within a broader regional and indeed global multimodal freight transportation planning framework. We are aware that private-sector companies use and track end-to end network performance measures; however, this data

is typically commercially sensitive. Identifying ways to access and share some of this data would be a significant step forward in understanding the performance of key gateways, corridors, and supply chains.

Opportunity for better modal and jurisdictional coordination: At present, transportation policy and planning in the GLSLB is largely undertaken by mode or jurisdiction. Moving forward, one or more coordinating bodies could be established to work with regional and modal agencies as well as transportation providers, shippers, and their associations to work together to identify and address barriers to the performance of key supply chains and related multimodal freight transportation systems in the GLSLB and beyond. For example, a pan–North American body, coordinating both U.S. and Canadian interests vis-à-vis the multimodal freight transportation system, could go some way in doing this. However, it is recognized that such an initiative risks becoming unwieldy as a result of all interests and constraints involved. Nonetheless, there is an opportunity to review current regional and global freight transportation coordinating initiatives to identify practical opportunities for the GLSLB.

Opportunity for regional strategic framework to identify multimodal freight transportation priorities: A strategic framework can help prioritize initiatives and investment to improve the performance of the GLSLB multimodal freight transportation system. Indeed, by making priorities and objectives clearer, it would underscore tradeoffs and lead to more structured and consistent choices across competing projects. At present, there is no national transportation plan in the U.S. Canada has established a National Framework for Strategic Gateways and Trade Corridors, which is viewed as a positive model by stakeholders on both sides of the U.S.-Canadian border. Regional and national freight transportation policy makers could work together to identify broad regional, national, and continental freight transportation and economic policies, and anchor these in a strategic framework.

Opportunity for multimodal funding and funding mechanisms: Appropriate multimodal funding and funding mechanisms would helpful to support investment priorities. At present, there is no multimodal freight transportation funding mechanism in the U.S. In Canada, the Gateways and Border Crossings Fund is one model that seeks to provide funding to priority multimodal freight transportation projects that are in line with the Canadian National Framework for Strategic Gateways and Trade Corridors. The recent Transportation Investment Generating Economic Recovery (TIGER) grant program in the U.S. also provides some useful lessons for multimodal freight transportation funding.

Opportunity for greater infrastructure investment: There will always be a greater need for infrastructure investment—both public and private—to support improvements in the performance of the freight transportation system, across all modes. A number of infrastructure investment projects are planned, underway, or recently completed in the GLSLB. Examples of significant project plans (not all are funded) include the following:

- The Heartland Corridor.
- The CREATE Program in the Chicago area.
- The Detroit River International Crossing (DRIC).
- Detroit–Windsor rail tunnel to accommodate double stacking.
- Northeast CanAm Corridor.

TC is also expecting to soon announce its infrastructure investment strategy for the Ontario-Quebec Continental Gateway and Corridor.

Educating and raising awareness: There would be value in promoting greater awareness of the importance of multimodal freight transportation in the GLSLB and beyond, particularly for elected officials, but also for policy makers, planners, and researchers. Some related initiatives include North America's Corridor Coalition (NASCO) educational consortium,

which brings together institutions that play a vital role in training the next generation of transportation innovators. Other entities, including the Transportation Centers funded by the Highway Trust Fund in the U.S. and the Southern Ontario Gateway Council in Canada are also promoting awareness and education around the importance and need for regional freight transportation planning in the GLSLB.

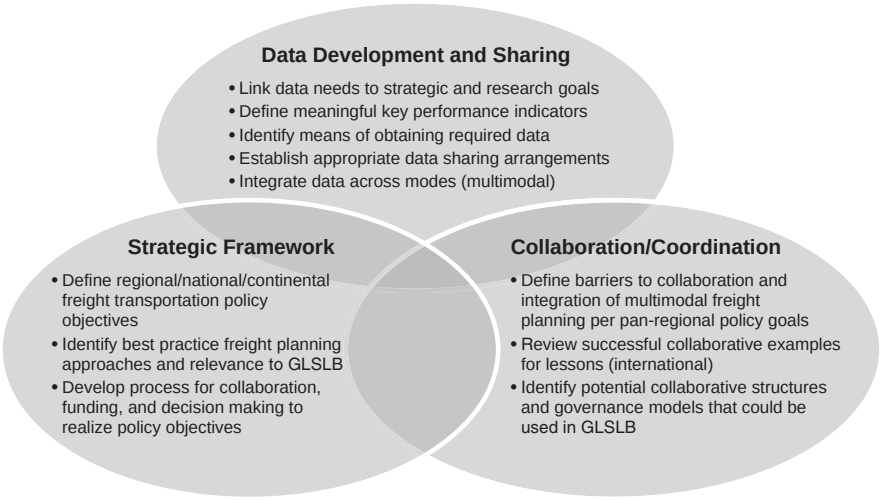
Conclusions

The multimodal freight transportation system in the GLSLB is complex. It spans numerous modes, geographies, and jurisdictions. It serves a wide variety of commodity and supply chains. In such a complex system, making informed, fact-based policy decisions can be particularly challenging. We present in this report a process framework for strategic freight planning, based on the lessons from this study. It is ambitious and in many respects represents a departure from the status quo approach to freight transportation planning in the GLSLB. It nevertheless may be a useful framework for addressing a number of the issues, barriers, and constraints noted by stakeholders consulted vis-à-vis freight transportation planning in the GLSLB.

Future Research

A number of areas for future research have been identified as part of this NCFRP Project 35 study of the multimodal freight transportation system in the GLSLB. As a point of departure, greater clarity is needed on specific regional/national/continental transportation policy objectives so that corresponding research goals and needs can be established.

Based on our consultations, significant research work could be undertaken, focused in three intertwined areas: data development and sharing, collaboration and coordination, and the development of a strategic framework to guide these efforts and freight transportation planning.



Of course, further research and analysis to address the modal barriers and constraints identified in this report will continue to be important. But more research on multimodal and supply-chain–specific performance matters is particularly needed to inform a coordinated approach to strategic policy and investment decisions that are in line with regional, national, and continental transportation policy objectives.

CHAPTER 1

Background

1.1 Project Genesis

The multimodal freight transportation system within the Great Lakes–Saint Lawrence Basin (GLSLB, or Basin, as defined in the map below) provides linkages to key gateways and corridors in the U.S. and Canada and plays an important role in connecting the economy of North America, the Heartland region in particular. The economic productivity of the Basin is dependent on the overall transportation performance of the multimodal freight system in the GLSLB.

The multimodal freight transportation network around the GLSLB comprises 15 large international ports and 50 regional ports, as well as major road, rail, airport, and pipeline connections (Figure 1-1).

Many parts of the surface transportation system around the GLSLB are capacity constrained and congested, whereas the marine assets of the GLSLB, including its waterways, are largely underutilized (albeit constrained by other impediments including regulation, physical characteristics, geography, etc.).

In order to support investment and planning initiatives, policy recommendations, and a coordinated effort to maintain an effective multimodal freight transportation system in the GLSLB, research is needed to document and better understand the contribution of the Basin to the economic vitality of North America and to help realize the total modal potential of the area.

Accordingly, in April 2010, a request for proposal was issued by TRB for a study focusing on *Multimodal Freight Transportation Within the Great Lakes–Saint Lawrence Basin* (NCFRP Project 35). In November 2010, the CPCS team was awarded the contract to undertake this research effort. The output of this study will yield clear policy, planning lessons, and supporting research tools, data[1], and analysis to be used to support future work and research to improve the performance of the regional multimodal freight transportation system.

1.2 Objectives

This study has three objectives. The first one consists of describing the current multimodal freight transportation system in the GLSLB and the importance of its performance for regional economies (i.e., Minnesota, Wisconsin, Michigan, Illinois, Indiana, Ohio, Pennsylvania, New York, Ontario, and Quebec). The second one aims to identify and define opportunities to improve the performance of the GLSLB multimodal transportation system, to the benefit of regional and

[1]In this report, the word *data* is treated as a singular mass noun, to conform to common usage.

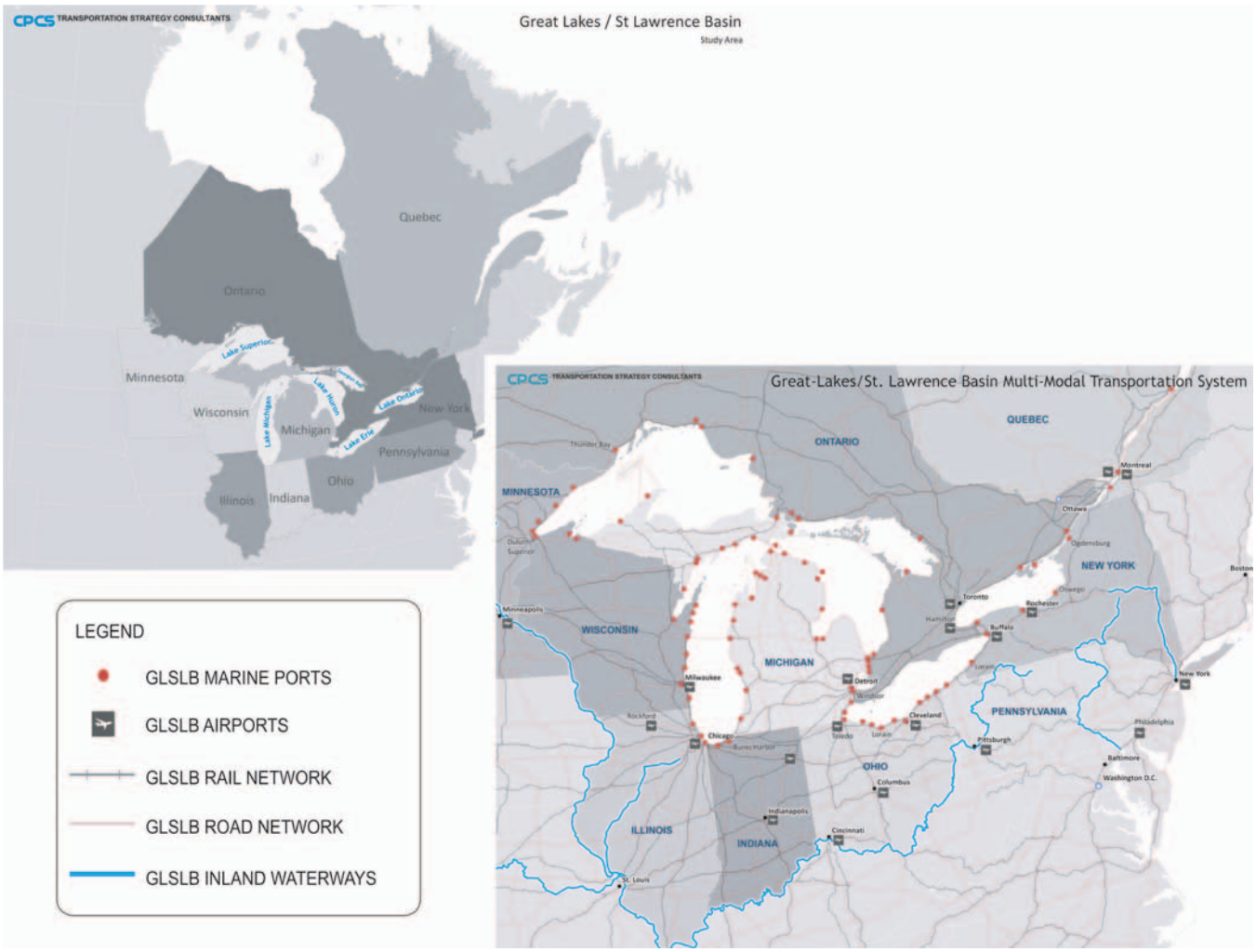


Figure 1-1. GLSLB and regional multimodal freight transportation system (Source: CPCS mapping of data from various geo-sources).

national economies on both sides of the U.S.–Canada border. The third is to promote longer-term performance improvements through further research and analysis.

The research work seeks to address the following specific key questions:

- What is the multimodal freight transportation system in the GLSLB?
- What is the economic impact of the multimodal freight transportation system in the GLSLB, by mode and major industry?
- How are public stakeholder groups encouraging the full and optimal use of the multimodal freight transportation system and what system integration barriers preclude this optimization?
- What can be done to make better use of the multimodal freight transportation system?

CHAPTER 2

Research Approach

2.1 Project Structure

The project was developed in several stages, as set out in Figure 2-1. The present Final Report is the output of Task 8, which combines earlier work developed as part of Tasks 1 through 7 of the assignment.

2.2 Methodology

The CPCS team developed interim working papers corresponding to Tasks 1 through 4, prepared an Interim Report (Task 5), conducted validation of research findings with stakeholders (Task 6), and developed a communications plan (Task 7). Together, these documents inform this Final Report. The inputs used in developing this Final Report and previous working papers include the following.

2.2.1 Previous Literature

The team completed a literature review (60+ studies) to identify existing research relevant to this NCFRP Project 35 study. The full list of studies reviewed is included in Appendix A.

2.2.2 Use of Public Data

The team drew extensively on a variety of transportation and infrastructure data, obtained from public U.S. and Canadian sources. This data was analyzed and treated to generate meaningful insights, as appropriate. In many cases, we had to manipulate data for greater consistency and comparability when obtained from different sources. Where data was obtained from different jurisdictions, the most recent data for a common period was used. In some cases, this meant using older data than may have been available in certain jurisdictions to ensure a common data year across jurisdictions. In all cases, references to source data used are provided. Relevant data has also been consolidated in a geographic information system (GIS) format.

2.2.3 Stakeholder Consultations

The team consulted extensively with relevant stakeholders in the GLSLB. The team contacted 88 stakeholders in the U.S. and Canada, 53 for which consultations were completed, representing views from all levels of government in the U.S. and Canada, all freight transportation modes and related industry associations (Figure 2-2).

A full list of the organizations consulted is provided in Appendix B. A formal consultation guide was used to solicit input from study participants. This consultation guide is included in Appendix D.

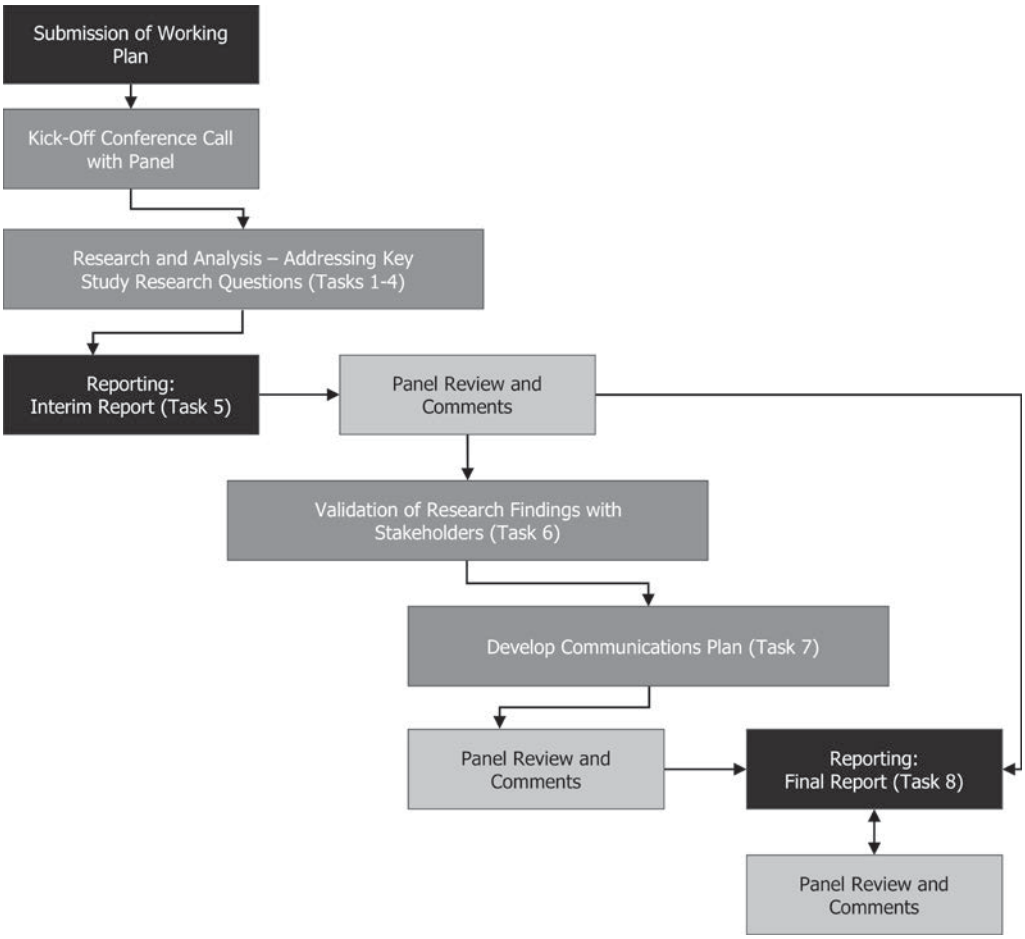


Figure 2-1. Study structure.

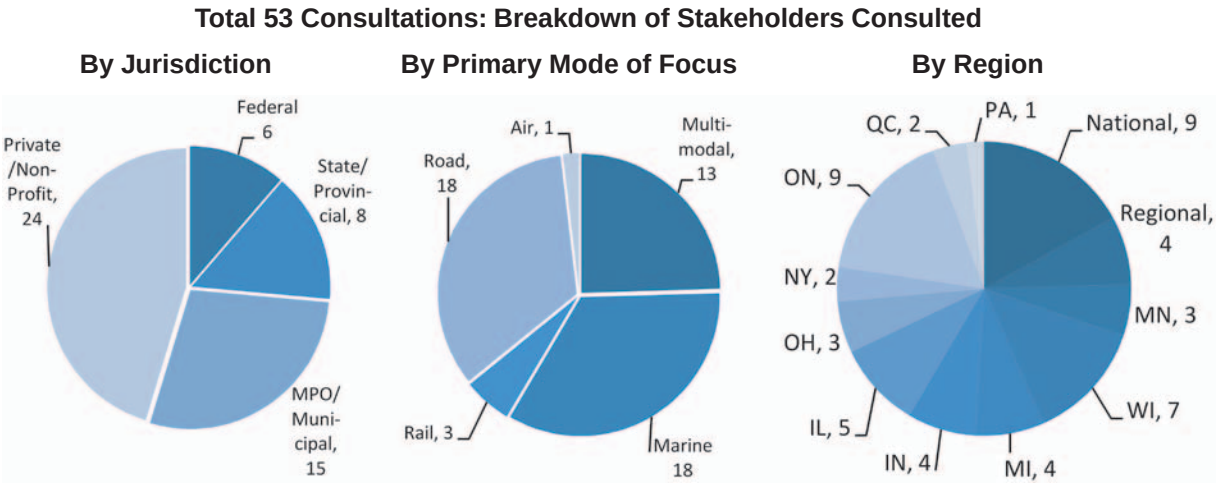
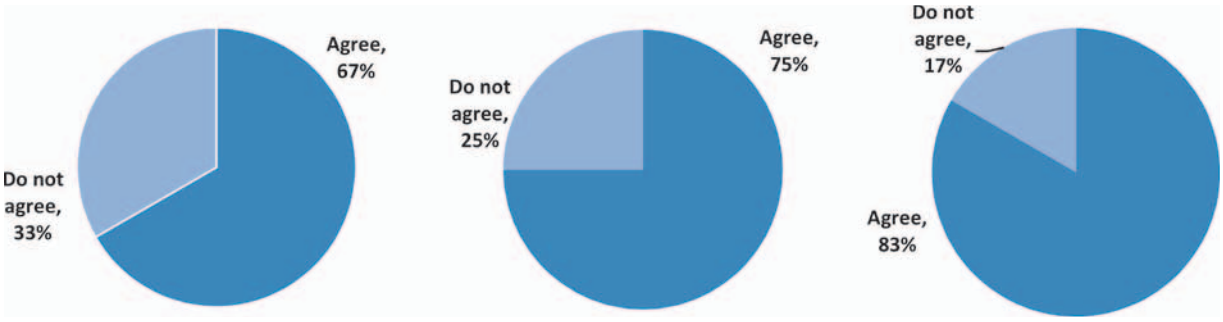


Figure 2-2. Breakdown of stakeholders consulted (Source: CPCS, based on the detailed list of stakeholders consulted).



"Do you concur with the major findings and conclusions [of the Interim Report]?"

"Do you feel this report accurately depicts the state of bi-national planning efforts between U.S. and Canada?"

"Do you agree with the recommendations for future research?"

Figure 2-3. Summary of validation process (Respondents = 12).

2.2.4 Economic Impact Analysis

The evaluation of economic impacts (Task 2) focuses on the overall economic impact of the transportation industry in the U.S. and Canada. This includes an analysis of transportation activity in the GLSLB region as well as direct and indirect impact of this activity on U.S. and Canadian economies outside the region. Standard economic methods, relying mainly on input-output models of the U.S. and Canadian economies, were used for conducting the economic impact analysis.

2.2.5 Stakeholder Validation

The Interim Report was distributed to a selection of relevant stakeholders with an interest in the GLSLB multimodal freight transportation system, including all those consulted in the preparation of the Interim Report. This survey was viewed by 108, was started by 50, and was completed by 20 of the invited participants. Additionally, a webinar was held on September 15, 2011, for interested stakeholders, oversight committee members, and consultation participants.

Respondents felt that the topic was well covered and that the supply-chain approach to defining cargo movements was helpful in coming to terms with the bigger picture of GLSLB freight flows. Some respondents, however, felt that more granularity within some commodity groupings and the addition of more definitive conclusions would have provided greater insight. Further, the need to understand and measure external costs and better formulate and explore legislative differences between jurisdictions were all seen as necessary next steps. On the whole, the majority of those surveyed as part of the validation process agreed with the major findings of the study. A greater number agreed with the general conclusions and recommendations (Figure 2-3).

2.3 Caveats and Limitations

The reader should be aware of the following caveats.

Data used in this report comes from a variety of public sources and is not in all cases comprehensive, complete, or consistent. CPCS does not guarantee the accuracy or completeness of data provided by third parties. As appropriate, CPCS did its best to ensure the reasonableness of the data used and to treat the data to be consistent (e.g., U.S. and Canadian data). In some cases,

assumptions were made to this end. Related assumptions are noted as appropriate. Confidential data was not used for this study given that the report will become public.

In terms of the consultation process, we believe that we have received input from a representative sample of stakeholders with an interest in the GLSLB multimodal freight transportation system. For the most part, those consulted asked not to be quoted or for comments to be attributed to them. Accordingly, most comments referenced are included without reference or attribution. CPCS does not guarantee the completeness of comments provided, although we did our best to ensure that key themes and issues noted by stakeholders are appropriately reflected in this Final Report.

Lastly, unless otherwise indicated, the opinions expressed in this working paper are those of CPCS, and do not necessarily reflect the views of TRB, the governments of the U.S. and Canada, or other stakeholders in the GLSLB.

CHAPTER 3

Findings and Applications

3.1 GLSLB: Regional Context

3.1.1 Economic Importance of the GLSLB Region

The markets and population bases around the GLSLB are substantial, as are the transportation needs derived from these markets. Twenty-eight percent of American economic activity (in eight states) and 58% of Canada's economic activity (in two provinces) is based around the GLSLB (Figure 3-1). As a whole, the GLSLB region accounts for 30% of the combined U.S.-Canada economic activity.

3.1.2 Demographic Importance (Markets)

The same is true in terms of population, with the GLSLB accounting for 27% of the American population and 62% of Canada's (Figure 3-2). In 2009, the GLSLB region accounted for 30% of the combined U.S.-Canada population. Five cities of more than 1 million people are in the GLSLB region, of which three are in the United States (New York, Chicago, and Philadelphia) and two in Canada (Toronto and Montreal). An additional 16 cities have population of 250,000 or more (12 in the United States and four in Canada). In Canada, four of the five largest GLSLB cities have direct water access to the GLSLB for freight transportation. In the United States, Chicago is at the heart of regional transportation activity, with a port on Lake Michigan and the most significant rail infrastructure in North America. Another five U.S. cities with population above 250,000 have direct access to the Great Lakes (Figure 3-3).

3.2 Economic Importance of the GLSLB Multimodal Freight Transportation System

The United States and Canada are among the world's most trade-dependent nations. Their continued prosperity depends fundamentally on their ability to efficiently transport goods. The GLSLB multimodal freight transportation system has a primary role in supporting local, regional, and international trade and economic activity.

3.2.1 The Impact of Freight Industries

In 2007, freight transportation industries in the GLSLB, as a productive sector of the economy, employed over 1 million individuals, generated $200 billion in gross output, $88 billion in GDP, and $59 billion in personal income. These industries also directly contributed $24 billion in taxes.

When indirect and induced effects are included, the impact is much larger. The overall economic impact in the region and beyond (direct, indirect, and induced) of GLSLB freight transportation industries in 2007 was estimated at 3.8 million jobs, $627 billion in gross output, $311 billion

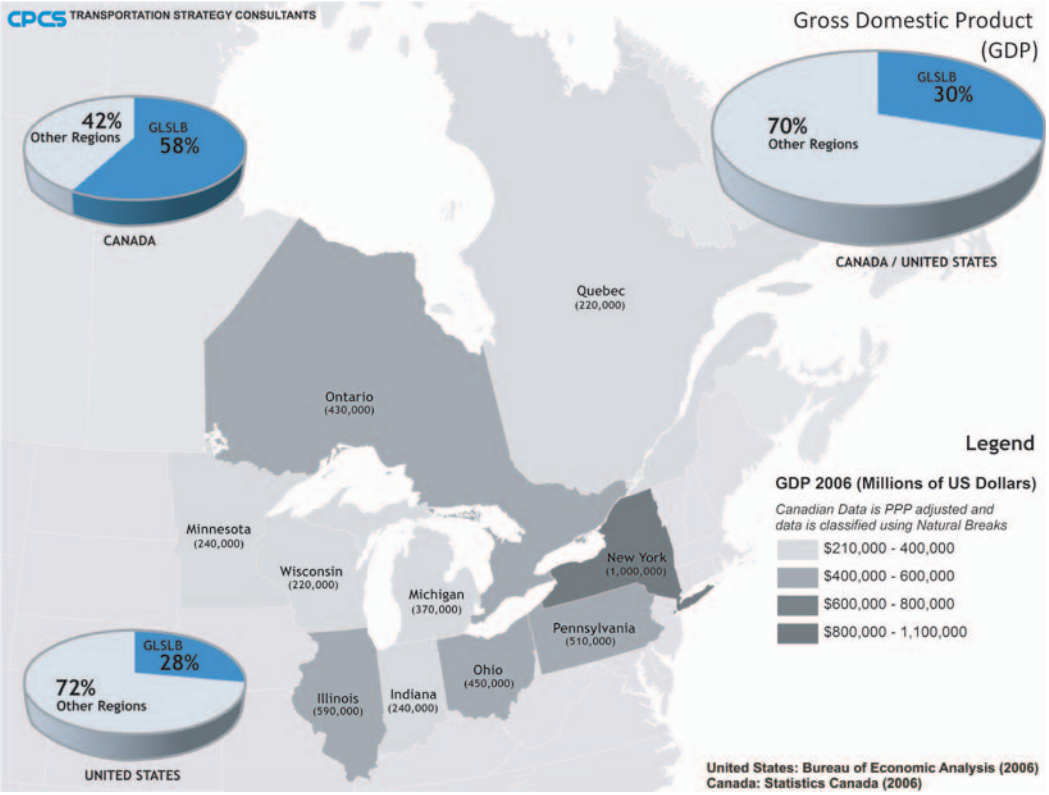


Figure 3-1. Economic importance of the GLSLB region in Canada and the United States, 2006 (Source: Bureau of Economic Analysis and Statistics Canada).

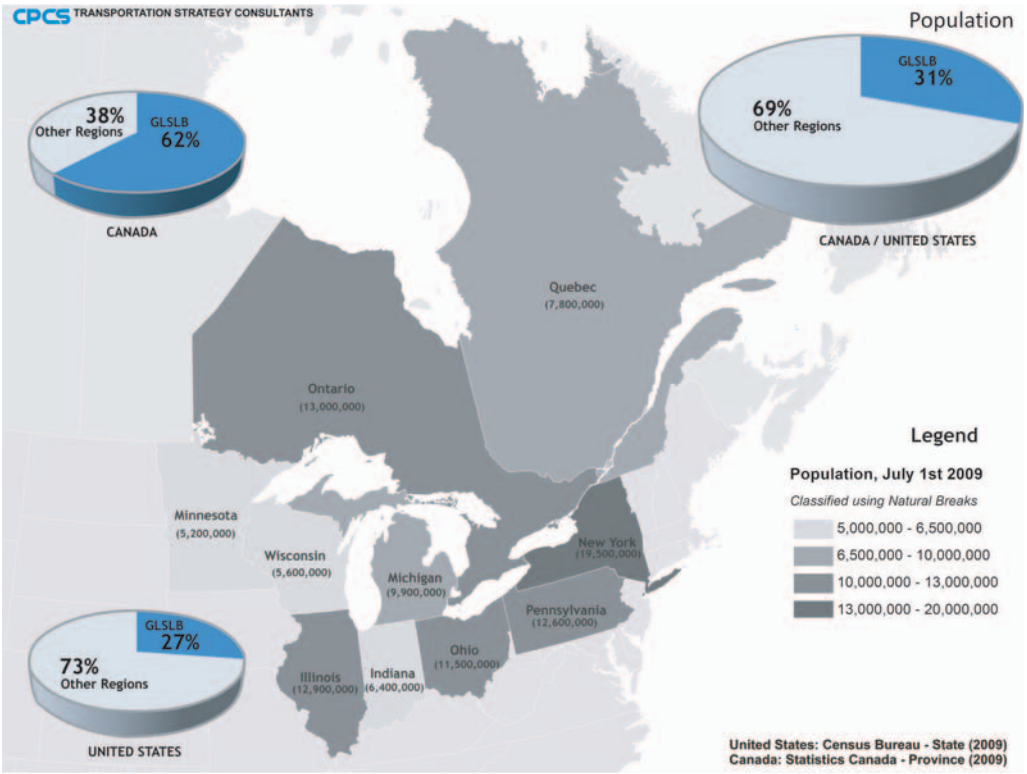


Figure 3-2. Demographic importance of the GLSLB region in Canada and the United States, 2009 (Source: Census Bureau and Statistics Canada).

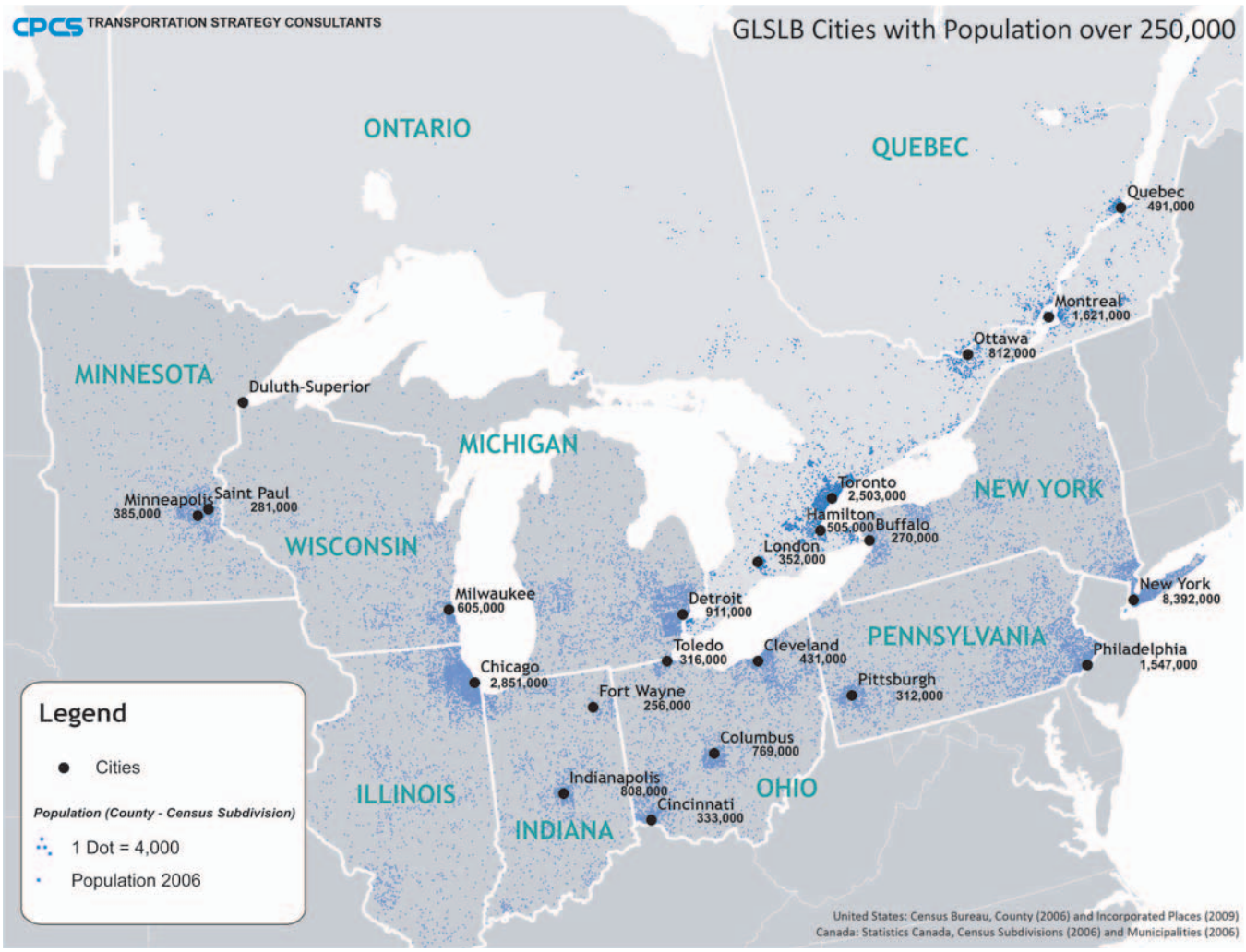


Figure 3-3. Population distribution in the GLSLB region (Source: Census Bureau and Statistics Canada). *This selection of cities is used for mapping purposes throughout the report.

in GDP, $200 billion in personal income, and $87 billion in taxes. Just over half of the freight output in the region occurred in the trucking industry, over 4% in marine transportation, about 3.3% accrued due to pipelines, 11% in the rail freight industry, and the remaining 26% in air cargo.

New York and Ontario are the state and province in the GLSLB region with the largest shares of freight transportation, direct employment, and output in the region. New York accounted for 18% of the region's direct freight transportation employment and 19% of freight transportation output (Figure 3-4). Ontario accounted for an additional 16% of GLSLB freight direct employment and output.

Through indirect and induced spending, freight activity in the GLSLB region generates indirect and induced effects in the rest of the U.S. and Canada of more than 1.1 million jobs, $182 billion in output, $90 billion in GDP, and $54 billion in personal income.

3.2.2 Supply-Chain Impacts

In addition to being a producing industry, transportation plays a unique role in supporting economic activity by delivering the necessary inputs for production as well as moving intermediate

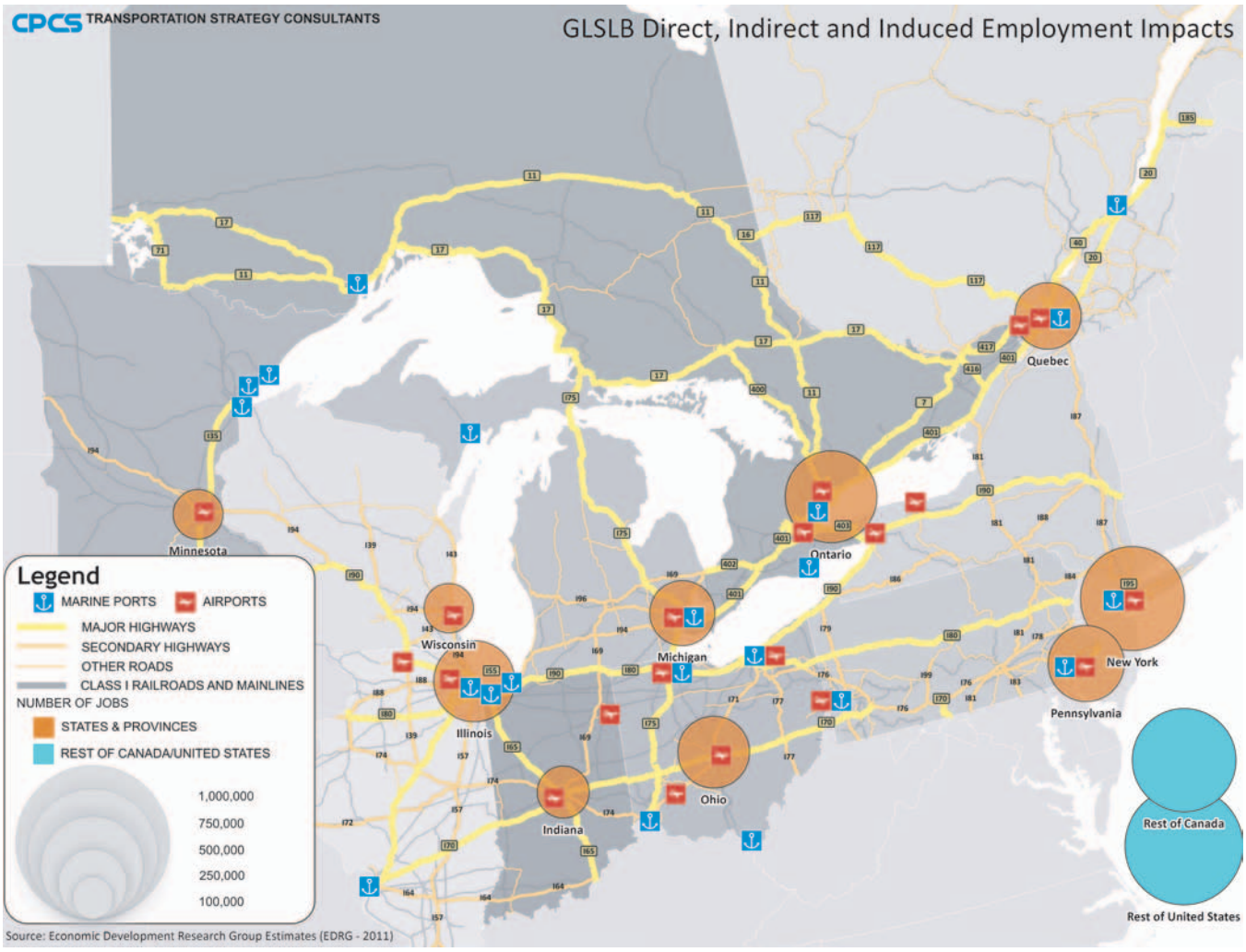


Figure 3-4. Total employment impacts of GLSLB freight industries by geography (Source: CPCS mapping of underlying data developed by Economic Development Research Group).

and final production to markets where goods are consumed. This analysis may be thought of as "supply-chain" impact. The concept of "supply-chain" impact recognizes that in addition to the direct impact of output from freight providers in the freight industry itself, economic impact is created by "upstream" producers and "downstream" consumers of goods carried. More specifically, the supply-chain impact analysis answers the following question:

> *"Given existing supply chains and commodity flows supported by the GLSLB transportation system, what is the relative economic importance of these supply chains for the GLSLB economies?"*

For this purpose, commodity flows using the GLSLB transportation system are categorized as supporting one of three potential types of supply chains[2]:

1) **Regional:** Movement of commodities across or within GLSLB states and provinces.
2) **National:** Movement of commodities between the GLSLB and the rest of Canada or the United States.
3) **International:** Movement of commodities between the GLSLB and countries other than Canada and the United States.

[2]Through traffic, that is, traffic that does not stop in the GLSLB at any point, is not accounted for in this analysis.

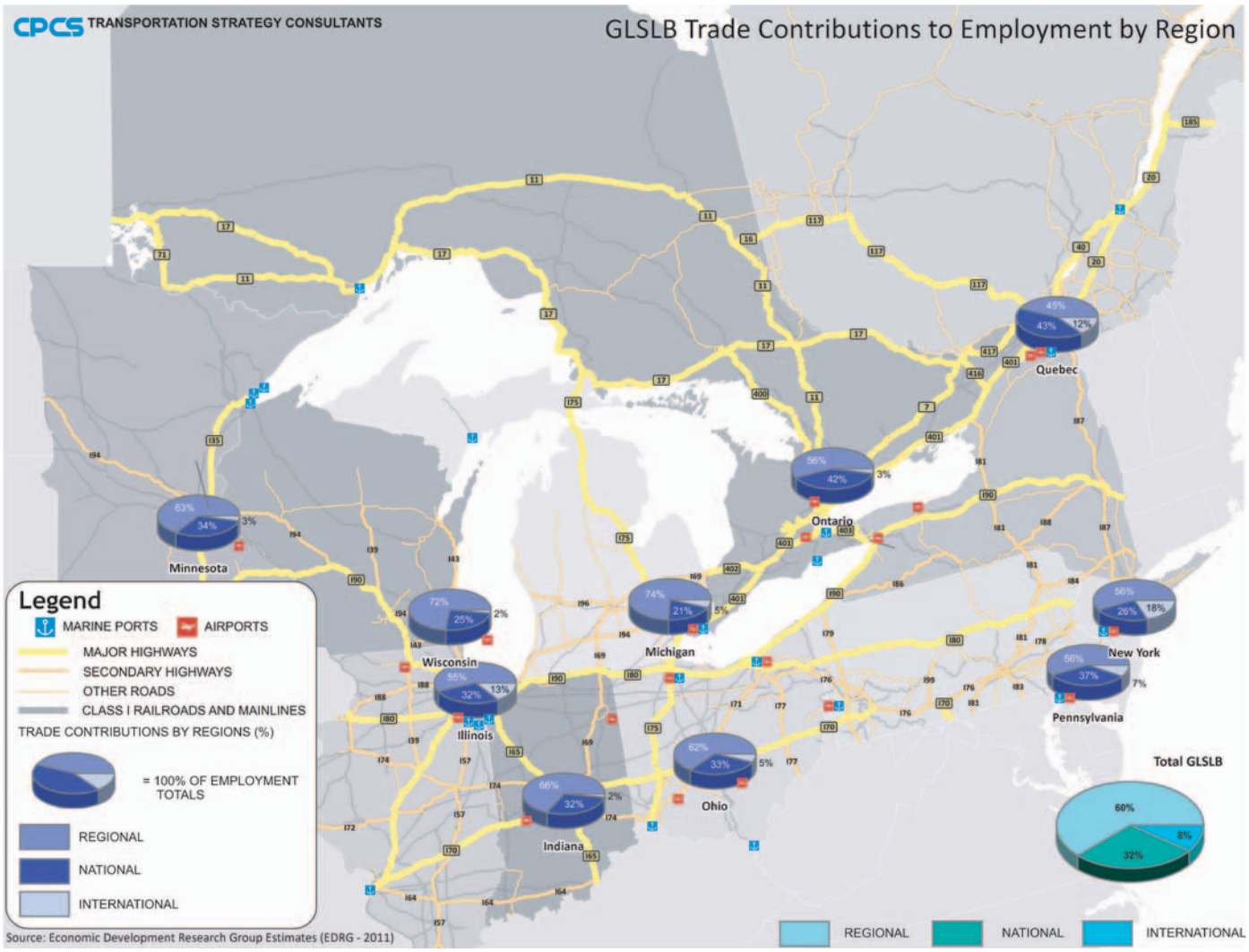


Figure 3-5. GLSLB employment reliance on international, national, and regional trade and supply chains (Source: CPCS mapping of data developed by EDRG).

Each of these supply chains uses a different mix of modes, supports different industries, and has a different set of economic impacts on the region. In the GLSLB as a whole, 60% of total employment can be attributed to regional commodity flows (mostly intra-state and intra-provincial flows), 32% to national trade, and 8% to international trade, roughly in line with the value of goods shipped through each supply chain. Figure 3-5 provides an overview of the relative importance of each supply chain for each GLSLB state and province.

These supply-chain variations are reflected in the importance of each mode for GLSLB economies. While all GLSLB state and provincial economies relied primarily on trucking, rail also supported a large number of jobs in Ontario, and air transportation supported nearly 100,000 jobs in New York State.

3.2.3 Economic Impacts of Particular GLSLB Supply Chains

An important feature of the GLSLB is the heavy cross-border economic integration. Assessing the economic significance of transborder flows within the GLSLB is thus particularly interesting. As a share of overall commerce among Great Lakes states and provinces, transborder

flows represent only 6% of the value of goods being shipped. Their economic importance, however, well outweighs their value. Indeed, they account for 25% of total employment impacts (i.e., 5.4 million of the 22.2 million jobs generated by all commodity flows within the region) and 26% of value-added impacts. Similar levels of economic importance are noted for output and income.

Pushing the analysis to particular origin–destination (O–D) pairs within the GLSLB region provides a clearer picture of trade patterns and economic dependencies. It reveals that the most significant regional transborder trading pair is Ontario and Michigan, which alone account for over 1.4 million jobs, $513 billion in output, $139 billion in value-added, and $103 billion in personal income. This is not surprising given the tight cross-border integration of the automotive industry in this region.

Similarly, it is unsurprising that motor vehicles are the commodity with the largest economic impact in the regional trade of the region, accounting for 10% of regional trade employment impact, 17% of output, and 12% of value added.

3.3 Description of the GLSLB Multimodal Freight Transportation System, by Mode

This section provides an overview of each mode in the GLSLB multimodal freight transportation system, and related characteristics. A multimodal perspective is provided in a later section.

3.3.1 Marine

3.3.1.1 System

The marine component of the GLSLB multimodal freight transportation system comprises 15 large international ports, 50 regional ports, the Great Lakes–St. Lawrence Seaway System (GLSLSS) and its 19 locks, and a network of inland waterways, including, in particular, the Mississippi River with its major tributaries of the Ohio and Illinois Rivers (Figure 3-6).

3.3.1.2 Traffic

It is estimated that more than one billion tons of cargo moves annually by water through the GLSLB. About 40% of that cargo is handled by U.S. waterways; another 30% via deep-water ports in New York, Pennsylvania, and Quebec; and 30% by Great Lakes–St. Lawrence System (GLSLS) ports upstream of the Port of Montreal. The overall marine transportation system serves a mix of domestic U.S., North American, and overseas markets, and caters to a wide range of vessels, including lakers, tankers, multi-purpose, container, and cruise ships. Several key industries rely on water transportation for their inputs, including the grain, auto, and steel industries. It is also of critical importance to industries needing to move bulk commodities in high volumes, particularly iron ore, coal, petroleum, chemicals, and cement. Figure 3-7 provides an overview of traffic handled by key ports in the GLSLB while Figure 3-8 provides an overview of traffic moving along the waterways in the GLSLB.

3.3.1.3 Major Commodities

The majority of traffic moving by water in the GLSLB is heavy, bulk commodities, including natural resources. In terms of tonnages by commodity, it is estimated that coal accounted for 24% of marine traffic in 2007 (Figure 3-9). Minerals, a category dominated by iron ore and, to a lesser extent, sand, gravel, and stone, accounted for 32% of traffic in 2007. Fuels and basic chemicals (mostly crude petroleum) and agricultural and food products

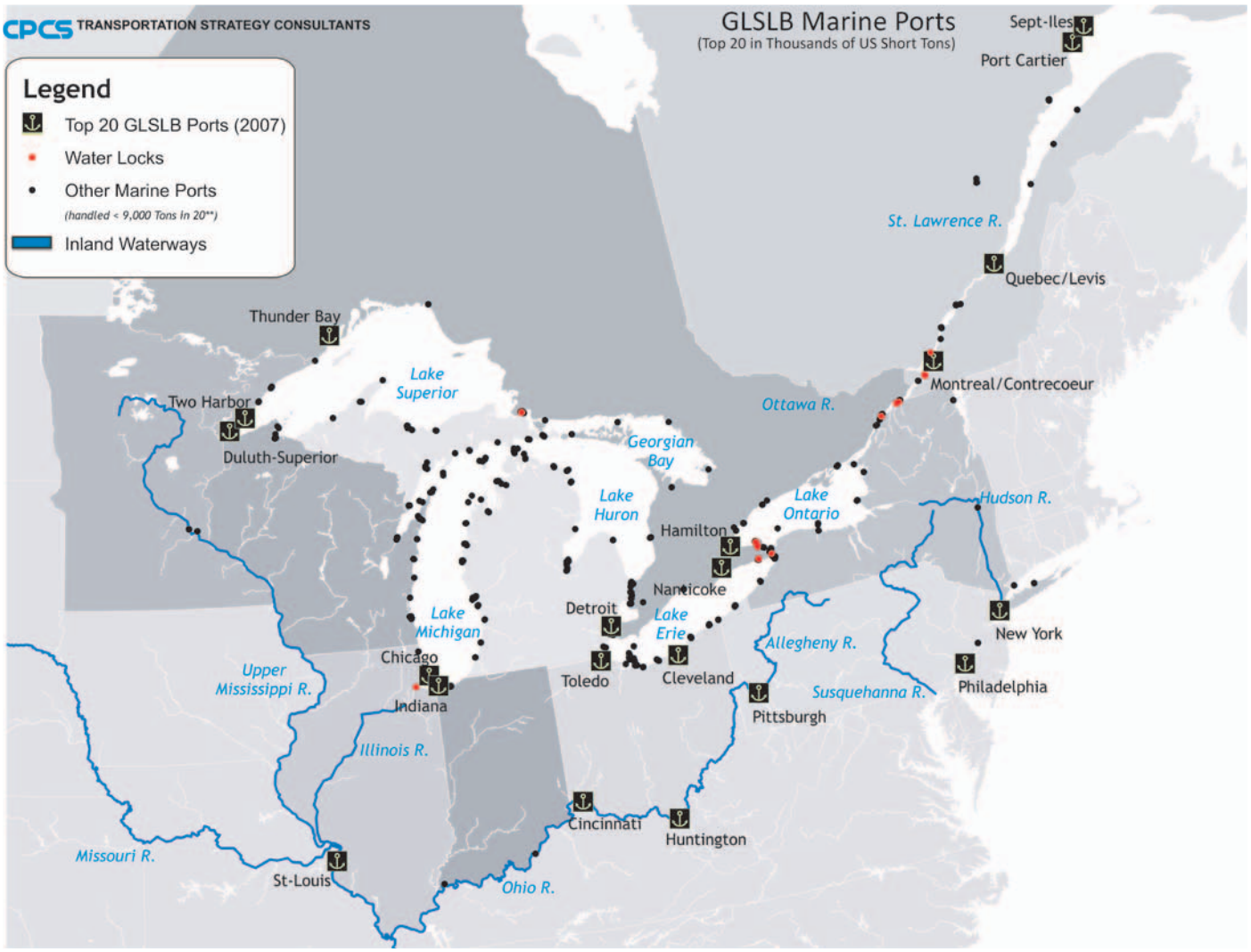


Figure 3-6. GLSLB marine ports and major inland waterways (Source: U.S. Bureau of Transportation Statistics).

(mostly grains, in particular corn and wheat) accounted for 11%. Other products, including manufactured products, equipment, forestry and paper products, and metal products, accounted for only 10% of total tonnages.

3.3.1.4 Trends

The continued movement toward larger ships for international traffic, coupled with the physical limitations of the lock system, means that deep-sea ports are likely to see their tonnages grow more rapidly than Great Lakes ports. The modal forecast for the GLSLB and the rest of the marine sector for the U.S. and Canada suggests a continuation of this trend. In 2020, the share of GLSLB traffic in total marine traffic in the U.S. and Canada is expected to be 30%, down from 37% in 2001 (Figure 3-10). The expansion of the Panama Canal is not expected to have a major impact on GLSLB ports, maybe with the exception of the Port of New York/New Jersey.

3.3.1.5 Performance

We assess performance of the marine sector (and other sectors subsequently) in terms of capacity, efficiency, competitiveness, safety, and environmental sustainability. It is recognized

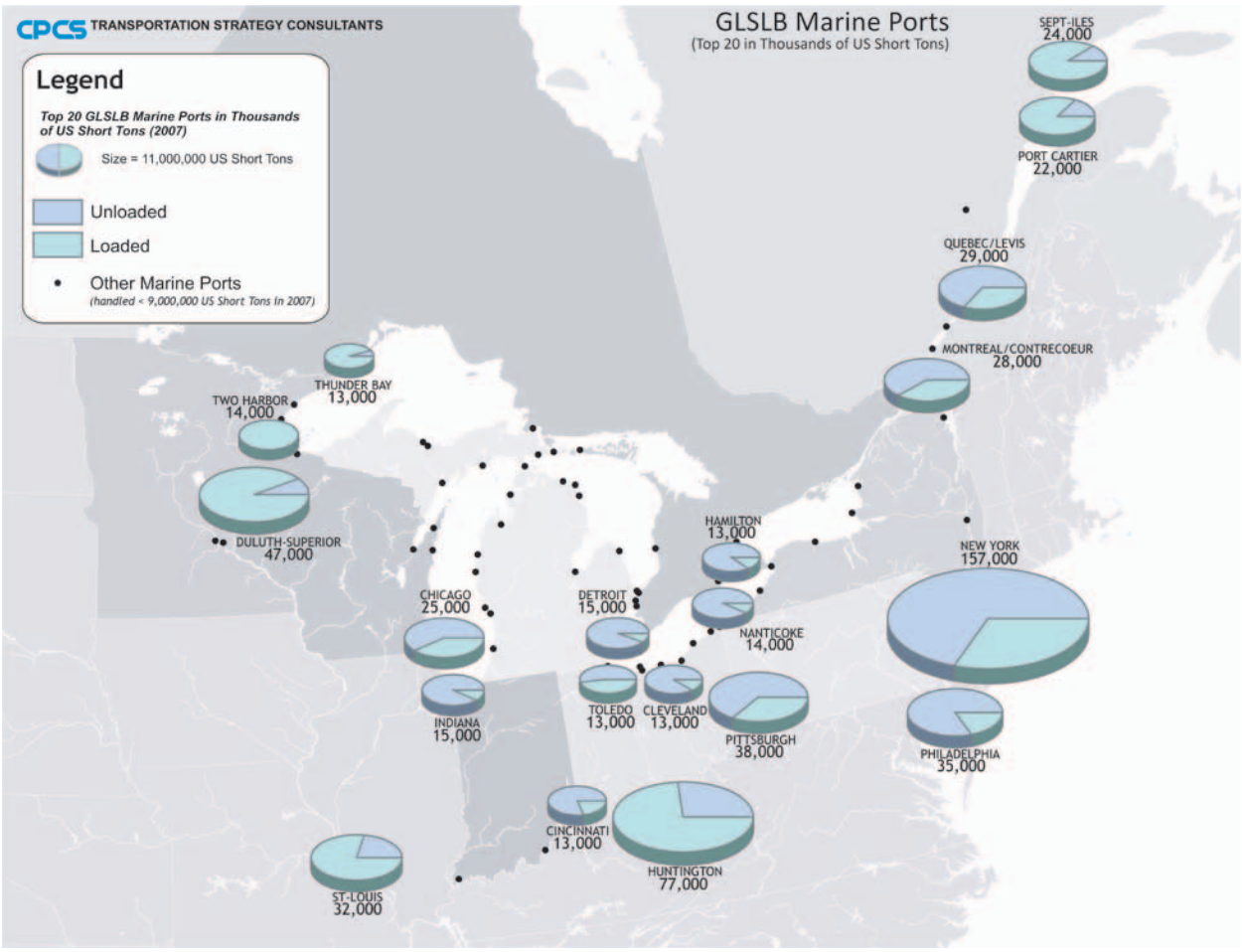


Figure 3-7. Tonnage loaded and unloaded at major GLSLB ports, 2007 (Source: USACE, Statistics Canada).

that performance can be a function of much more than these factors, but these provide a practical basis for providing an overview of performance.

Capacity. The marine sector in the GLSLB is typically described as under capacity. All major ports surveyed said they had available capacity, and more than half (56%) said that they had significant available capacity (Figure 3-11).

While these findings include only a sample of ports, the available capacity in GLSLB ports is expected to be common to most ports.

Capacity constraints on the waterways in the GLSLB are not related to traffic volumes (demand), per se, but by the physical attributes of the GLSLB waterway system, including, but not limited to, issues of water depth, lock size in seaways, and the Mississippi River system, the closure of the St. Lawrence Seaway three months of the year, a host of regulatory barriers, and other issues described in a later section.

Efficiency and Competitiveness. The GLSLB marine system is most competitive for carrying heavy and low-value bulk and liquid bulk traffic (i.e., traffic already moving on waterways). For intermodal container or roll-on/roll-off (RORO) traffic, the waterways have proven less competitive for a host of reasons (slower transit times, lower frequency of service, increased

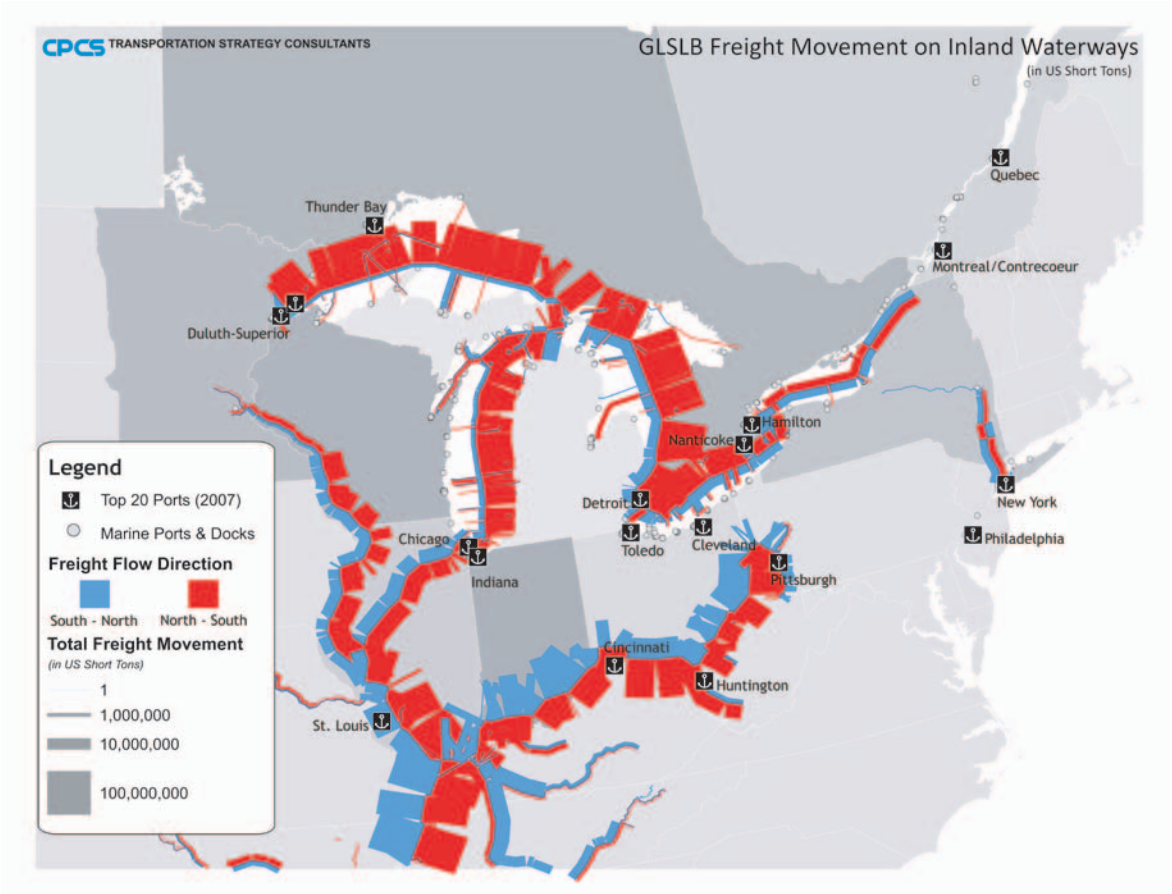


Figure 3-8. Total tonnage moved on inland waterways in the GLSLB, 2007 (Source: USACE, Natural Canada).

handling requirements, closure of St. Lawrence Seaway for three months of the year, regulatory barriers, perception, competition from railways, etc.). There is, nevertheless, great interest among GLSLB ports and St. Lawrence Seaway stakeholders to increase the competitiveness of the marine mode, particularly for the movement of containers.

Safety and Environmental Sustainability. From a safety standpoint, the number of incidents and accidents are generally lower for marine transportation versus other modes. This is also the

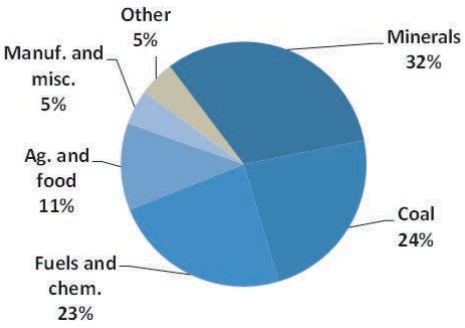


Figure 3-9. Tonnage by commodity in the GLSLB, 2007 (Source: USACE, Statistics Canada).

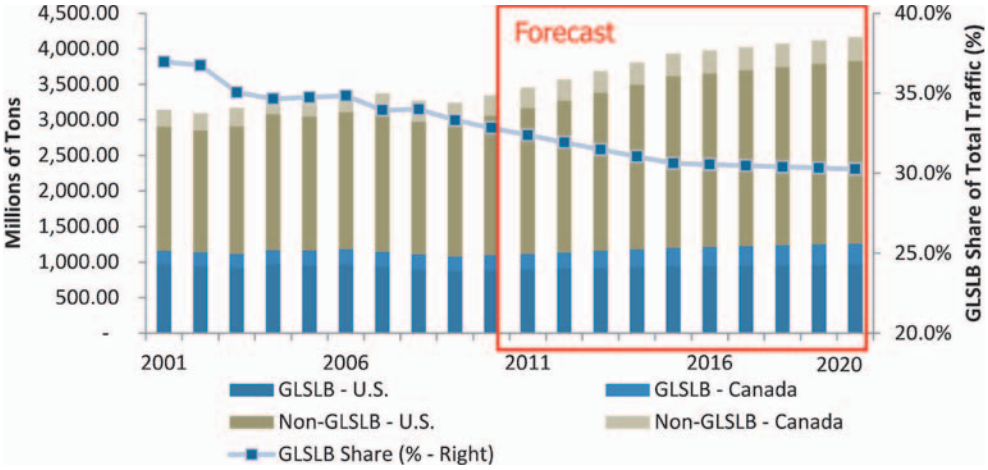


Figure 3-10. Trends and forecast for tonnage handled in GLSLB marine network, 2001–2020 (Source: U.S. FHWA, Statistics Canada).

case in the GLSLB specifically. Among other factors, the safety record of the marine mode is related to the lack of congestion on open waters and the extensive training/certification required for marine workers. Transportation by water is also significantly more fuel efficient than other modes and consequently could reduce the emission of greenhouse gases and other pollutants. Other environmental externalities (noise, accidents, spills, etc.) are also generally lower on a per ton-km basis than other modes.

3.3.1.6 Barriers and Constraints to Performance

With the system utilization below capacity, it is not the availability of marine transportation hindering its adoption, but rather a host of constraints—physical, regulation, governance, geography, and perception, among others. These barriers raise operational costs and the costs of entry and investment substantially for both shipping lines and shippers. Notable barriers include:

Jones Act: perceived as one of the most onerous regulatory constraints, the Act restricts cabotage in the U.S. to domestically built, flagged, staffed (75% of crew) vessels. Similar cabotage restrictions exist in Canada.

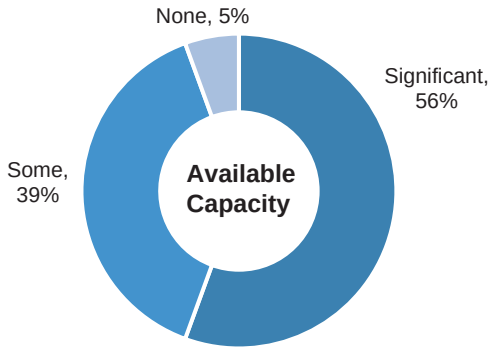


Figure 3-11. Capacity availability of surveyed GLSLB ports, 2011 (Source: CPCS Analysis, based on input from surveyed ports).

Harbor Maintenance Tax: a value-based tax levied on cargo discharged in U.S. ports. Many have argued that this makes marine transport less competitive than land-based transportation, which doesn't pay Harbor Maintenance Tax (HMT).

Pilotage: the mandatory use of marine pilots in many parts of the GLSLB marine system can represent a significant cost. This is a cost not incurred by competing modes, thereby rendering marine transportation less competitive.

Seasonality: the 3-month closure of the St. Lawrence Seaway from late December to late March, due mainly to maintenance and ice, discourages shippers from using multimodal marine transportation as this implies reorganizing supply chains in winter months.

Ballast Water Regulations: the threat of New York ballast water regulations, which are more stringent than available technology, may prevent the movement of marine vessels through the Seaway, in/out of the Great Lakes.

Dredging: inadequate dredging in some GLSLB harbors has resulted in the build-up of sediment, limiting draft, and leading to lightering and lower payloads in serving several GLSLB ports.

Governance and Communication: the GLSLB marine system is affected by a large number of governing bodies that make it difficult to establish any sort of unified and strategic mandate and coordination of services for the waterway, leading to inefficiencies in services and increased costs for users of the GLSLB marine transportation system.

3.3.1.7 Initiatives and Opportunities to Improve Performance

There are many opportunities for marine transportation. Many studies have been undertaken to identify measures to improve the sector's performance and competitiveness, including the U.S. Maritime Administration's (MARAD) *Great Lakes Fleet Revitalization Study*, and TC's recent *Hub-and-Spoke Container Transhipment Operations of the Marine Movement of Freight (Short Sea Shipping)*.

Other notable initiatives consist of: Highway H20 (a bi-national marketing initiative to promote the benefits of the GLSLB marine transportation system), Green Marine, and the Ballast Water Collaborative that was formed to allow industry stakeholder collaboration with regulators on the issues of Aquatic Invasive Species (AIS).

Technological innovations touched on in consultations include hands-free mooring in the Seaway lock system, radio-frequency identification (RFID) tracking, and improved emissions controls and scrubbers.

3.3.2 Rail

3.3.2.1 System

The rail component of the GLSLB multimodal freight transportation system comprises seven Class 1 railways, totaling 30,778 miles of track and 68 intermodal terminals (Figure 3-12).

3.3.2.2 Traffic

Approximately 1.17 billion tons of cargo originated from or was destined to a rail terminal located in the GLSLB in 2007. One-third of that traffic was moving within the region (374 million tons), with the other two-thirds moving from or to the region from/to elsewhere in North America (795 million tons). There are important differences across jurisdictions. For example, while

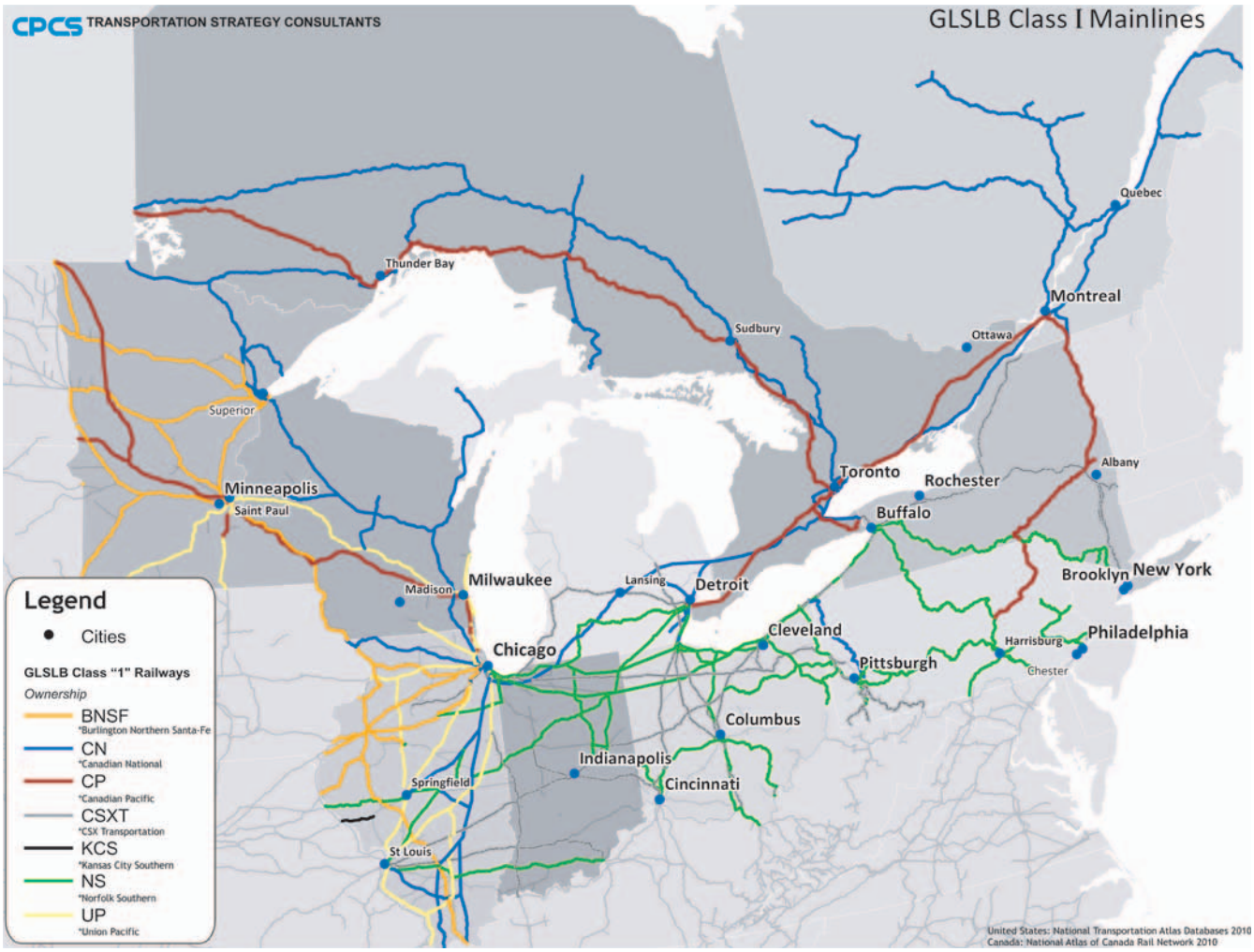


Figure 3-12. GLSLB rail network, Class 1 core network (Source: U.S. Bureau of Transportation Statistics, Railway Association of Canada).

Wisconsin has nearly five times more inbound than outbound rail traffic, Indiana has roughly balanced tonnages.[3]

Figure 3-13 provides an overview of traffic handled by railways in the GLSLB. Figure 3-14 provides an illustration of trade value at GLSLB rail border crossings.

3.3.2.3 Major Commodities

By tonnage, the major rail commodity movements are similar to those of the marine sector. Coal is the main commodity, accounting for 44% of total tonnage but less than 2% of the value of goods transported in the GLSLB. It is followed by iron ore (11%), which moves mainly within Canada from mine to port. In terms of value, vehicles and parts (30%) and manufactured goods (27%) account for the bulk of the traffic. Most of the rail traffic, when measured in value, moves in containers (Figure 3-15). Indeed, based on the commodity groupings, we estimate that more than 70% of rail traffic value is containerized.

[3]Wisconsin's imbalance was created when this state lost the Wisconsin Central Railroad which was a Class 3 carrier focused on local industry. Once purchased by a multi-national carrier whose business model favored long-haul traffic, rail freight balance in Wisconsin suffered.

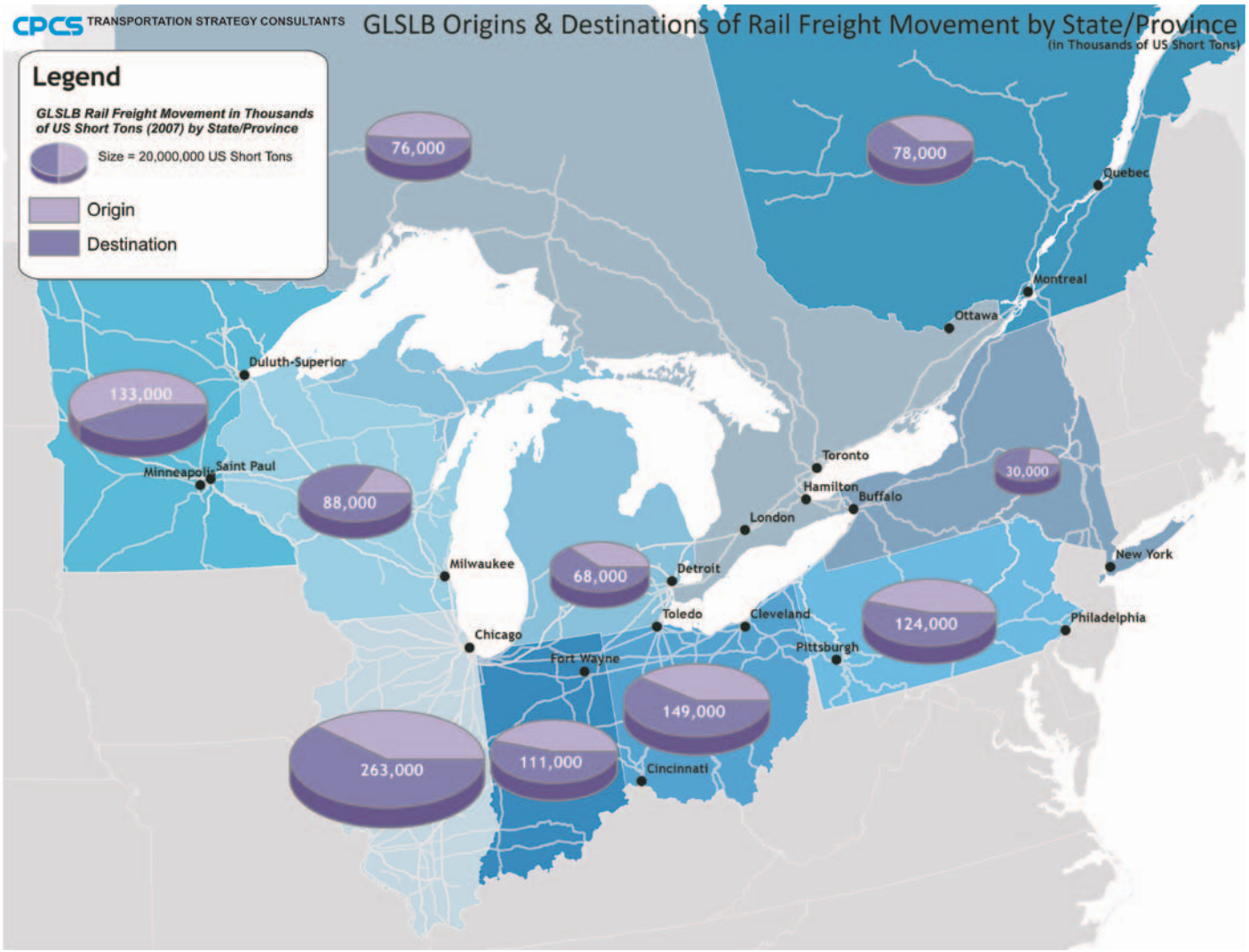


Figure 3-13. Rail tonnage by GLSLB state and province, 2007 (Source: Association of American Railways, Statistics Canada).

3.3.2.4 Trends

GLSLB rail traffic has increased annually, except in 2008 when it decreased with the economic downturn. The share of the GLSLB rail traffic has been fairly stable (between 52% and 53%) and it is expected to continue to be so. The forecast for the GLSLB and the rest of the rail sector in Canada and the United States suggests slow but consistent growth: 2.3% and 0.9% for the 2009–2015 and 2015–2020 periods in the United States, and 2.8% and 1.3% respectively in Canada (Figure 3-16).

In low population areas such as the Upper Peninsula of Michigan, some short-line carriers have taken actions to abandon rail lines. These actions are as a direct result of mill closings and the loss of businesses using rail. Many short lines struggle with low-density lines, especially in areas with many bridges.

3.3.2.5 Performance

Railway performance is driven by private-sector operations and investment, perhaps more so than roads, which are largely publicly planned and funded. Again, performance is assessed

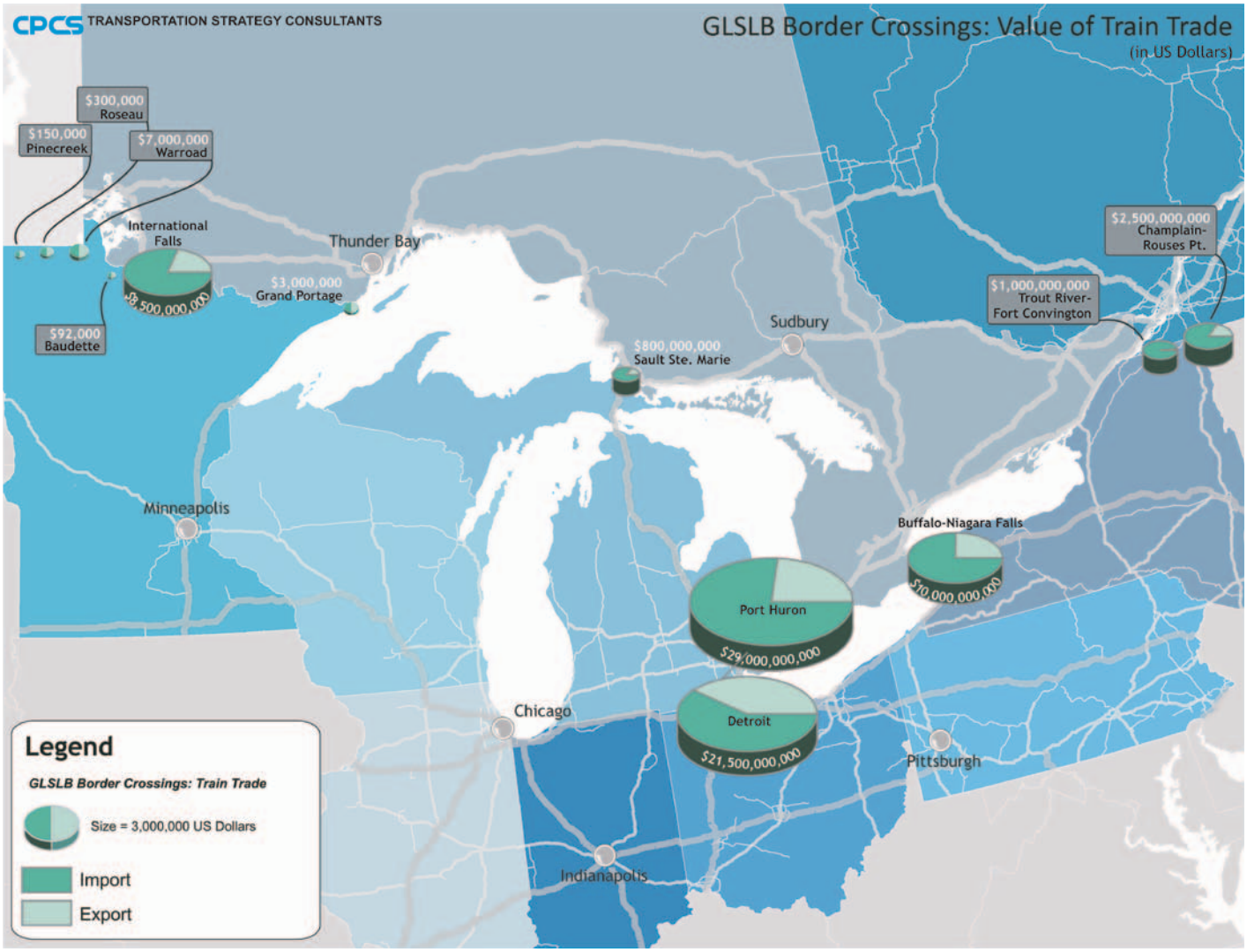


Figure 3-14. Trade value at GLSLB rail border crossings, 2007 (Source: BTS North American Transborder Freight Data).

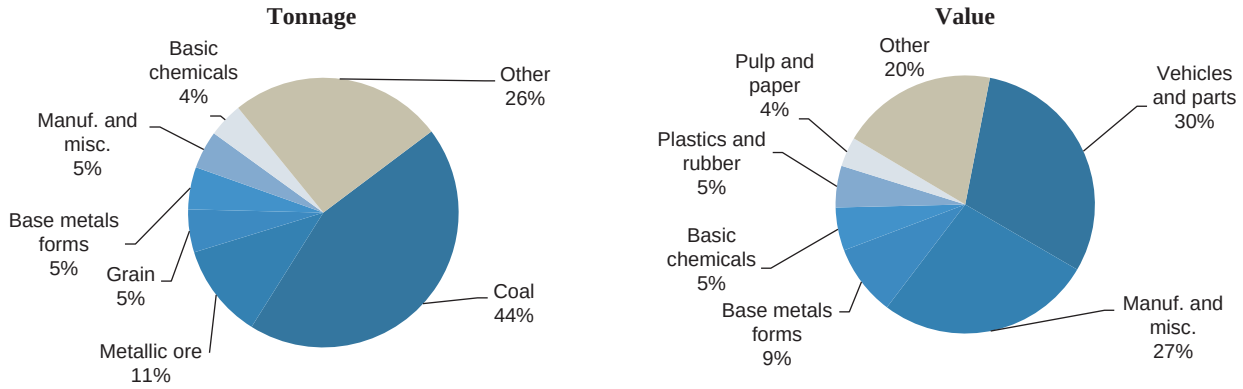


Figure 3-15. Relative importance of GLSLB rail traffic by commodity, in tonnage and value, 2007 (Source: Surface Transportation Board, Statistics Canada, U.S. FHWA).

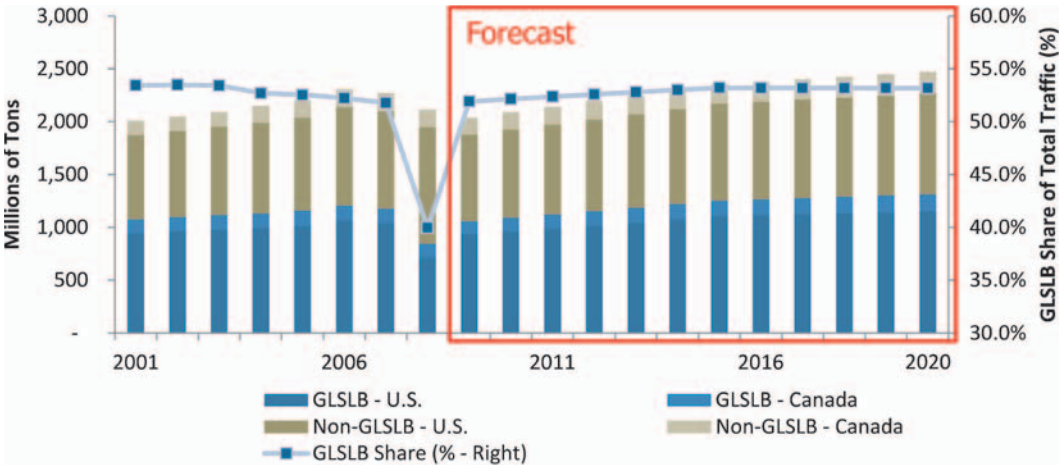


Figure 3-16. Trends and forecast for tonnage handled in GLSLB rail network, 2001–2020 (Source: Transportation Situation and Outlook Report 2007).

here in terms of capacity, efficiency, competitiveness, safety, and environmental sustainability (Figure 3-17).

Capacity. Corridor capacity issues on the GLSLS network are most acute in the Chicago area. Without appropriate investment, these concerns are expected to spread to entire corridors as freight demand increases in the future.

In an assessment of the long-term capacity expansion needs of the continental U.S. freight railroads, the Association of American Railways (AAR) estimated that an investment of $150 billion for rail infrastructure expansion and improvement was needed between 2007 and 2035 to keep pace with expected growth in rail traffic. Of that amount, about $135 billion is related to Class 1 railway networks.

Efficiency and Competitiveness. Over the past 20–30 years, Class 1 railroads have rationalized their operations to increase productivity by focusing on core corridors with line-haul rail labor productivity more than doubling (a 135% increase) between 1987 and 2008 in the United States. Rail operations in Canada followed a similar trend.

While increased productivity was good in terms of rail efficiency, it did not necessarily improve the competitiveness of the railway on all fronts. Indeed, the focus on efficiency and rationalization by railroads, while keeping costs down, also had the effect of reducing the level and quality of service for some shippers.

Safety and Environmental Sustainability. Overall, rail-related incidents have decreased in the U.S. and Canada over the past 10 years, and the GLSLB region followed a similar, albeit less pronounced, trend. In terms of environmental efficiency, rail is much less CO_2-intensive than truck and air transportation, but is generally more CO_2-intensive than marine shipping and pipelines. Assuming one-third of the rail traffic in Canada and the United States occurs in the GLSLB, 7.4 million tons of CO_2 (6.7 million metric tonnes) and 2.42 billion gallons of fuel consumption are reduced each year from the trucking mode.

3.3.2.6 Barriers and Constraints to Performance

Rail sector performance constraints and barriers can be divided into six categories. Although most of these issues may not be necessarily specific to the GLSLB region, they reflect concrete challenges faced by planners and stakeholders in the GLSLB.

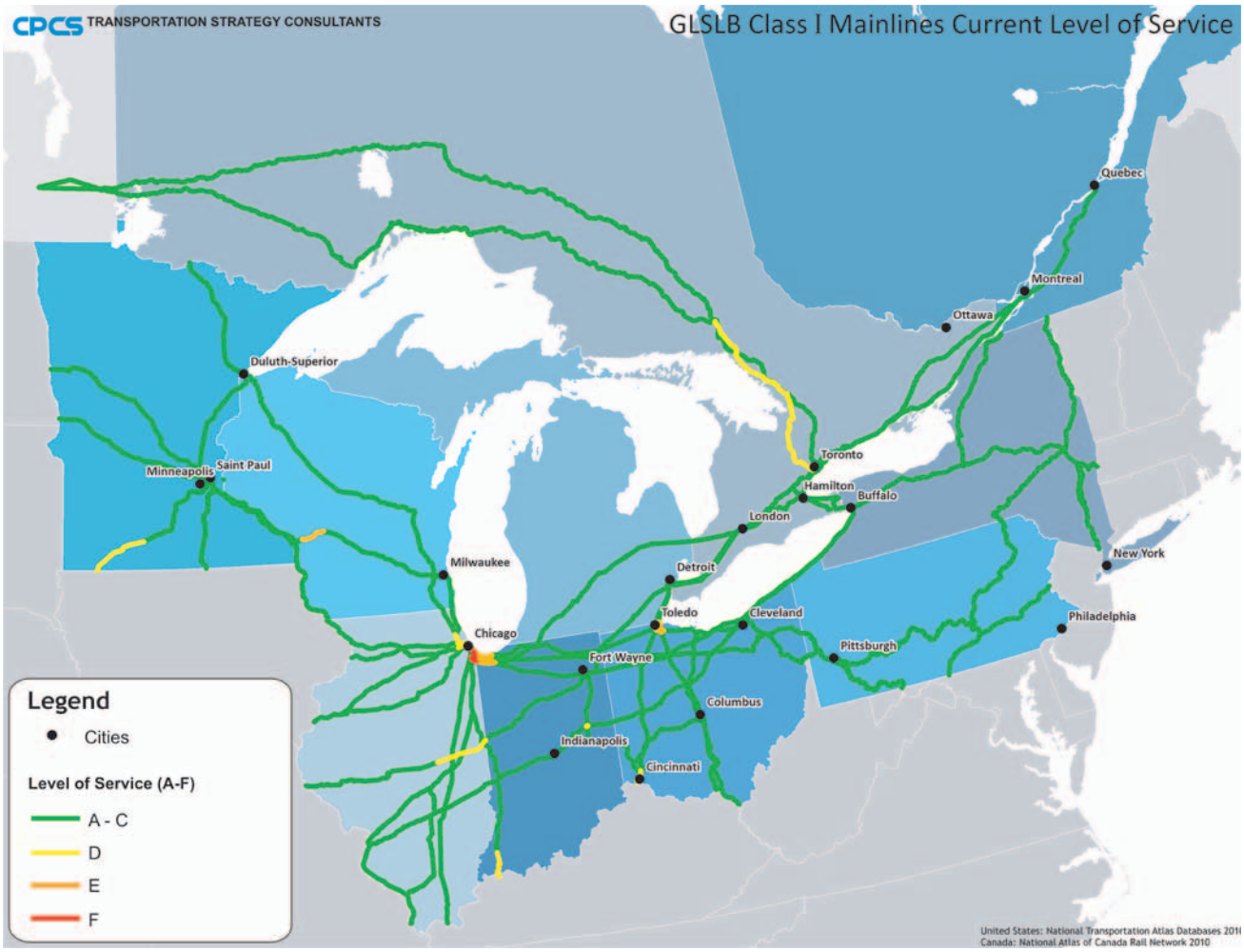


Figure 3-17. Rail level of service in the GLSLB 2007[4].

Infrastructure issues: capacity-constrained rail infrastructures, especially around Chicago, create hold-ups, and local residents often oppose new rail infrastructure projects. Low-density lines often struggle to generate enough revenue to cover maintenance costs. This is especially true in areas where there are many lakes, rivers, and streams, where bridges are necessary.

Operational issues: rail rationalization and a lack of competition in smaller corridors hurt rail level of service in the region. When Class 1 railroads are running at capacity, it is often difficult for short lines in the region to get equipment. Busy Class 1 carriers often lack capacity to move business to and from short-line operators during peak season.

Funding level and structure: lack of timing coordination, strict modal funding structure, and inadequate public funding lead to difficulty in implementing projects. Most states in the region offer railroad investment programs and loans for economic development, yet Class 1 carriers have

[4]Level of service in the United States is taken from the National Rail Freight Infrastructure Capacity and Investment Study (Cambridge Systematics, 2007). In Canada, traffic volumes were developed by CPCS from high-level corridor estimates on tonnage in 2009, based on CN and CP Yearbooks (public), then transformed to number of trains per day using corridor-specific assumptions about train length, empty ratios, and gross weight per railcar. Capacity in trains per day and rail level of service was developed using identical assumptions as those detailed in Cambridge Systematics (2007) for the United States.

raised the bar for access to heavily traveled mainline corridors. Most carriers require extensive side track structures and switching arrangements, which often preclude the financial capability of individual companies to make the related investments.

Data availability/information regarding rail operations: limited data availability and knowledge about railway operations by politicians limit the inclusion of rail into overall planning initiatives.

Multijurisdictional governance: regulations and policies often increase costs and complexity of rail infrastructure projects.

Alignment of public and private incentives: public- and private-sector incentives are not well aligned, a fact exacerbated by a lack of communication and understanding between the two sectors.

3.3.2.7 Initiatives and Opportunities to Improve Performance

There have been some major collaborative efforts including public and private stakeholders, with specific funding envelopes attached. In the United States, one prime example is the CREATE project, a first-of-its-kind partnership between the U.S. DOT, the State of Illinois, City of Chicago, Metra, Amtrak, and the nation's freight railroads, with investment slated to be $2.5 billion. In Canada, the Continental Gateway strategy went one step further by linking a significant funding envelope to a national freight strategy encompassing not only numerous jurisdictions, but also all modes of transportation from a systems perspective.

Based on stakeholder consultations, opportunities for rail in the GLSLB can be articulated along three key dimensions: education, integration, and new infrastructure. A number of infrastructure opportunities identified by stakeholders include a new CP (Canadian Pacific) rail tunnel at the Windsor–Detroit crossing to enable the handling of double-stacked containers.

3.3.3 Road

3.3.3.1 System

In the United States, key north-south highways (which are assigned odd numbers) include I-35, I-55, I-65, I-69, I-75, and I-95. On the east-west axis (which are assigned even numbers), key GLSLB highways include I-70, I-80, and I-90. The GLSLB is also served by 24 other Interstate highways (e.g., I-57, I-39, I-88, I-94, and all other non-multiples of five), which complement the major arteries, generally over shorter distances. Finally, the system is also served by hundreds of three-digit highways which act as feeders or connectors between major interstates (Figure 3-18).

In Canada, each province has its own nomenclature. In terms of corridors, the key highways are those along the St. Lawrence River, starting with the 20 in Quebec City, which meets the 401 in Ontario, all the way to Detroit where it meets I-75.

The GLSLB region also possesses many high-volume truck border crossings, most notably at Detroit, MI, Buffalo–Niagara Falls, NY, and Port Huron, MI. These three crossings handled 80% of all transborder truck containers in the GLSLB region in 2007.

3.3.3.2 Traffic

In 2007, approximately 4.75 billion tons of cargo were handled by the GLSLB road network, constituting 33% of total truck tonnage in the United States and Canada. Truck traffic is particularly heavy around urban areas, notably Chicago, Detroit, Cleveland, Indianapolis, New York,

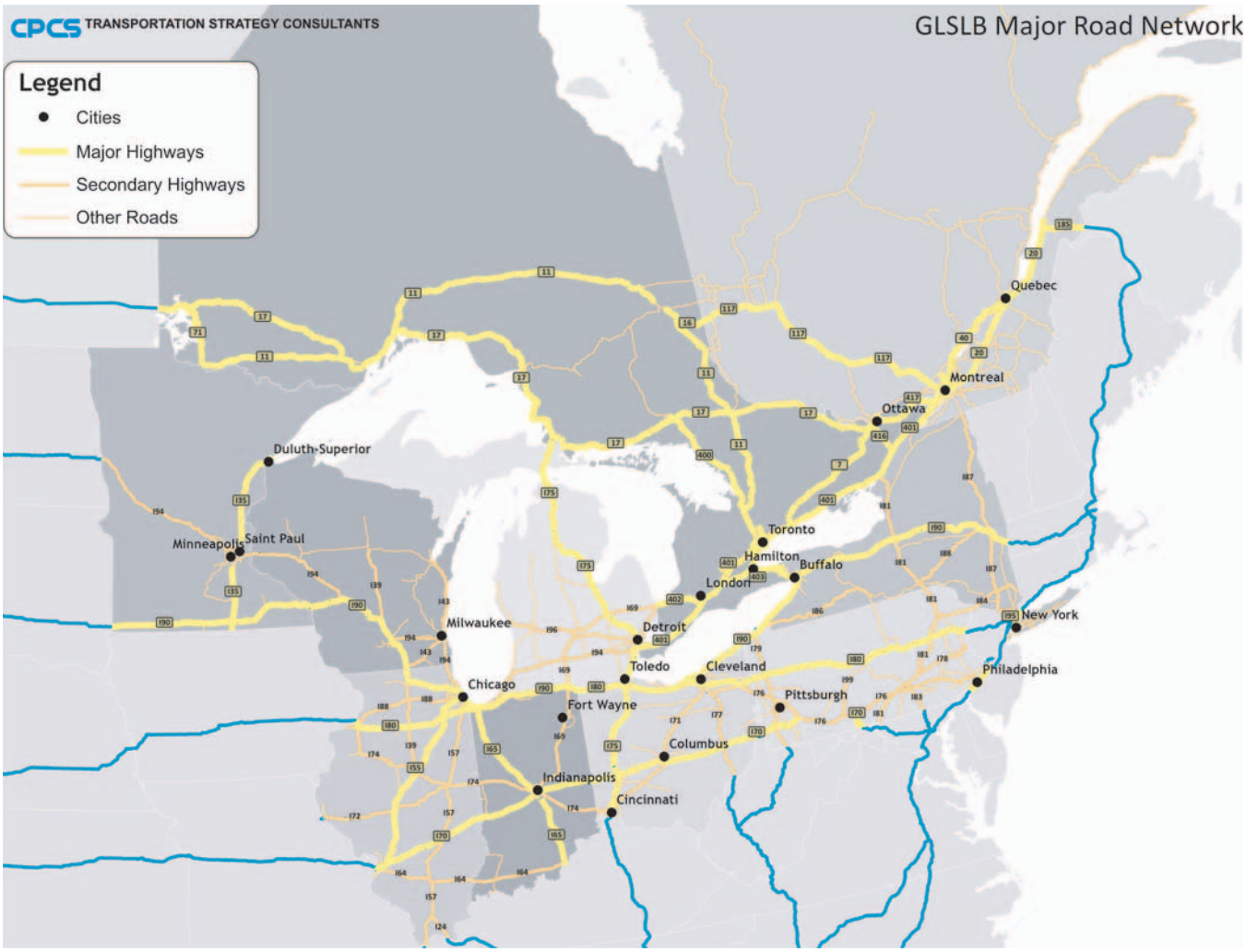


Figure 3-18. Simplified road network in the GLSLB (Source: U.S. Bureau of Transportation Statistics, Transport Canada).

and Philadelphia. Unsurprisingly, the large majority of intercity traffic on GLSLB roads occurred within the region as most trucks do not travel long distances.

Figure 3-19 illustrates the annual average daily truck traffic in the GLSLB. Figure 3-20 displays truck tonnage by jurisdiction in the GLSLB.

3.3.3.3 Major Commodities

The major road commodity movements are slightly different than those of the marine and rail modes. Mineral products, in particular, gravel, account for a quarter of total truck tonnage in the region. Food products come second at 23%, followed by fuel at 10% (i.e., petroleum products and coal). By value, consumer goods constitute 25% of the total moved by truck in the GLSLB. A share of this is intermodal traffic, moving to/from a port or rail intermodal facility. Machinery, including electronics, accounts for 17%, while food products account for 14% (Figure 3-21). This breakdown reflects the industrial base of the GLSLB.

3.3.3.4 Trends

The forecast for the U.S. and Canadian truck sectors suggests steady growth between 2009 and 2020(Figure 3-22). In the United States, growth is expected to be slightly faster than the

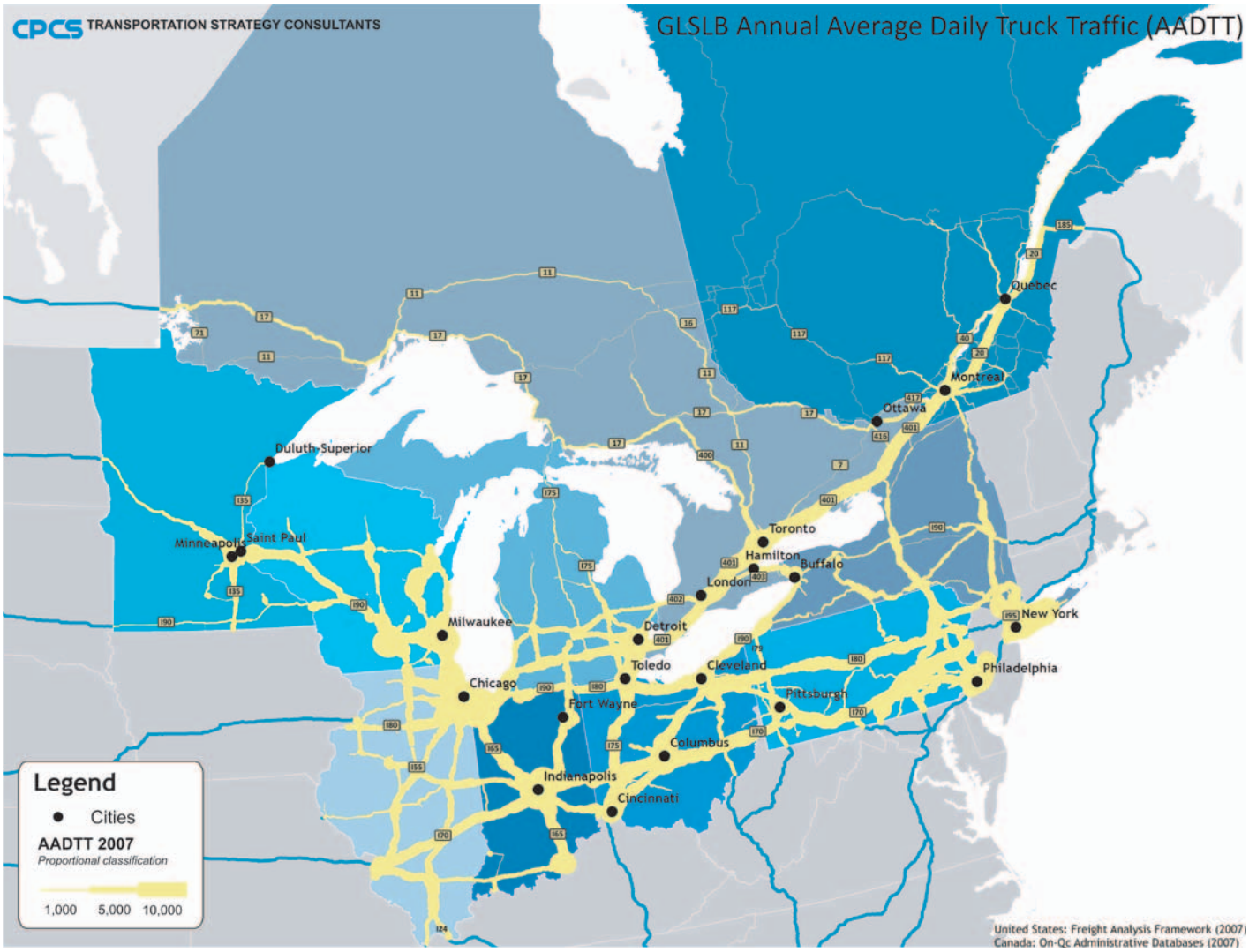


Figure 3-19. Annual average daily truck traffic in the GLSLB, 2006–2007 (Source: FHWA, Statistics Canada).

rail and marine modes, in part because the downturn affected truck traffic more heavily than other modes. In Canada, the forecast is similar, but growth is expected to be even steadier over time. Little change is expected in the proportion of North American truck traffic occurring in the GLSLB.

3.3.3.5 Performance

Capacity. Urban areas are currently the major source of road congestion and delays in the GLSLB. As of 2007, every major urban area in the GLSLB had significant roadways with traffic exceeding capacity (Figure 3-23). However, outside of the major urban centers, highway infrastructure is adequate in handling current levels of traffic and does not contain major segments of road that were near or over capacity. Yet, by 2040, without significant upgrades to the existing infrastructure, 41% of the GLSLB network will encounter over capacity conditions (from 28% in 2007).

Efficiency and Competitiveness. Truck freight productivity has experienced a steady increase over the past 25 years, which has largely paralleled an increase in productivity throughout the U.S. and Canadian economies. However, while incremental technologies and innovations

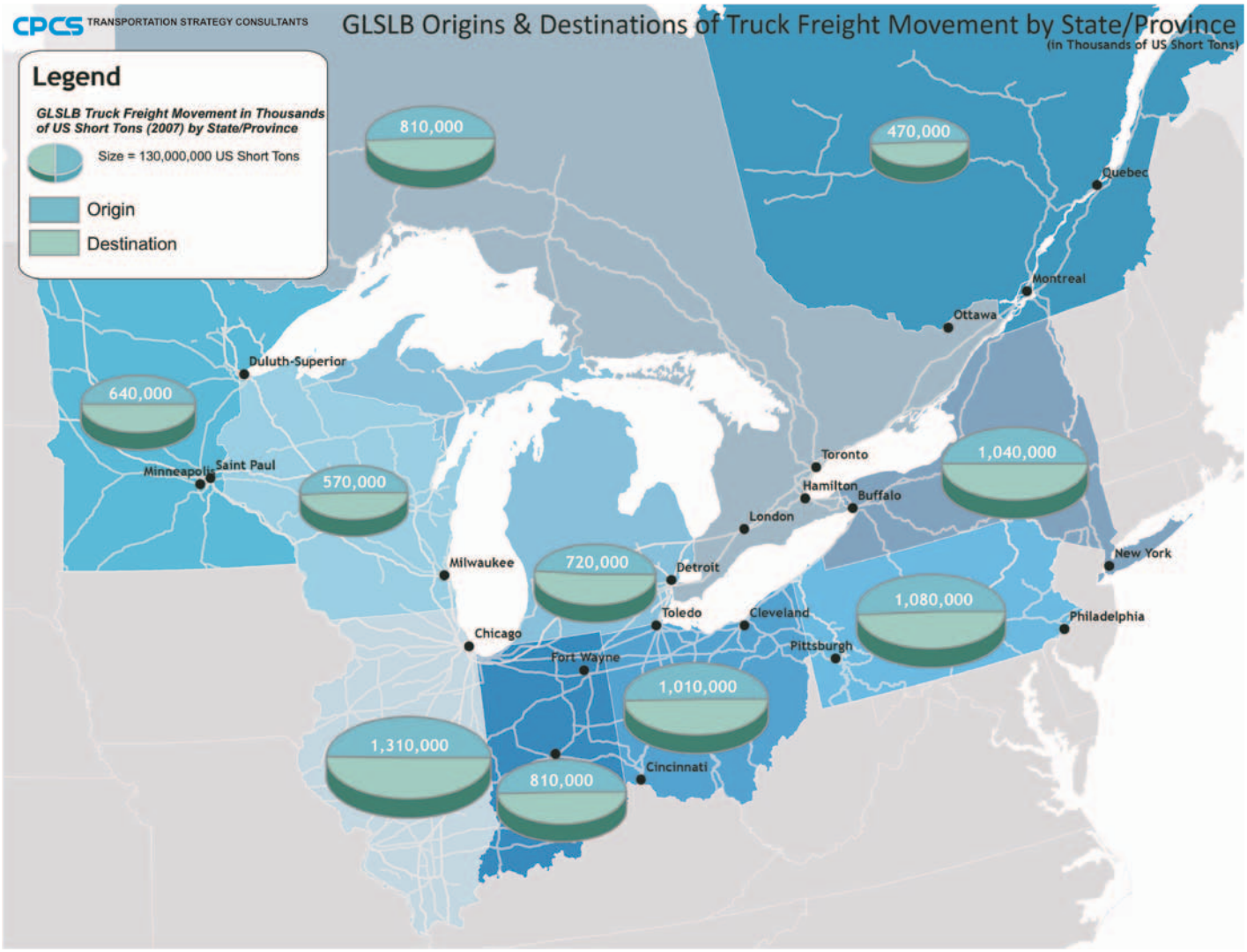


Figure 3-20. Truck tonnage by state and province in the GLSLB, 2006–2007 (Source: FHWA, Statistics Canada).

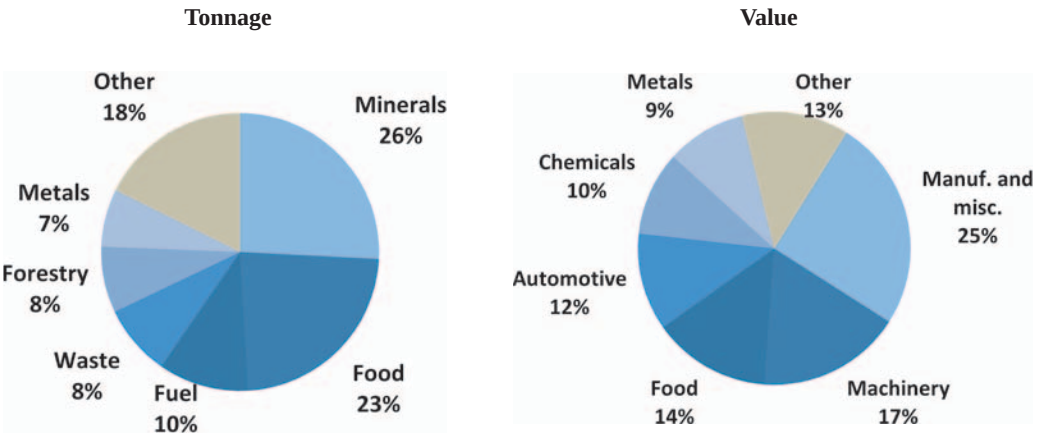


Figure 3-21. Relative importance of GLSLB truck traffic by commodity, in tonnage and value, 2007 (Source: FHWA).

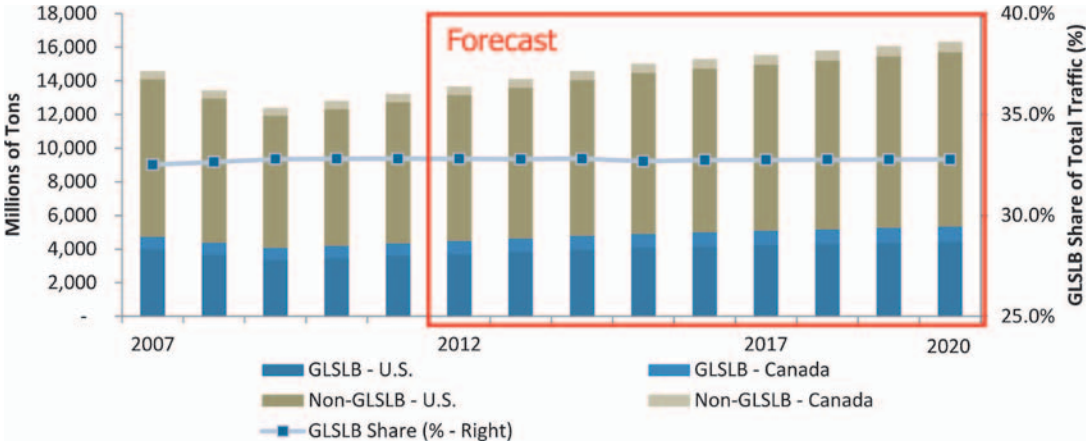


Figure 3-22. Forecast for truck tonnage with an origin or destination in GLSLB, 2007–2020 (Source: Transportation Situation and Outlook Report 2007).

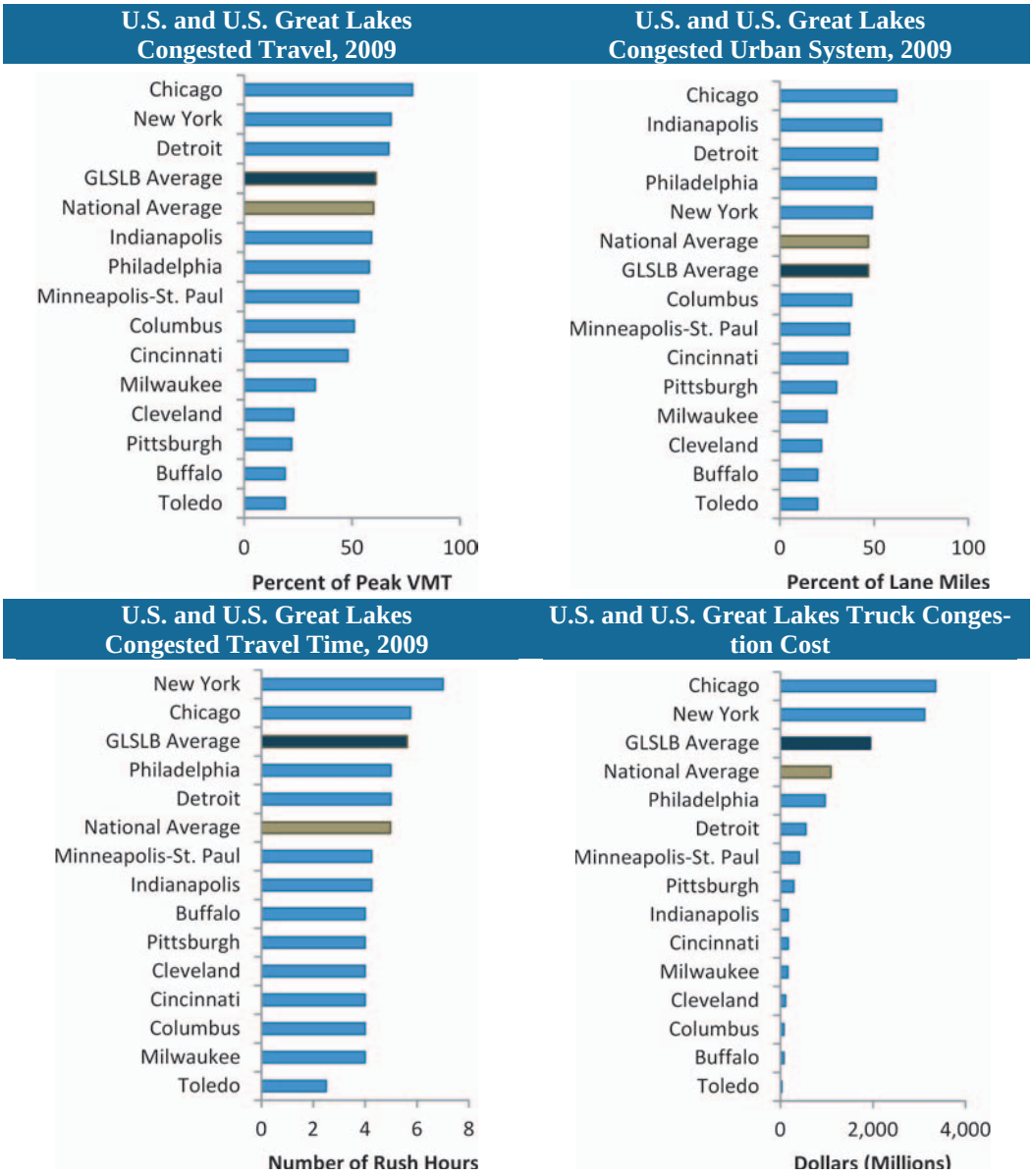


Figure 3-23. U.S. and U.S. Great Lakes urban congestion, 2009 (Source: 2010 Urban Mobility Report).

have been introduced to increase operational and technical efficiencies, there has not been any major or ground-breaking change in the road transportation industry. In Chicago, one of the most congested cities in the region, open-road tolling has helped reduce delays caused by toll collection. Intelligent transportation systems have been used for variable messaging signs to help alert and reroute travelers at specific choke points.

In terms of performance, one of the most important aspects of road-based freight in the GLSLB is border crossing between the U.S. and Canada. Together, the GLSLB crossings account for 63% of car, truck, and bus traffic that crosses the U.S.–Canada frontier. However, these border crossings are continually under pressure, both due to increased traffic and increased security measures.

Safety and Environmental Sustainability. The number of traffic incidents involving large trucks in the U.S. has been on an overall decline in the past 10 years, but has remained relatively constant over the past 20 years. However, this trend is not mirrored in Canada where injuries in large truck collisions have grown steadily over the periods for which data is available. Canadian fatalities, however, have remained fairly constant in number.

One thing to note is that the trucking industry has not significantly benefited from the decline in accidents. Indeed, the cost of settlements has increased significantly, resulting in much higher premiums and/or deductibles. One resulting effect of these increased insurance costs was a reduction in the number of independent owner operators.

With regard to environmental considerations, trucking is greatly disadvantaged when compared to other modes in terms of greenhouse gas emissions and energy efficiency per ton-mile. Coupled with the concentrated effect of congestion in urban areas, trucking becomes a major contributor to localized pollution. Thus, trucking is particularly susceptible to any environmental legislation or more stringent emission standards. Experiments with truck-stop electrification have been undertaken along several corridors to help reduce engine idling emissions.

3.3.3.6 Barriers and Constraints to Performance

The major constraints and barriers to road transportation in the GLSLB tend to be localized rather than systemic, resulting from the wide variance in traffic between different parts of the roads and highways system. They can be summarized into five categories.

Urban congestion: urban centers create bottlenecks that restrict the movement of freight, and the effect is worsened near key ports that are located near major centers, access to which requires driving through non-freight traffic corridors.

Regulatory issues: the new Compliance, Safety, Accountability 2010 regulations, cabotage laws (which prevent foreign truckers from carrying loads within two points in another country), and new truck driver hours of service laws hinder trucking's competitiveness. Another important constraint, the lack of harmonization for truck size and weight, leads to lower asset utilization and wasted resources.

Infrastructure and border issues: infrastructure capacity is already exceeded within major cities and will be exceeded along a number of major corridors within the next 20 to 30 years.

Financing the Big Picture: municipalities are not able to sufficiently maintain or expand key components of regional road networks due to inadequate financing capabilities and limited budget horizons.

Multijurisdictional coordination: crossing of jurisdictional boundaries along roads and highways, and the consequent need to adhere to multiple differing rules, creates inefficiencies and is an overall impediment to streamlined freight flows.

3.3.3.7 Initiatives and Opportunities to Improve Performance

The major current initiatives taking place within the GLSLB to support road transportation chiefly involve infrastructure investment and regional coordination. Under the stimulus packages, the GLSLB has already experienced a $7.2 billion influx of U.S. and Canadian federal funding for the construction, maintenance, and upgrading of highways and roads. Efforts are also being made to create a partnership similar to the existing rail-oriented CREATE, the Ambassador Bridge, and the Detroit Intermodal Freight Terminal among other initiatives

Aside from opportunities resulting from the allocation, distribution, and investment of stimulus funding, the GLSLB region would benefit from steps to optimize border crossings, share information across jurisdictions, seek non-road alternatives, and integrate and coordinate regional regulations (e.g., size and weight), planning, and decision making.

3.3.4 Air

3.3.4.1 System

The GLSLB serves as one of North America's major air cargo hubs and contains 36 of North America's 156 airports that handle over 10,000 tons of cargo per year.

3.3.4.2 Traffic

The GLSLB relies on a few dominant air hubs, with the GLSLB's 20 largest airports making up 95% of the cargo traffic, and the top five airports making up 66% of traffic. Notably, the biggest airports in the United States are more focused on unloading and serve as hubs for delivering goods to their surrounding areas. This pattern is repeated in Canada with the airports of major urban centers serving as unloading facilities, while secondary airports focus on loading (Figures 3-24 and 3-25).

3.3.4.3 Major Commodities

The most striking feature of the commodity traffic by air is the uneven distribution of weight and value. While the top five commodities account for 82% of the value of air freight, the top five commodities by weight account for only 57% of the weight of all freight (Figure 3-26).

3.3.4.4 Trends

Between 2007 and 2020, air cargo handling in the GLSLB is forecasted to grow by an average of 5.4% per year with a forecast 18.5 million tons handled in 2030. However, due to the impact of the 2008/2009 economic crisis, a part of that growth will be in the form of recovery of the 19% drop in traffic that occurred between 2007 and 2009. Yet, the region is seen as being well poised for a strong recovery with annual rates of growth of 6% between 2009 and 2015 and then slowly tapering off into an average of 4.8% per year between 2015 and 2020 (Figure 3-27).

It should be noted that the recent economic troubles have hurt the GLSLB air cargo traffic more so than the continental average; by the time of this writing, the GLSLB was not expected to have recovered its relative position of 2007 and is estimated to account for just 22% of the North American air cargo traffic. This could be, in part, due to the sensitivity of the sector to the automotive industry.

3.3.4.5 Performance

Capacity. Almost all airports in the region could double their annual handled cargo tonnage without having to undertake major expansions. Only Chicago O'Hare appears to have capacity issues, with theoretical capacity utilization above 80%, as per Figure 3-28.

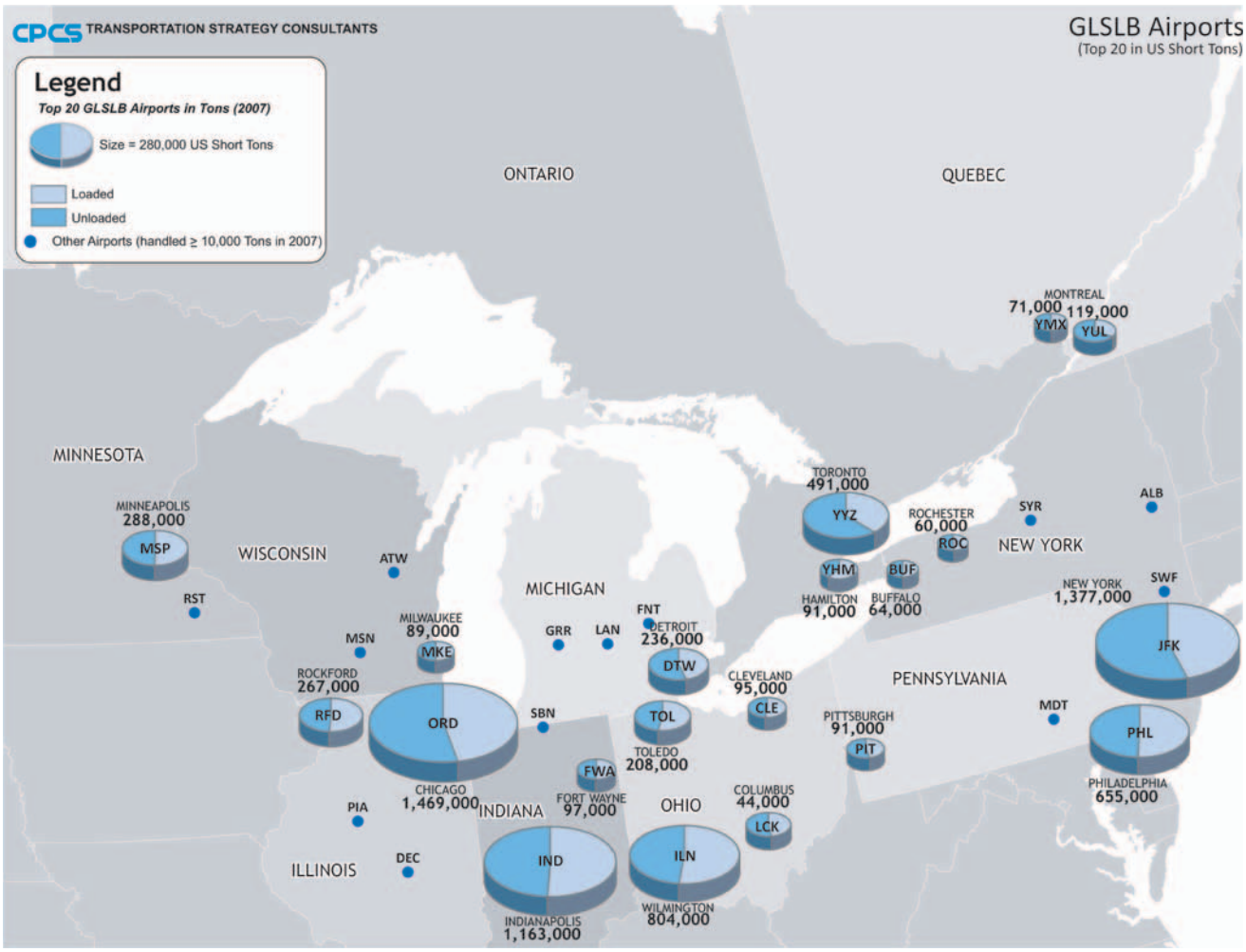


Figure 3-24. Top 20 GLSLB airports and activity (Source: US Department of Transportation, Statistics Canada).

Efficiency and Competitiveness. The majority of air cargo rides in the belly of passenger planes, which strains the region's largest airports as their facilities must accommodate both passengers and air freight, each having different flow characteristics.

There is more divergence across companies than across markets. Cargo-only firms charge a premium as they offer door-to-door service and can capitalize on their strong reputation.

In general, cargo transport in the GLSLB region is neither more expensive nor cheaper than elsewhere in the U.S. or Canada (with exception of Canada's north and remote regions).

With regard to speed, all the major North American markets are less than 4 hours away from GLSLB airports (Figure 3-29). In addition, the increase in cross-polar flights may provide new supply-chain opportunities for GLSLB airports as distances to many Asian and northern European cities are much closer going over the North Pole.

Safety and Environmental Sustainability. Air transport is generally regarded as being environmentally unfriendly. Notably because of air, noise, and visual pollution, the airline industry is often targeted by environmentalists. Airports and aircraft have significant levels of emissions and profoundly transform the space in which they operate.

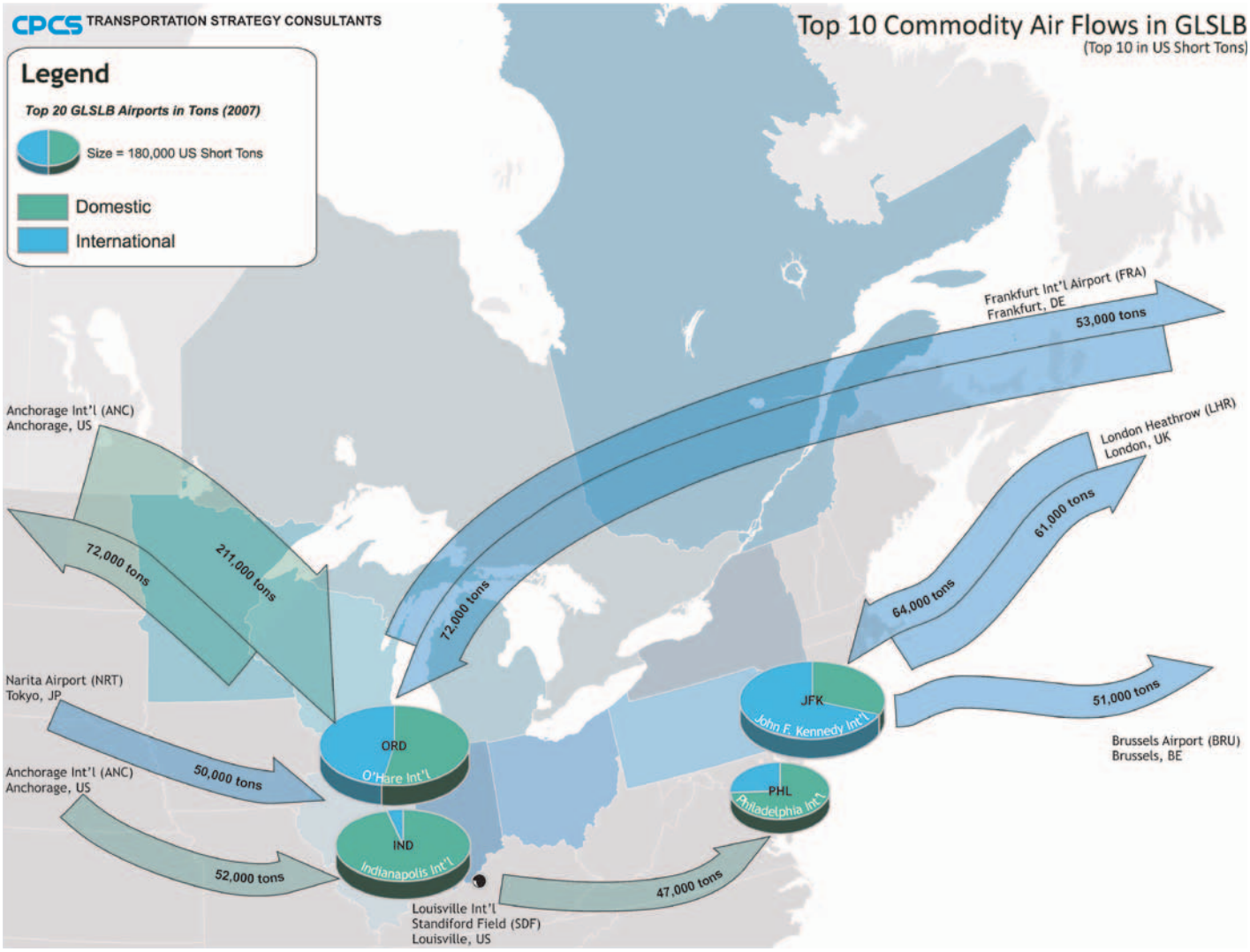


Figure 3-25. Major flows by origin–destination, 2007 (Source: U.S. Department of Transportation, Statistics Canada).

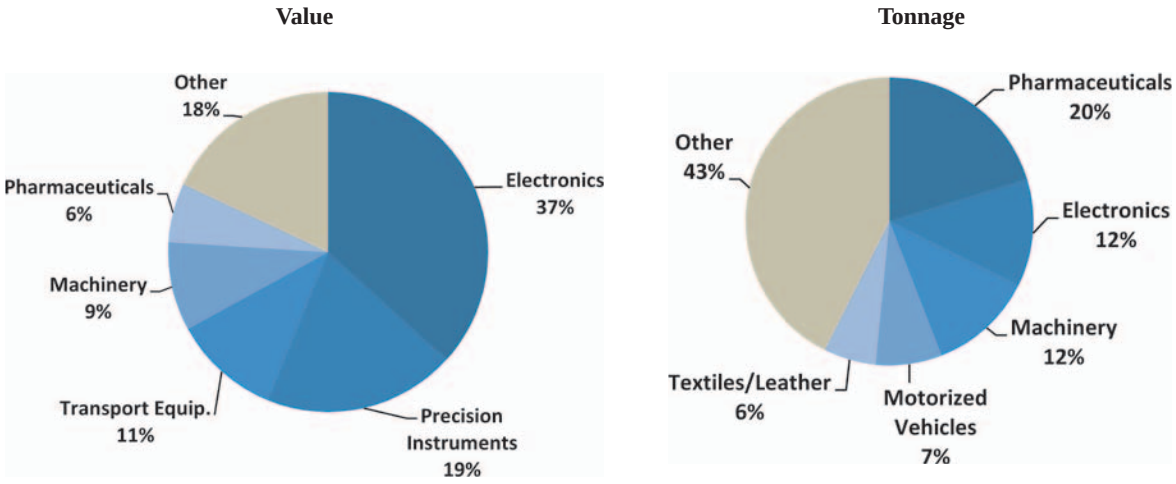


Figure 3-26. Shares of value and weight of commodities transported by air in the GLSLB, 2007 (Source: U.S. FHWA).

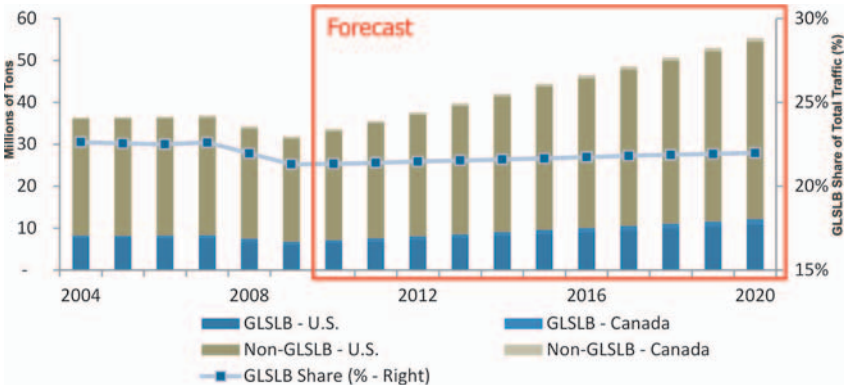


Figure 3-27. Trends and forecast for tonnage handled in GLSLB air network, 2004–2020 (Source: U.S. FHWA, Statistics Canada, Transport Canada).

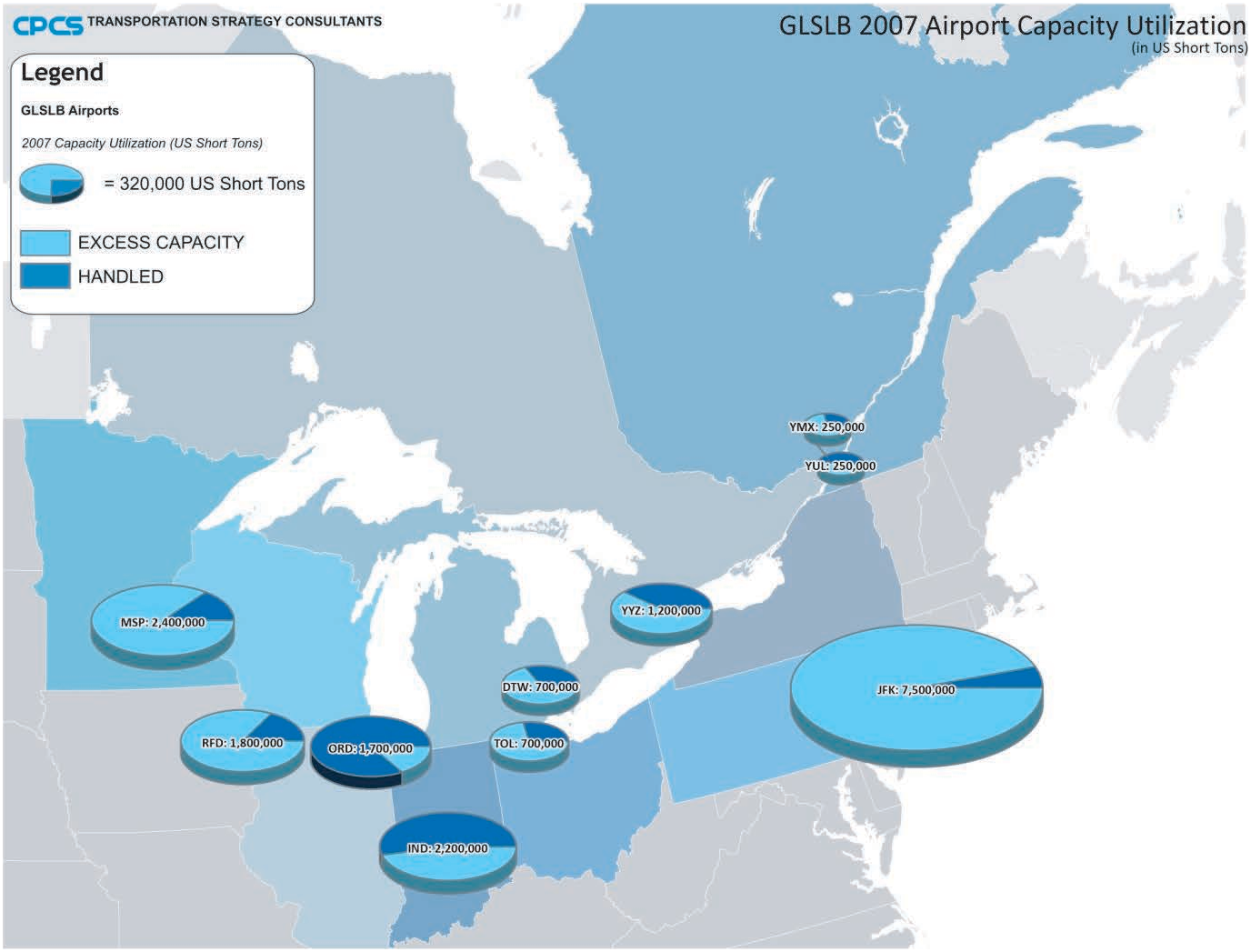


Figure 3-28. GLSLB airports capacity utilization (Source: Airports Authorities websites, CPCS analysis).

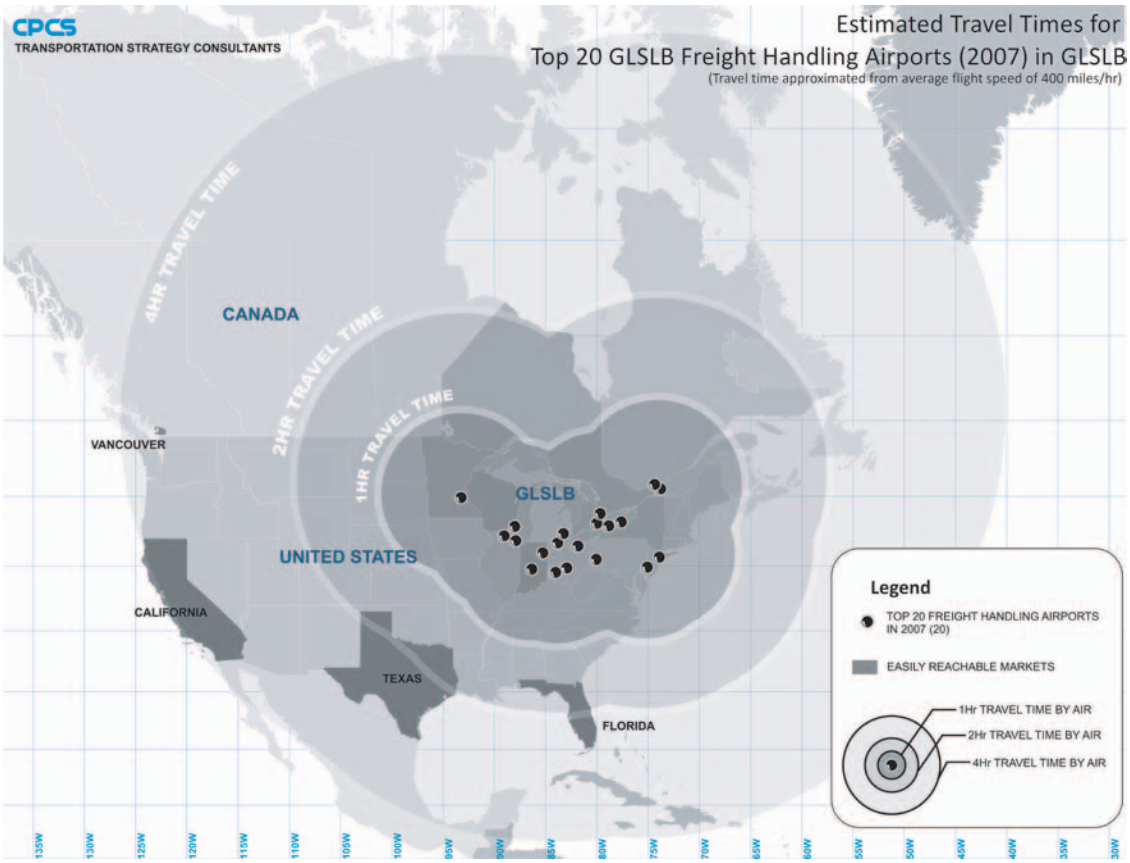


Figure 3-29. Estimated travel times for top 20 GLSLB freight handling airports (Source: CPCS Analysis).

There is generally significant local resistance to airport establishment or expansion projects, often grounded in issues around expropriation, noise, pollution, and safety. Consequently, airport authorities put in place restrictive measures for passenger and cargo traffic such as curfews, noise thresholds, and over-flight trajectory modifications.

3.3.4.6 Barriers and Constraints to Performance

In general, firms involved in air freight transportation and distribution face similar challenges, mostly concerning deficient intermodal connections and inadequate infrastructure.

Regulated Costs and Public Investments: airport rents in Canada translate into higher cost for airport authorities, thereby placing them at a structural disadvantage compared to their American counterparts.

Landing Fees: airport landing fees vary in the GLSLB with Canadian airports having particularly high landing fees, thereby discouraging increased interconnectivity with the U.S. transportation network.

Bilateral Agreements and Regional Coordination: the positive impacts of Canada–U.S. bilateral agreements have yet to be proven.

3.3.4.7 Initiatives and Opportunities

Constraints and barriers in the GLSLB air transportation industry suggest that additional integration efforts are needed. Whether it is for standardization of procedures, landing fees, or

airports rents, more cohesive policies are needed so as to provide a level playing field, greater competitiveness, and higher development potential.

If air transportation is to grow significantly in the region, it will have to go beyond its niche markets. Integrated business models, such as that buttressing the Aerotropolis development in Detroit, are becoming the norm.

The Detroit Aerotropolis represents a substantial investment and emphasis on passenger and freight integration. Illinois is undertaking substantial highway upgrades around Chicago–O'Hare to accommodate air freight congestion issues. Midway runways were recently expanded to allow larger planes. Will County, IL, has been planning a "third airport" in the Chicago area, which would provide additional capacity for the growing Chicago population. Air freight carriers have established secondary freight hubs in Rockford, IL, to support UPS and in Indianapolis, IN, to support Fedex. The Wilmington, OH, Airport and Airborne Business Park were taken over by DHL in 2003. In 2009 DHL closed the facility and eliminated 8,000 jobs. Wilmington, OH, is looking at plans to repurpose this facility. Rickenbacher, OH, is co-located with a railroad intermodal integrated logistics center. Indianapolis Airport is working with local real estate firms to improve its multimodal freight presence by linking rail, road, and air assets together in one central area.

Another potential opportunity relates to the development of a Great Northern Route (GNR). Recently discussed by cargo experts, the GNR is a large air freight transportation project that can eventually lead to a new coordinated international trade route through Northern and Polar Regions. Related impacts could be important, but major GNR-related developments are not expected in the short term.

3.3.5 Pipeline

3.3.5.1 System

The pipeline system moves a significant tonnage of gas and hazardous liquids to and throughout the region directly to end users, ranging from power plants to private residences (Figure 3-30). Most of the pipeline network is privately owned and operated. Three operators have cross-border pipelines for natural gas in the GLSLB: TransCanada, Alliance, and Enbridge. By far, the most significant is TransCanada, which has a geographical network structure akin to those of Canadian railways.

3.3.5.2 Traffic

In 2007, approximately 556 million tons of cargo were handled by the GLSLB pipeline network, constituting 26% of all tonnage moved by pipeline in the United States and Canada (Figure 3-31). With large oil and gas fields lying mostly outside the region, most pipeline movements were between the GLSLB and the rest of North America. Nearly 89% of pipeline movements in the GLSLB were in the U.S., more than for any other modes. Of the estimated 1.44 billion tons of product moved by pipelines in 2007, about 28% of it had the GLSLB as an origin or destination. Transborder movements accounted for 24% of GLSLB pipeline tonnage, mostly due to the imports from Canada's oil-rich western region (Figure 3-32).

3.3.5.3 Major Commodities

The major pipeline commodities are well known: natural gas, crude petroleum, fuel oils, gasoline, and other petroleum products. In the GLSLB, crude, gasoline, and fuel oils accounted for half of commodity movements, with the other half being mostly natural gas. Looking at it in terms of value does not change the picture much, with the relative weights of different commodities remaining similar (Figure 3-33).

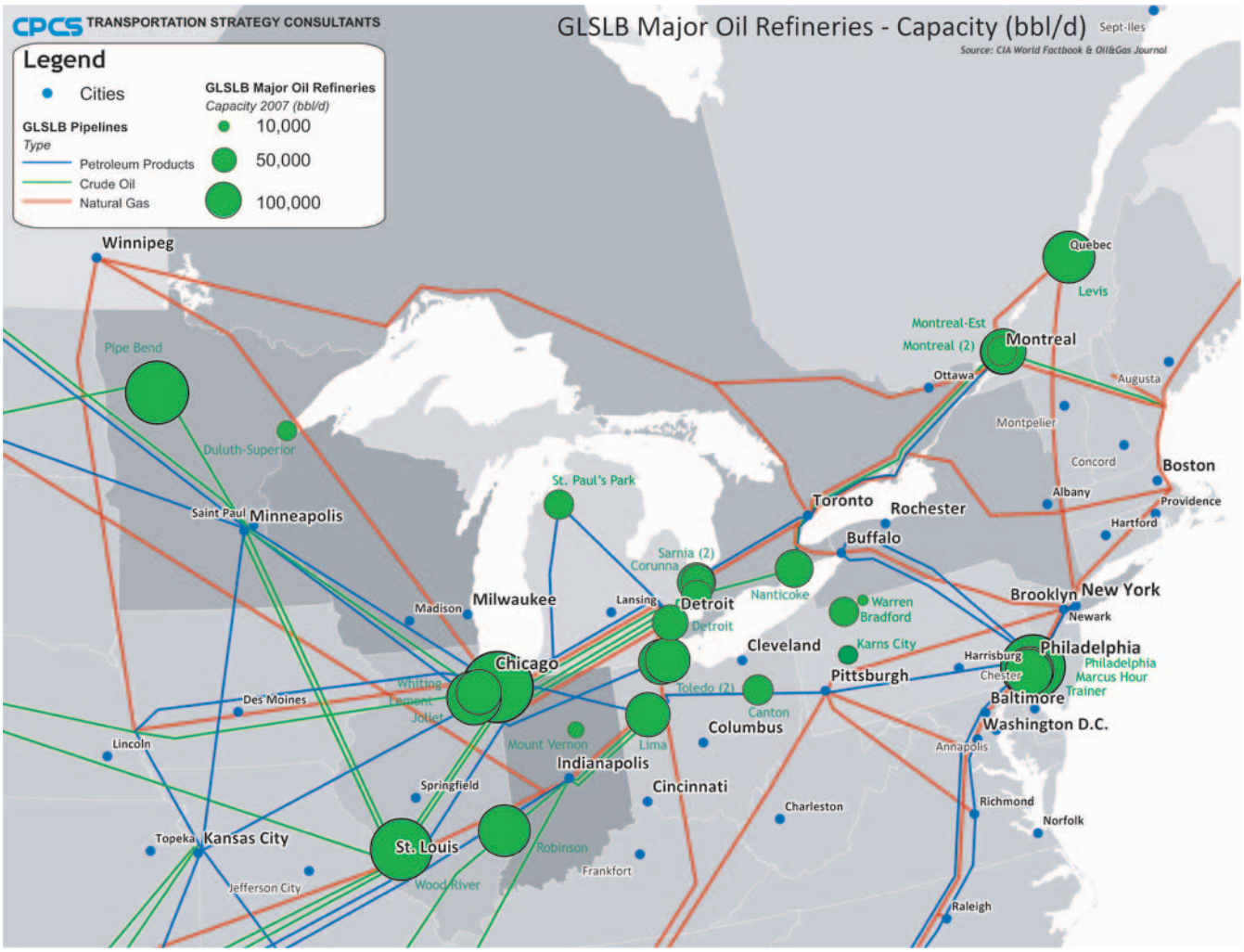


Figure 3-30. Stylized pipeline network and refineries in the GLSLB (bbl/d = barrels per day) (Sources: Natural Resources Canada, Atlas of Canada, U.S. Department of Energy, and Oil & Gas Journal).

3.3.5.4 Trends

The forecast for the GLSLB pipeline sector in Canada and the United States suggests increasingly slower growth between 2009 and 2020 (Figure 3-34). In the U.S., total tonnage moved by pipelines with an origin or destination in one of the eight GLSLB states is forecasted to have the slowest growth of all modes. This is not particularly surprising, as growth for these flows will be driven largely by demographic trends, which are not particularly buoyant in the region. In Canada, the forecast differential between the GLSLB and other regions is even starker. Based on population growth, pipeline traffic in the GLSLB is estimated to grow at 1% for the entire 2009 to 2020 period. These trends mean that a decline in the GLSLB share of pipeline movement is expected.

3.3.5.5 Performance

Capacity. The GLSLB lies at the crossroads of several areas of oil and gas production, refining, and distribution.

The main lines for natural gas are those traveling from Western Canada to Toronto via Sudbury and from the southern U.S. to New York via Pittsburgh (Figure 3-35). The capacity of these two lines exceeds 5 billion cubic feet per day each.

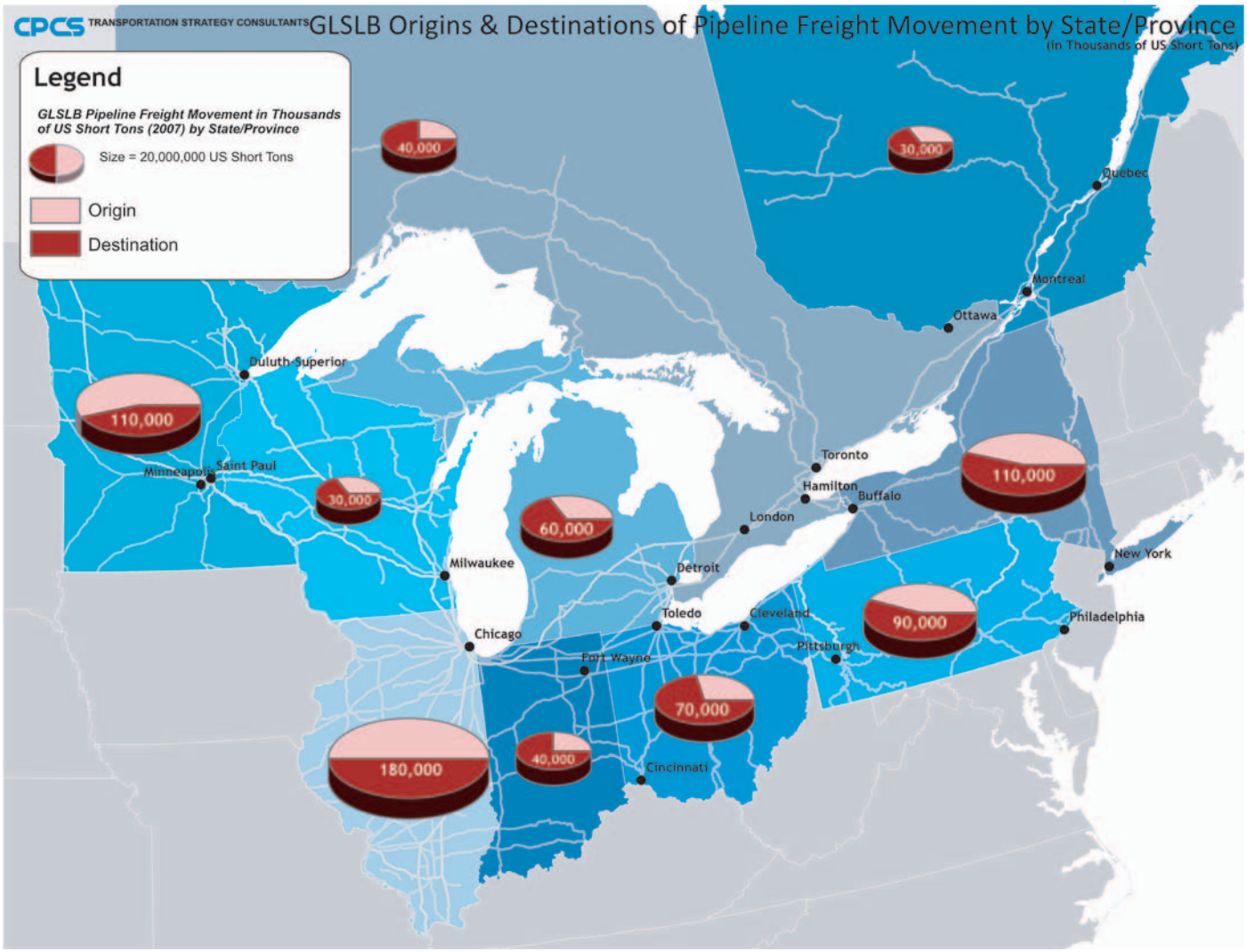


Figure 3-31. Inbound and outbound tonnage in GLSLB states and provinces, 2007 (Source: U.S. FHWA, Statistics Canada).

As in the case for crude oil, the main pipelines originate from Alberta and the U.S. southern region. Alberta's pipeline capacity is approximately 500,000 barrels per day while the one from the Gulf of Mexico is more than one million barrels per day. There is an extensive network of pipelines between Portland, ME, and Montreal with a total capacity of one million barrels per day (Figure 3-36).

Efficiency and Competitiveness. Using pipeline transportation has many advantages. Pipelines provide stable and consistent flow as well as autonomous routing with few intermediaries. It is also cheaper to transport petroleum products and liquid bulk through pipeline than through trucking, rail, or shipping. Maintenance costs are also generally low. Of all transport modes, pipeline is least subject to delays and frequency interruptions, since it has its own channels and networks, not shared with passenger transport or any kind of alternative traffic.

Safety and Environmental Sustainability. In North America, and in the GLSLB in particular, pipeline infrastructure wear is a major concern for regulators since an important part of the pipeline system in North America is very old: 41% of the total GLSLB distribution network is at least

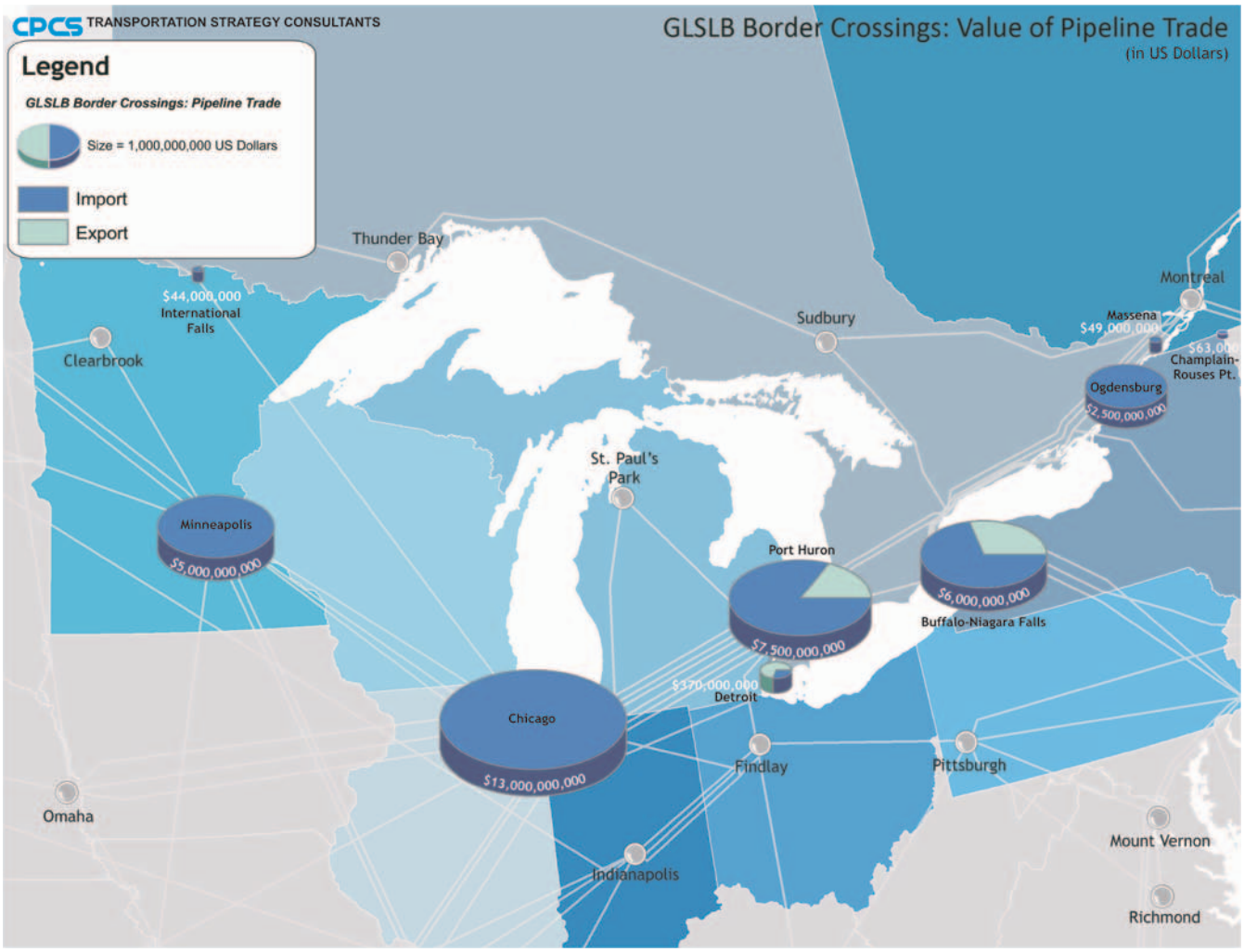


Figure 3-32. Value of trade at GLSLB pipeline border crossings, 2007 (Source: BTS North American Transborder Freight Data).

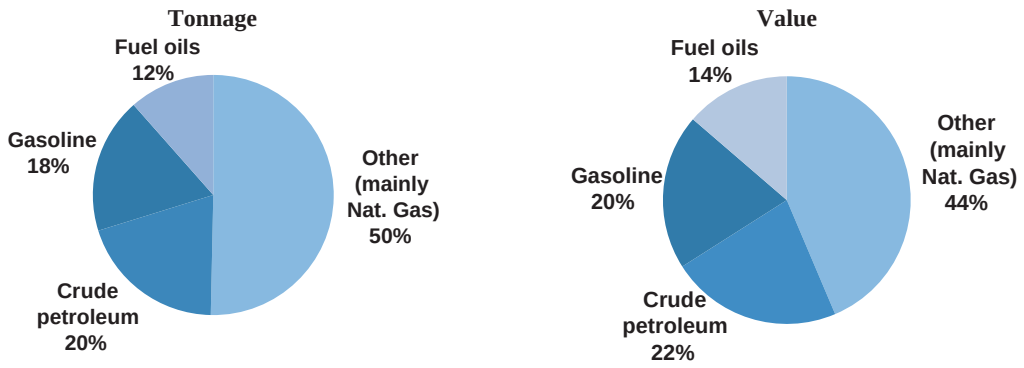


Figure 3-33. Relative importance of GLSLB pipeline traffic by commodity, tonnage, and value, 2007 (Source: U.S. FHWA, Statistics Canada).

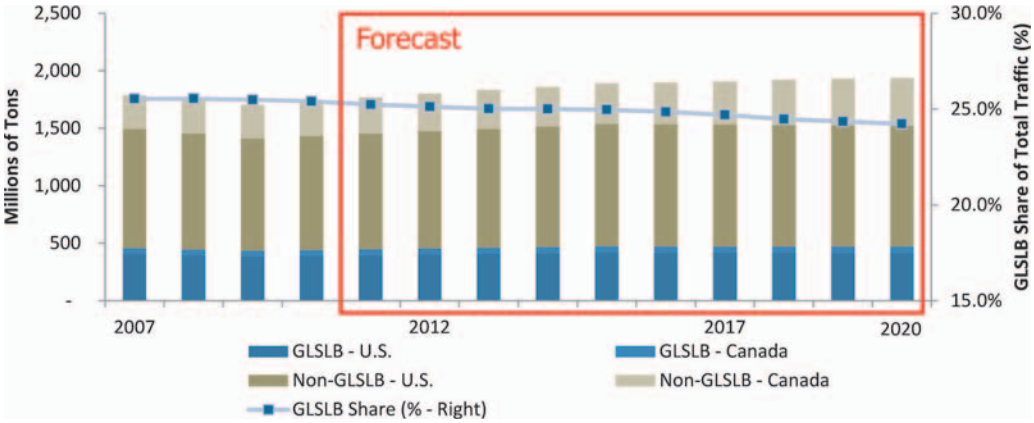


Figure 3-34. Forecast for pipeline tonnage with an origin or destination in GLSLB, 2007–2020 (Source: U.S. FHWA, Canadian Association of Petroleum Producers).

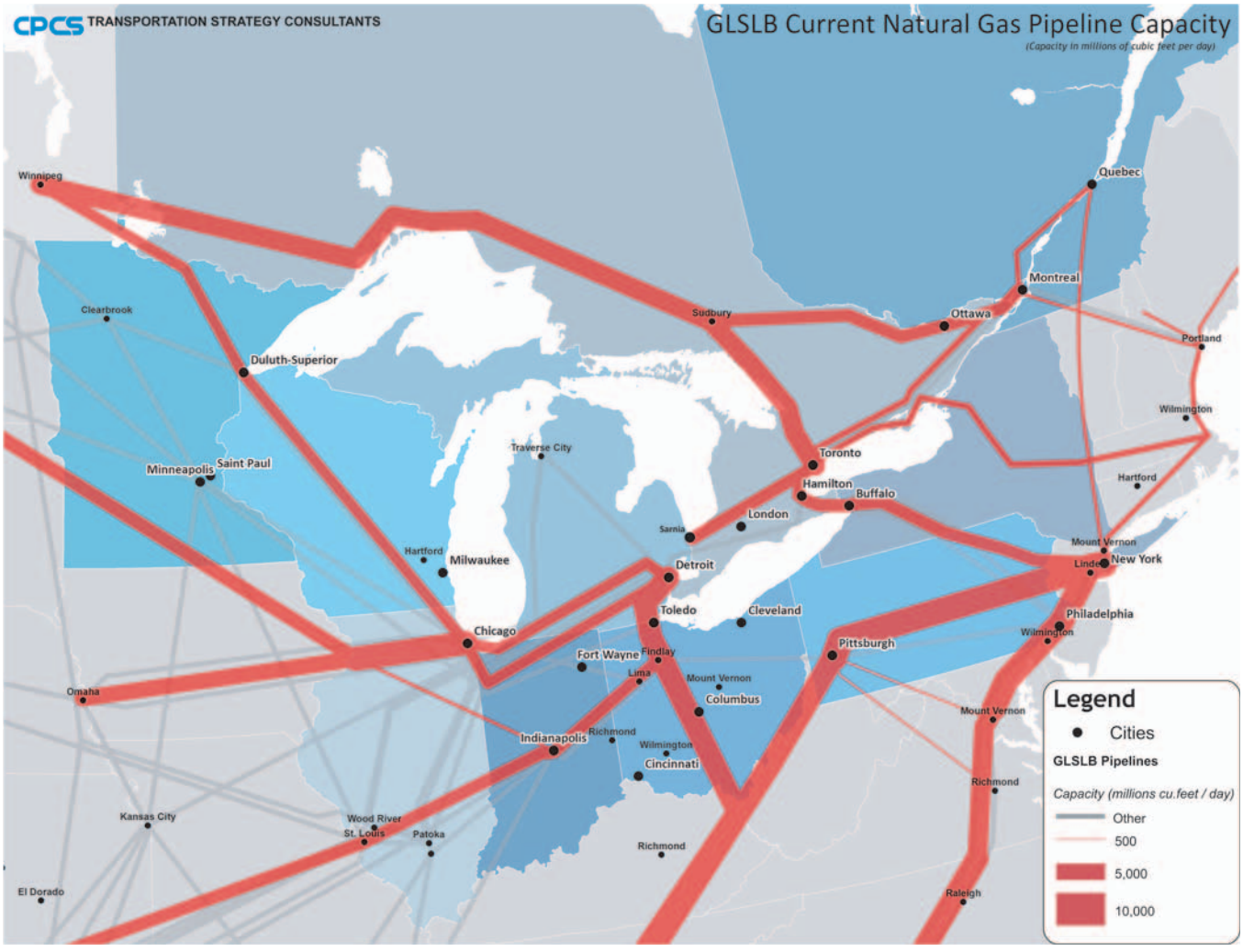


Figure 3-35. GLSLB current natural gas pipeline capacity (Source: U.S. Energy Information Administration, Natural Gas Supply Basins Relative to Major Natural Gas Pipeline Transportation Corridors).

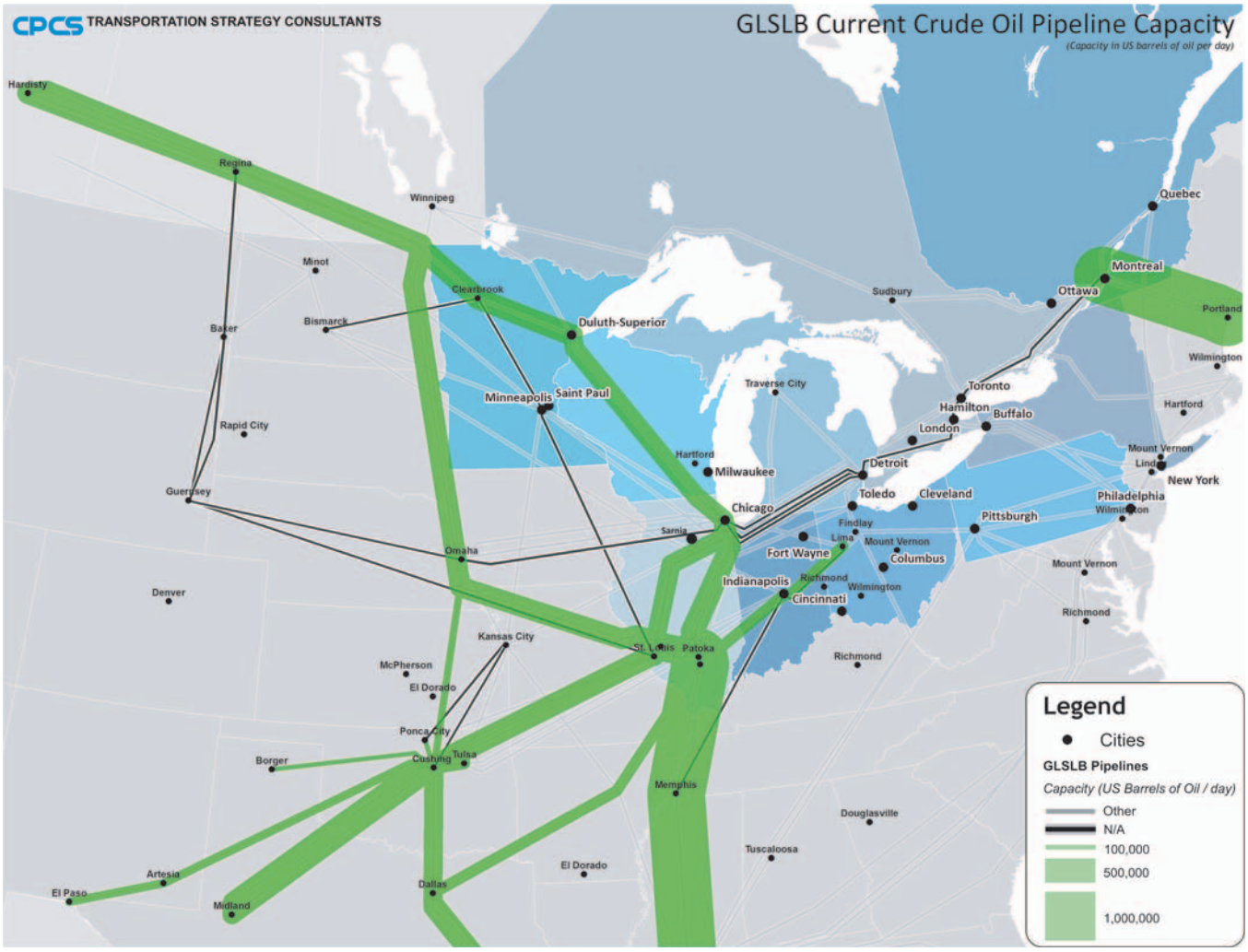


Figure 3-36. GLSLB current crude oil pipeline capacity (Source: Miller, Chevalier, and Leavens, The Role of WTI as a Crude Oil Benchmark, Purvin & Gertz Inc.).

40 years old, while nearly half (49%) of transmission pipelines in GLSLB are 40 years old and over. Other concerns include responses to spillage and regulations relating to spillage compensation.

3.3.5.6 Barriers and Constraints to Performance

The main constraints for pipeline transportation developments are in the areas of safety and environmental regulations. Indeed, pipelines are prone to spills, sabotage, and wear, and the consequences of an accident can be quite extensive.

3.3.5.7 Initiatives and Opportunities to Improve Performance

Pipeline operations and investment are almost entirely dependent on the private sector. Such infrastructure generally follows the trends and business models of its owners, rarely taking into account regional and national interests. The recent case of the Keystone XL Pipeline expansion project (which, in fact, is largely outside the GLSLB) points to regulatory realities and often diverging private and public interests. Nevertheless, from a multimodal standpoint, the business-driven focus of pipeline owners tends to complicate the integration of pipelines in transport supply chains. In addition, pipelines have the huge disadvantage of lack of diversity, since this transport mode can only carry liquid and gaseous products. This eliminates a significant share

of freight, solids, bulk, and food products as a possibility for this type of facility. Thus, the development potential of the pipeline system is quite limited in the GLSLB region, since energy and petroleum industries may actually be the only real sectors targeted. It could, however, be interesting to develop the potential of water routing in the U.S. through the pipeline network of the GLSLB region.

3.4 Performance of the GLSLB Multimodal Freight Transportation System

3.4.1 Understanding Freight Transportation Performance

The "performance" of the GLSLB multimodal freight transportation systems is complex, particularly when assessed from a multimodal, multijurisdictional, and multicommodities perspective (Figure 3-37). Complicating matters is the reality that the GLSLB is a region within a larger continental and global transportation network, serving regional and international supply chains.

Transport-chain performance can be assessed from different perspectives. Public policy makers, transportation providers, and beneficial cargo owners (BCOs) can have very different performance objectives and drivers vis-à-vis freight transportation performance, as shown in the figure below.

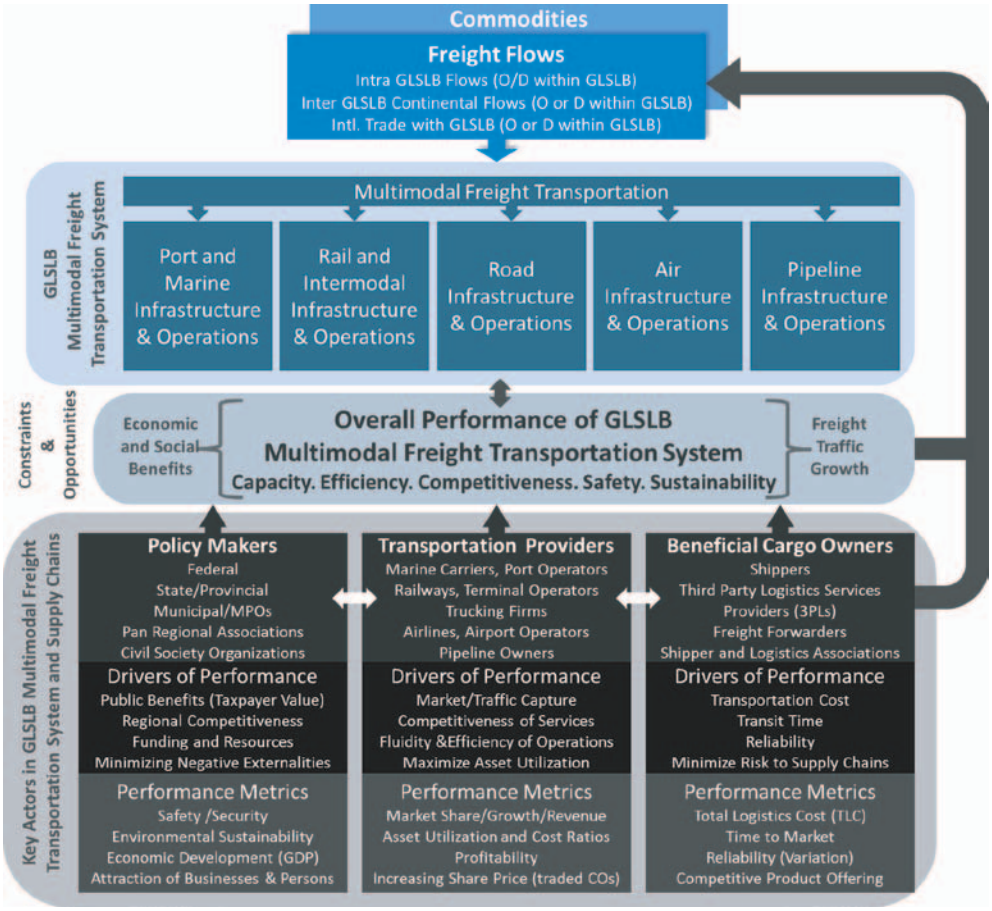
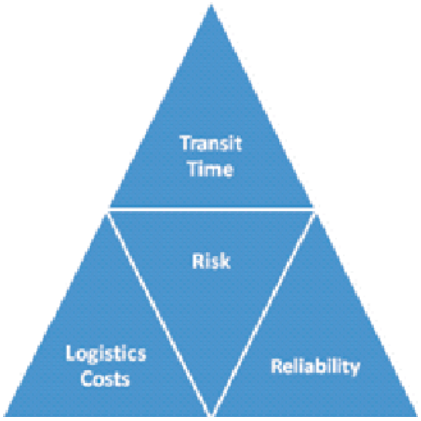


Figure 3-37. Multimodal freight transportation performance framework.

The perspective of the freight (shippers) is arguably most salient in assessing the performance of multimodal transportation. By and large, shippers assess freight transportation performance on the basis of total logistics cost, transit time and reliability, and related risks thereto.



- **Logistics costs:** Considers the full array of costs to make products available to the final consumer, namely transport, warehousing, and transshipment. Supply-chain managers are particularly sensitive to the stability of the cost structure (consistent costs), implying that routes having cost fluctuations may be discarded in favor of routes of a higher cost, but with less volatility. The concept of cost is relative since its importance is in relation to the value of the cargo being carried. Cost considerations tend to be primary considerations for low-value cargo, such as commodities (e.g., paper) more so than high-value goods (e.g., electronics).
- **Transit time:** A factor that is increasingly being considered, since it strongly influences inventory carrying costs and inventory cycle time, is supply-chain management. So, for cargo that has a higher value (clothing) or is perishable (food products), the routing option that is the fastest and/or shortest will often be preferred.
- **Reliability:** Relates to a factor that is mitigated by contemporary supply-chain management practices. For several supply chains, time can be a secondary factor as long as shipments arrive at the distribution center within an expected time frame. This is particularly important for industries that use a just-in-time (JIT) inventory management practice, such as parts of the automotive sector. If shipments are regular and reliability remains consistent, it is possible to organize supply chains accordingly by having more inventory in transit.
- **Supply-chain risk:** Relates to a factor that is generally imponderable and generally involves the level of confidence that the shipment will reach its final destination within expected costs, time, and reliability considerations. This also relates to shipment visibility; information about where freight is in the logistics process is extremely valuable, especially in uncertain periods of demand or if disruptions are likely. Low-risk routes or modes are obviously preferred over higher-risk routes.

Transportation decisions, including routing, mode selection, and other supply-chain decisions, including location decisions and inventory planning, are primarily made on the basis of appropriate tradeoffs between these performance factors as well as the characteristics of the freight, including origin and destination.

3.4.2 Commodity Perspectives on Multimodal Freight Transportation Performance

The multimodal freight transportation system in the GLSLB handles a diverse range of freight, serving a wide range of industries. The major commodities moving to, from, or within the GLSLB include coal (largely for regional power production), iron ore (for regional steel production and export), grain and other agricultural products (local consumption and export), automotive and machinery (supporting local manufacturing base), and other manufactured goods (including containerized imports for regional distribution, consumption, and exports). The importance of these commodities varies significantly when it is measured in weight or value (Figure 3-38).

The transportation needs of these commodities depend both on their intrinsic characteristics (e.g., weight, value, volume, perishability) and their market characteristics (e.g., origin, destinations, cost of alternative transportation). The following table (Figure 3-39) summarizes the interaction between modes and commodities for flows moving to, from, or within the GLSLB.

The "performance" of a transportation mode is assessed differently by different commodities on the basis of their different requirements. The following section explores some of the performance implications in the context of major GLSLB commodity supply chains.

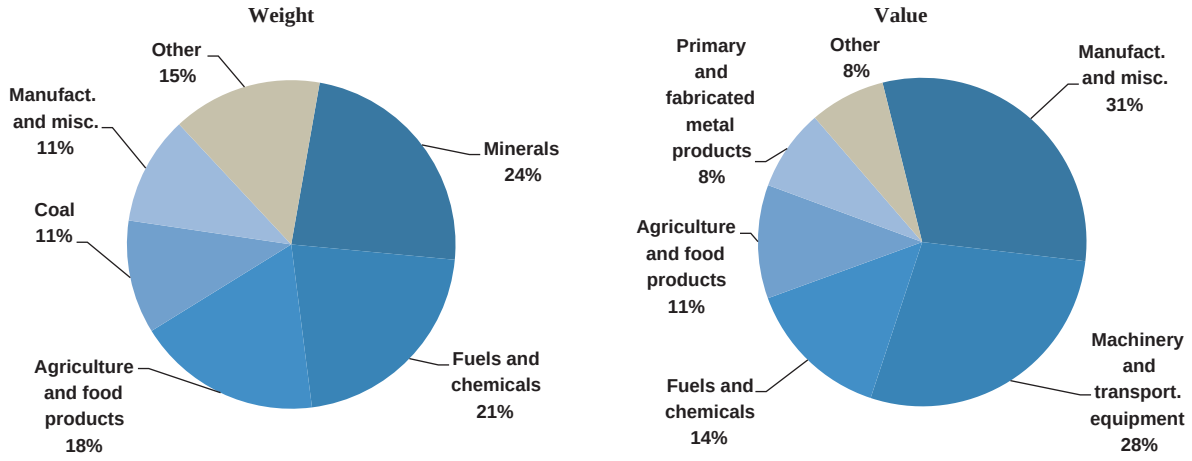
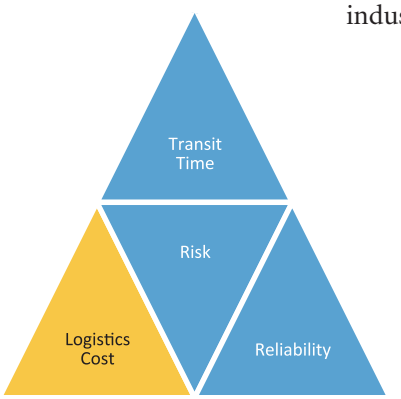


Figure 3-38. Top 5 commodities groups with an origin or destination in the GLSLB (Source: CPCS analysis based on modal data presented in Section 3.3).

3.4.2.1 Coal

Coal, one of the most significant single commodities transported by volume in the GLSLB, is largely captive to its transport chain, moving between three coal-producing regions (largely outside the GLSLB) to regional coal-fired power plants in the GLSLB, and to a lesser extent regional industries. In 2009, the region consumed 307 million tons of coal.



Coal is a low-value commodity and is relatively easy to stockpile. Accordingly, coal supply chains are less time sensitive than higher-value or hard-to-store commodities and thus generally favor lower-cost modes of transportation. Three major transportation modes carry large amounts of coal in the GLSLB: rail, barge/water, (short-haul) truck. Because coal is typically used for regional power production in the GLSLB with steady long-term demand, the performance of transportation providers, including cost, is typically anchored into long-term contracts. Coal's supply chains operate largely independently of other commodity supply chains (given different origins/destinations, etc.), but some parts of the regional rail, water, and, to a lesser extent, road network are shared with other commodities (and capacity is thus shared) (Figure 3-40).

3.4.2.2 Automotive Parts and Machinery

Automotive parts and machinery transportation is most significant in the GLSLB in terms of freight values. The industry is well integrated, with parts manufacturers and assembly plants on both sides of the U.S.–Canadian border, and processes often requiring goods to cross the border numerous times for the production of a vehicle (Figure 3-41). Michigan, Ontario, Ohio, and Indiana are major players in the region's automotive industry. Most of the industry inputs (e.g., parts) are regionally produced or warehoused close to the vehicle assembly plant due to JIT initiatives adopted a decade ago, but some are imported to the region, with particularly large quantities coming from Mexico through Texas (mostly by rail), or through the Port of Montreal and the Port of New York. Trade with Canada is central to the region's industry, with nearly 20 million tons of goods crossing the border each year, mostly through Detroit. The industry, of course, also serves both national markets, with significant volumes of finished products moving to large population centers. Plants serve both national markets, so products often cross the border for final delivery in markets outside the GLSLB.

Mode	Million tons	% (weight)	$ per ton	% (value)	Top Three Commodities by Mode By weight		Top Three Commodities by Mode By value	
Air	8.3	0.1%	$116,020	12.8%	Manufacturing and misc.	55.1%	Manufacturing and misc.	68.7%
					Machinery and transport. equip.	21.8%	Machinery and transport. equip.	24.9%
					Pulp and paper products	5.9%	Primary and fabric. metal products	1.9%
Marine	1,152.2	15.3%	$270	4.1%	Minerals	30.2%	Machinery and transport. equip.	38.2%
					Coal	22.4%	Fuels and chemicals	17.0%
					Fuels and chemicals	22.4%	Minerals	9.0%
Truck	4,742.8	63.0%	$1,160	72.8%	Minerals	25.8%	Machinery and transport. equip.	28.6%
					Agriculture and food products	23.3%	Manufacturing and misc.	26.1%
					Fuels and chemicals	17.2%	Agriculture and food products	14.1%
Rail	1,169.5	15.5%	$490	7.6%	Coal	49.2%	Manufacturing and misc.	33.1%
					Minerals	17.2%	Machinery and transport. equip.	32.3%
					Agriculture and food products	11.2%	Primary and fabric. metal products	9.4%
Pipeline	456.4	6.1%	$440	2.7%	Fuels and chemicals	100.0%	Fuels and chemicals	100.0%
					-	-	-	-
					-	-	-	-
All Modes	**7,529**	**100%**	**$1,003**	**100%**	**Minerals**	**23.5%**	**Manufacturing and misc.**	**30.6%**
					Fuels and chemicals	**21.3%**	**Machinery and transp. equip.**	**28.1%**
					Agriculture and food prod.	**18.1%**	**Fuels and chemicals**	**14.3%**

Figure 3-39. Modal and commodity breakdown of GLSLB freight flows (Source: CPCS Analysis based on modal data presented in Section 3.3).

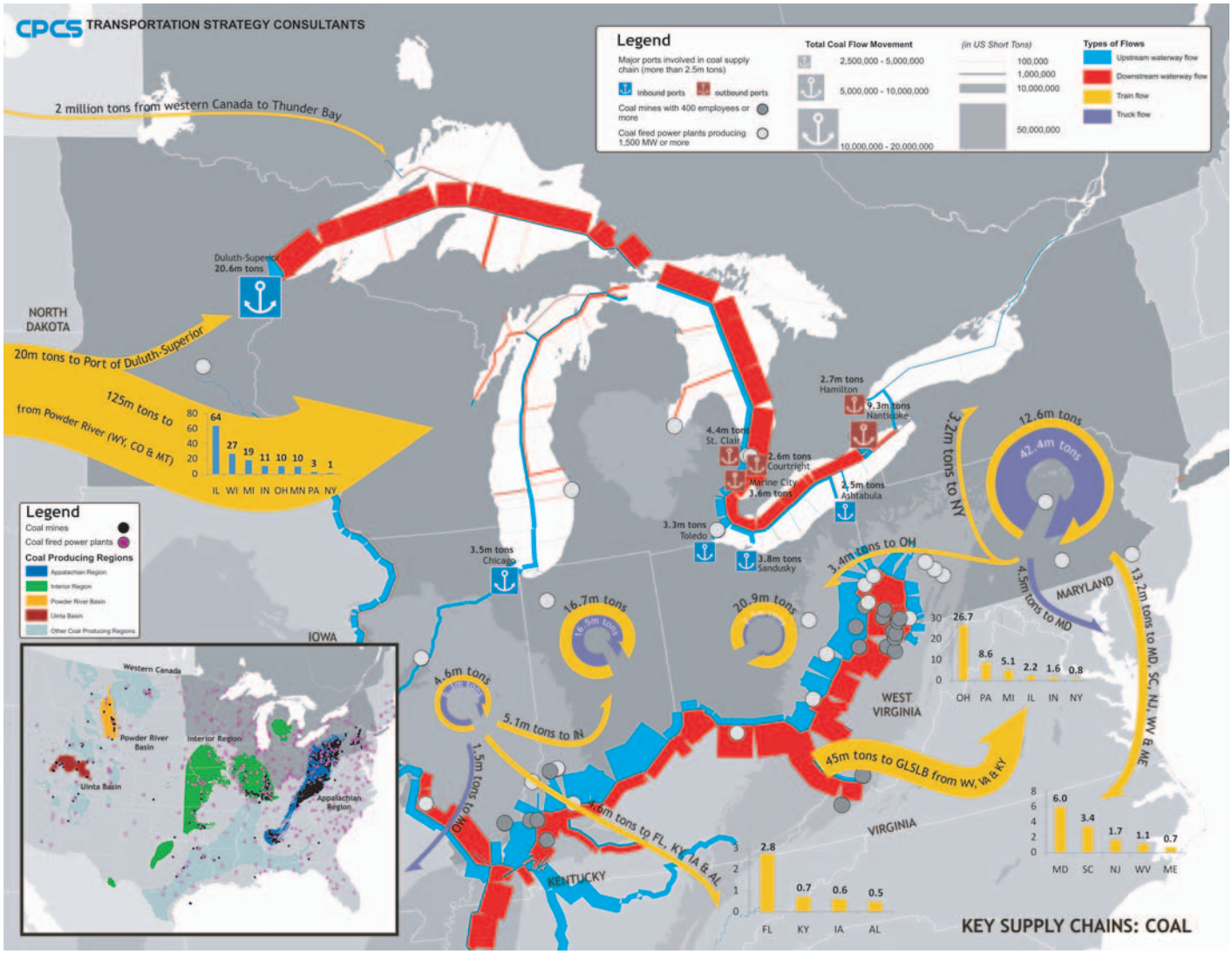


Figure 3-40. Multimodal freight transportation performance framework (Source: U.S. National Atlas, Ontario Power Generation, USACE, Statistics Canada).

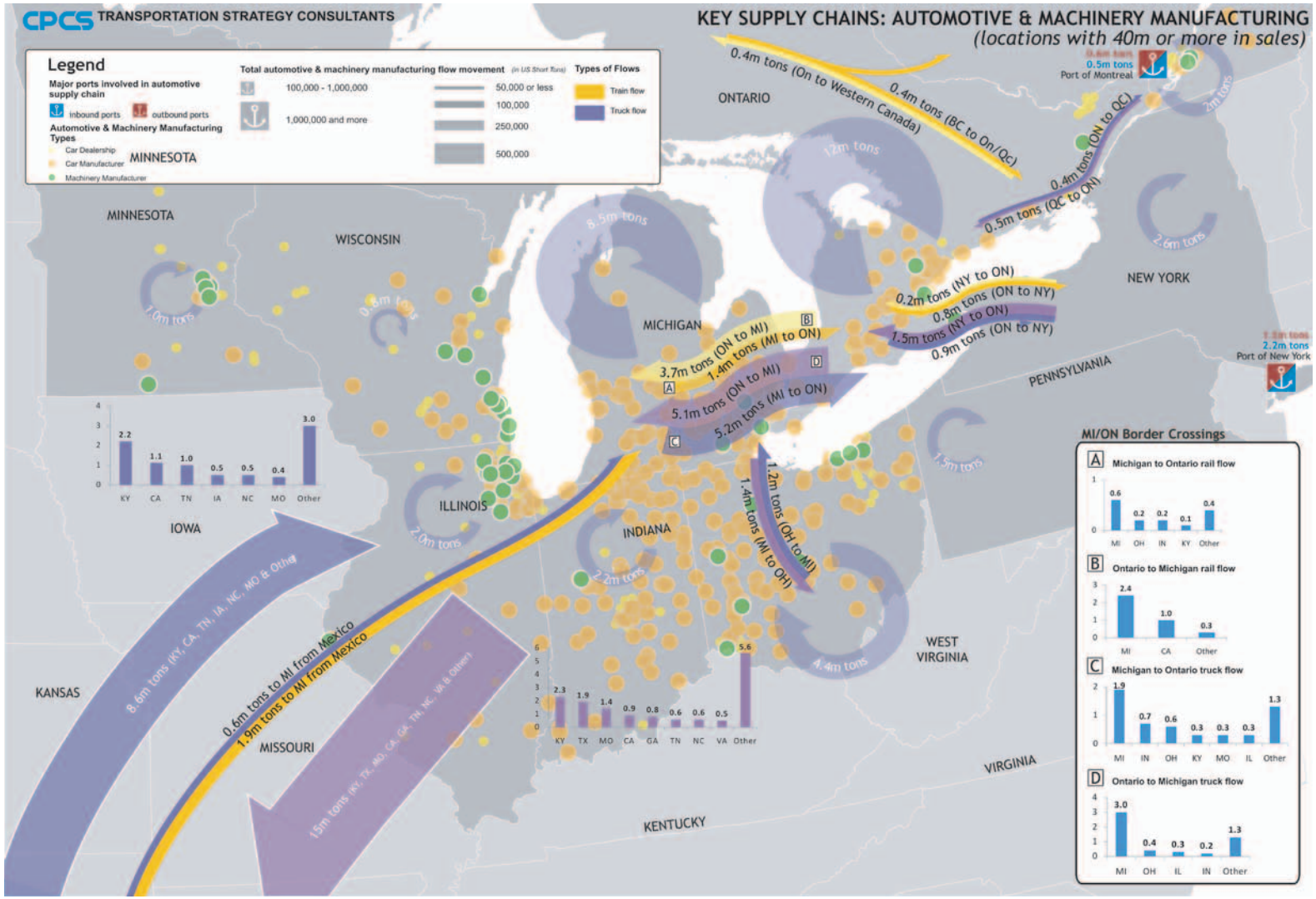
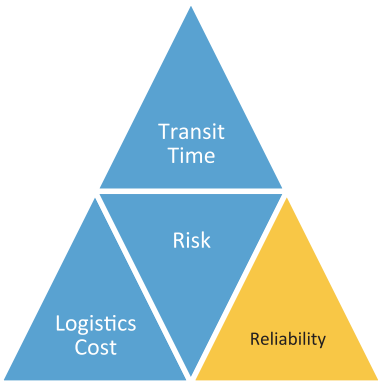


Figure 3-41. Key supply chains: automotive and machinery manufacturing (Source: USACE, Statistics Canada).

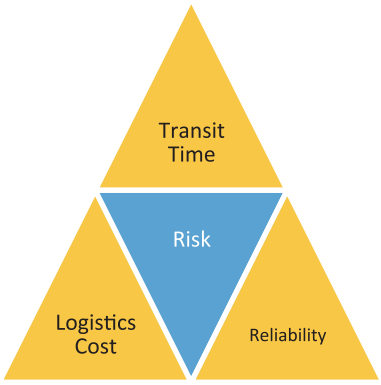
Given the importance of parts as inputs into the automotive manufacturing process, reliability is arguably the most significant driver and determinant of freight transportation performance for automotive supply chains in the GLSLB. The automotive industry relies mainly on truck for the movement of parts within the region and intermodal rail/truck for the import of parts. Given the time-sensitive production process, reliable and frequent deliveries are generally essential. This means that truck is often the mode of choice for intermediate inputs (e.g., parts). Final products, mostly fully assembled cars, are often transported by rail to final markets within North America. Spare parts and replacement components often move by truck due to order sizes and quantities.



3.4.2.3 Consumer Goods (Containerized)

Consumer goods and general cargo, moving in intermodal containers, also represent a significant share of regional freight traffic (Figure 3-42). Chicago is the region's undisputed intermodal and regional distribution hub with nearly 20 intermodal facilities serving a number of Class 1 railways, providing linkages to West Coast ports (Vancouver, Los Angeles/Long Beach, Seattle and Tacoma, Prince Rupert) and East Coast ports (including Montreal, New York, and Philadelphia). Chicago is the rail crossroads of North America connecting eastern and western U.S. Class 1 carriers with the two Canadian Class 1 carriers. This creates Chicago's dominant freight position given its easy accessibility via rail, road, water, or air from every U.S. border and coastal gateway.

Depending on what's inside the container, intermodal freight traffic can be high value (e.g., electronics) or lower value (construction materials or backhaul grain shipments for export). Most intermodal traffic moves by long distance by rail between coasts (import/export port) and the GLSLB. Truck transport moves intermodal freight the last/first mile, contributing to urban congestion, which, in turn, increases logistics costs, reduces reliability, and lengthens transit times for the movement/distribution of intermodal traffic. The performance of intermodal traffic is typically defined and assessed on the basis of transit time and logistics costs, where the two are related. Higher transit times necessitate higher inventory requirements, which lead to higher total logistics costs and vice versa. Reliability is also of importance, though inventory management practices typically seek to provide buffers where supply-chain reliability can be a challenge. The optimal tradeoff between transit time and logistics cost really depends on the nature of the goods inside the containers, but suffice it to say that most shippers using intermodal are looking for faster transit times and lower costs.



The number of inland intermodal terminals has been reduced recently, due to the railroad focus of making fewer intermediate network stops, in favor of moving full trains between dedicated ramp pairs. Ocean carriers are rationalizing the number of inland terminals they support and have announced intentions of no longer supplying chassis in North America. This will mean that drayage operators and local truck firms may have to invest in chassis to pick up and deliver products. This will have a profound impact on the demand for off-terminal parking and staging. It will also result in a more disciplined appointment process for live lifts at the rail terminal.

3.4.2.4 Other Commodities

Other major GLSLB commodities flows (grain, iron ore, petroleum products, etc.) likewise have different supply-chain characteristics and performance drivers and exert different pressures on the GLSLB multimodal freight transportation system (Figures 3-43, 3-44).

3.4.3 Significance of Commodity Perspectives on Performance

The performance parameters of different commodities moving through the GLSLB can be significant. This is also significant with respect to assessing the performance of the GLSLB

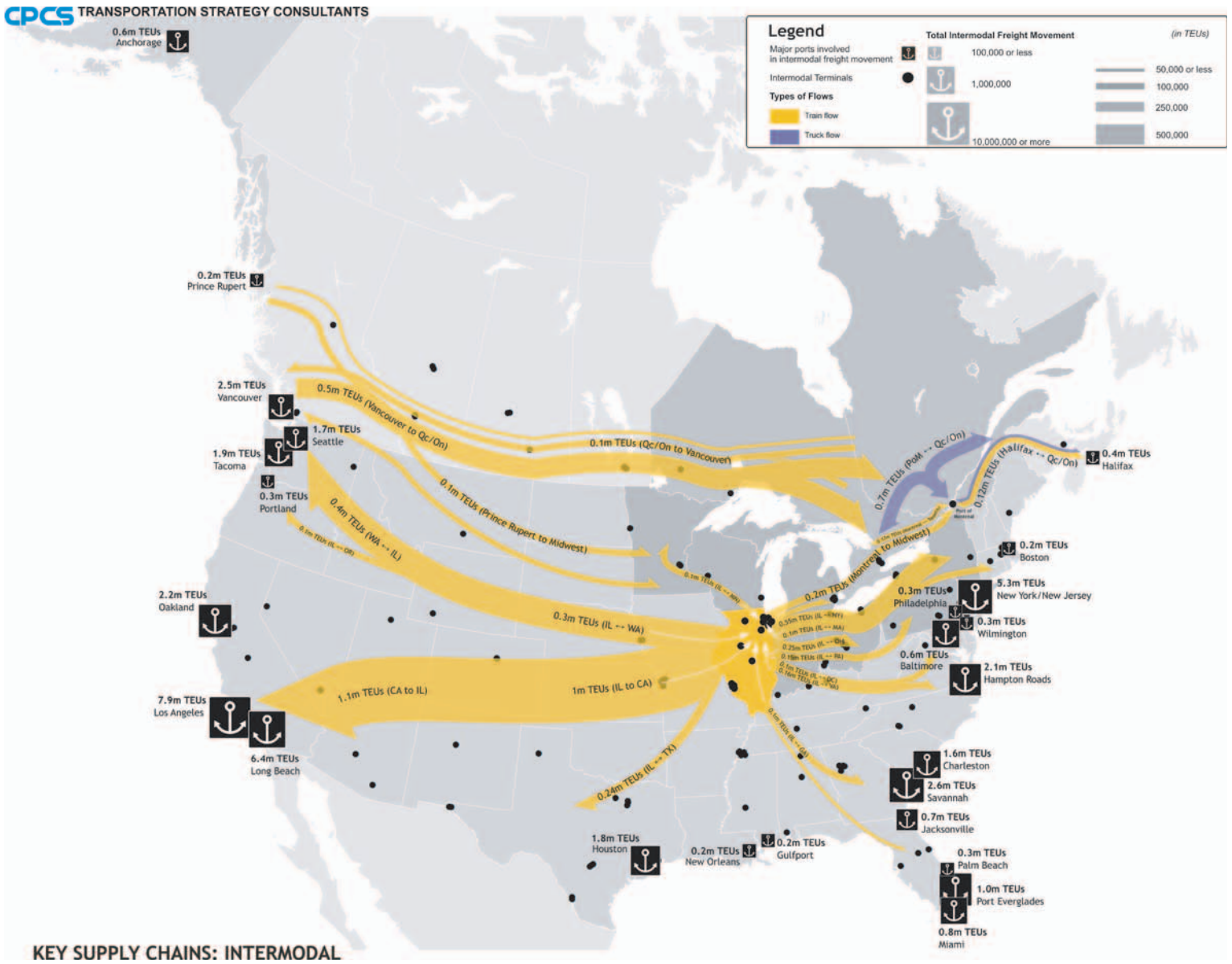


Figure 3-42. Key supply chains: intermodal (Source: Surface Transportation Board, Statistics Canada, Association of American Port Authorities).

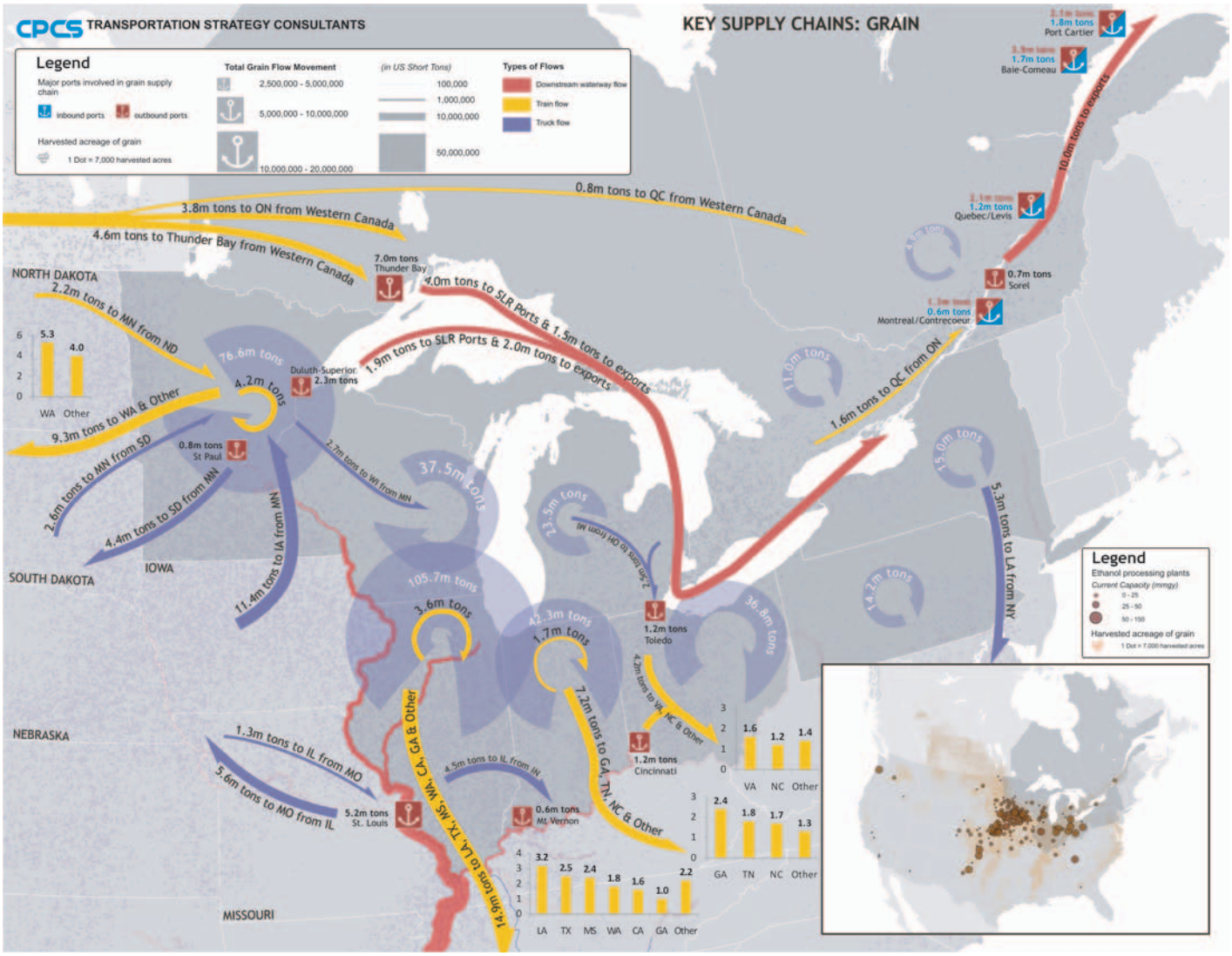


Figure 3-43. Grain supply chains in GLSLB (Source: USACE, Statistics Canada).

multimodal freight transportation system as a whole for a number of reasons. First, freight transportation performance must be assessed according to the respective supply-chain needs and goals of different commodities (e.g., coal vs. automotive parts vis-à-vis tradeoffs between transit time, logistics cost, and reliability). Second, different commodities and supply chains use the GLSLB multimodal freight transportation differently (different modes, different origins/destinations and routes, different requirements, etc.). Third, parts of the multimodal freight transportation system in the GLSLB are used and shared by many commodities (e.g., coal and containers moving on the regional rail network), in others they are not (e.g., iron ore and air parcel service). Some transportation performance issues could be shared or be in common with different commodities in some instances, and not shared or in common with others. For example, whereas urban road congestion may be a significant performance constraint for intermodal traffic, it is not for the movement of iron ore.

This creates a significant challenge for policy makers, transport planners, and researchers interested in understanding and improving the performance of the GLSLB multimodal freight transportation system as barriers and constraints to improving freight transportation performance

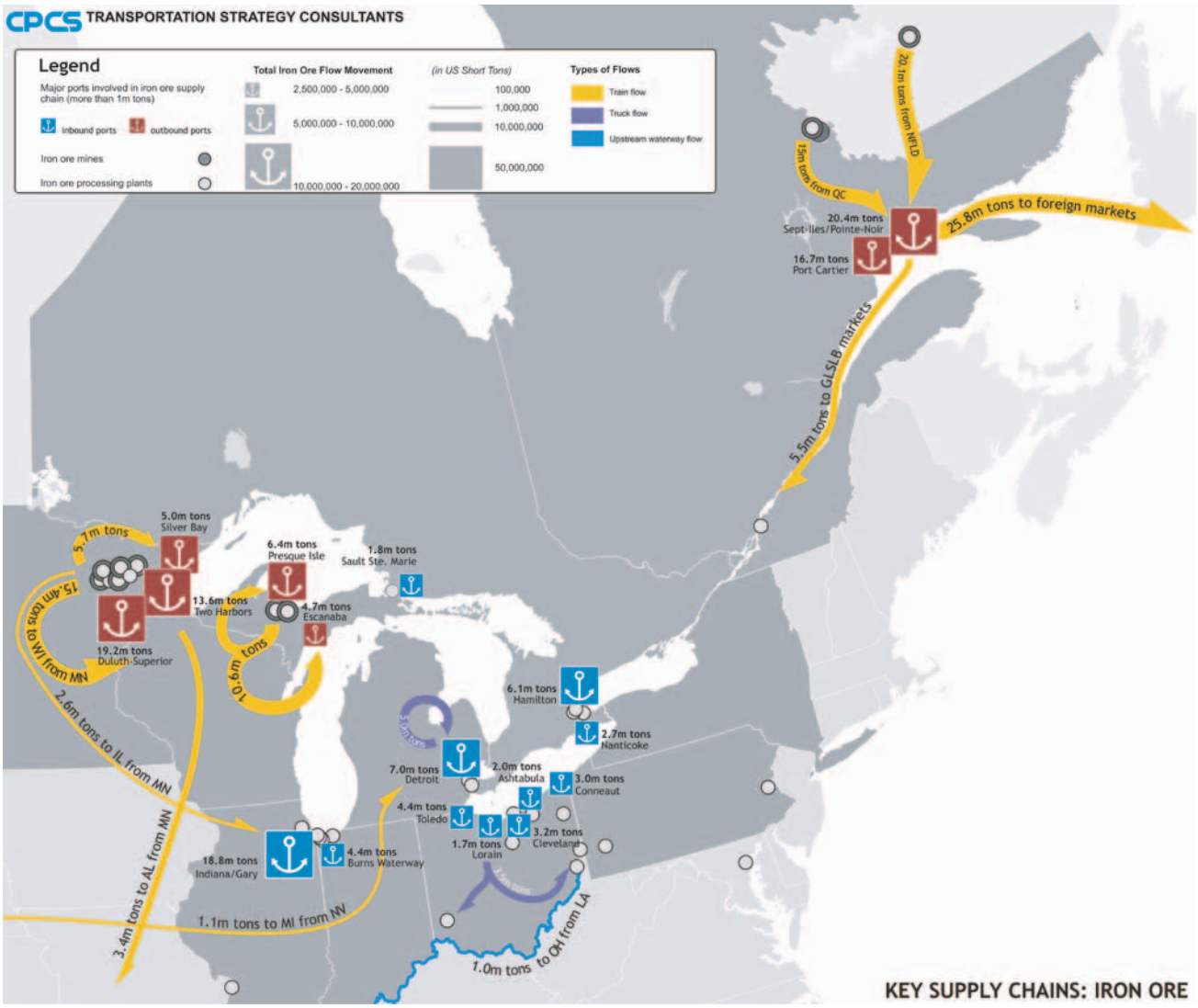


Figure 3-44. Iron ore supply chains in GLSLB (Source: USACE, Statistics Canada).

are often commodity supply-chain specific, as are the opportunities and initiatives to promote improved performance.

3.4.4 Assessing Performance of the GLSLB Multimodal Freight Transportation System

Unfortunately, good data on transport-chain transit times, costs, and reliability in the GLSLB is limited or nonexistent in the public domain (although freight forwarders, shippers, and supply-chain operators would be expected to track some of this data, it is generally deemed commercially sensitive and not made public). This is a notable gap in understanding the performance of the GLSLB multimodal freight transportation system and one which should be the focus of future research, to the extent possible[5]. Some ini-

[5]This future research would only be effective if conditions related to the availability of data change substantially or if provisions are made to ensure resources to gather selected information. Otherwise, this research would lead to the same conclusion: not enough data.

tial work is being done to assess transport-chain transit time, cost, and reliability metrics (albeit not specifically related to the GLSLB), although for the most part this is still in its infancy. Examples include the supply-chain fluidity indicators being developed by Transport Canada.[6]

Given the lack of performance data, we focus on the capacity, efficiency, and competitiveness of the GLSLB multimodal freight transportation system from the perspective of GLSLB stakeholders consulted for this study.

3.4.5 Capacity

Key Issues in Brief:

1) Road and rail most significantly capacity-constrained in the GLSLB, particularly around Chicago and other major urban centers.
2) Capacity constraints will get significantly worse over the next 30 years if not addressed.
3) Waterways and airports in GLSLB have excess capacity.

Road and rail infrastructure around major markets and freight transportation hubs in the GLSLB are capacity constrained. Figure 3-45 identifies road and rail capacity constraints in the GLSLB in 2007.

Four key messages emerge from this map. First, capacity constraints are most significant in and around large population centers in the GLSLB, including around Chicago, Detroit, Minneapolis, Toronto, and Montreal. Road congestion around these cities is in part due to passenger vehicles on the urban and peri-urban highway system that are intermixing with intercity truck movements[7]. Second, capacity constraints in the GLSLB are likely to intensify significantly over the next 30 years if appropriate measures to address capacity are not addressed. Third, capacity constraints are currently most significant on the region's roadways, but railways are likely to become increasingly capacity-constrained going forward. Fourth, if not addressed, capacity constraints will likely stretch further from urban centers, on both roadways and railways, creating new bottlenecks elsewhere in regional supply chains.

Unlike the regional road and rail system, the region's waterways and airports generally have excess capacity to handle freight. Excess capacity on the waterways was a recurring theme in discussions with stakeholders on both sides of the U.S.–Canadian border, although it was recognized that marine transportation was not always competitive for a variety of reasons discussed in the marine sub-section.

3.4.5.1 Capacity Constraints Around Chicago Most Significant

Capacity constraints and congestion are most significant around Chicago, the regional transportation hub for the GLSLB. This was noted by several stakeholders consulted.

"Chicago is a total modal bottleneck."

"All the trains and trucks are all trying to go to the same place at the same time."

(continued on next page)

[6]See http://www.tc.gc.ca/eng/policy/aca-acad-menu-683.htm for more details.
[7]Ring roads that were initially intended to facilitate intercity traffic, particularly for trucks, have now become "traps" where commuting interferes with intercity traffic.

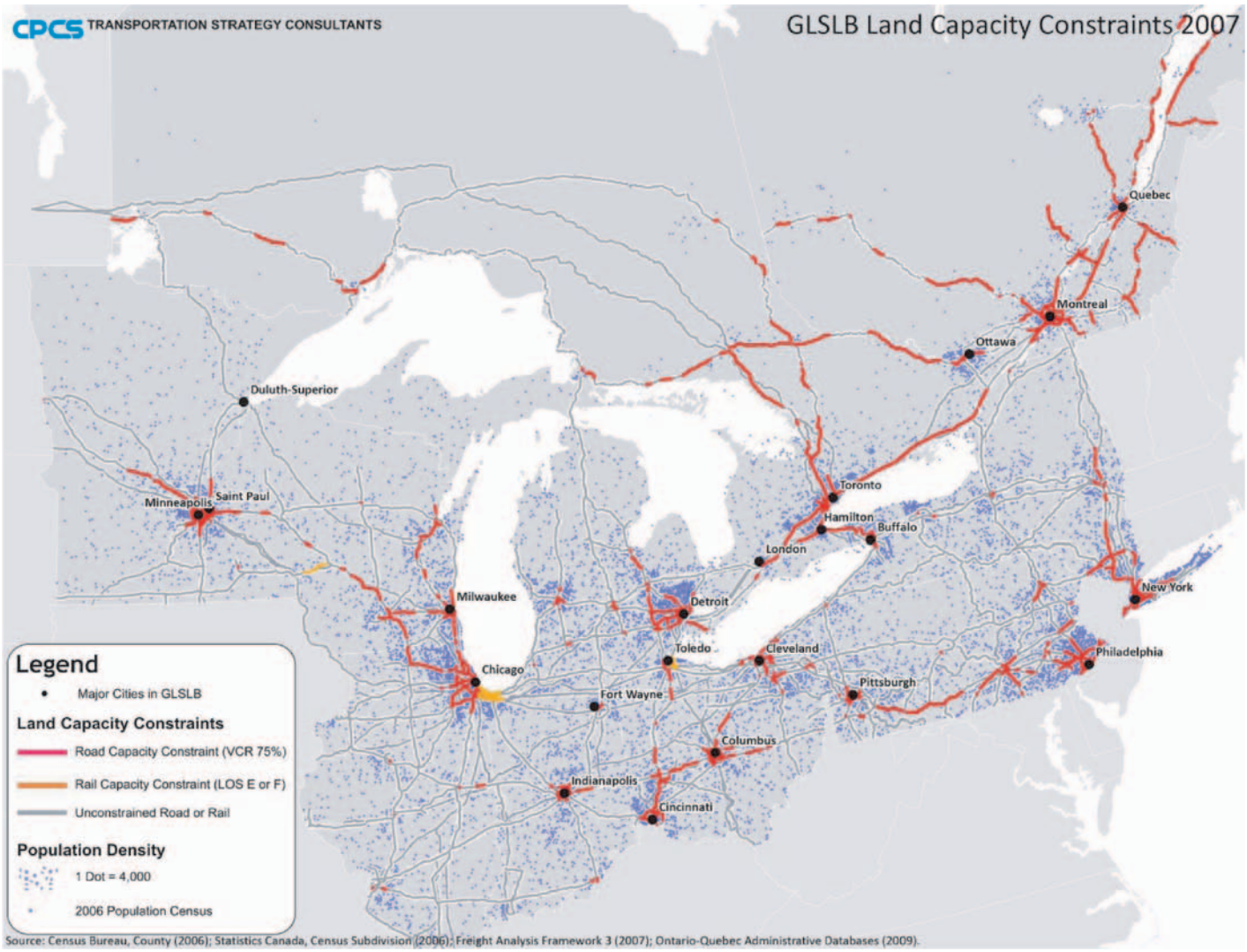


Figure 3-45. GLSLB land (rail and road) capacity constraints, 2007 (VCR = vehicle capacity ratio) (Source: CPCS analysis. Data from Census Bureau, County (2006); Statistics Canada, Census Subdivision (2006); Freight Analysis Framework 3 (2007); Ontario-Quebec Administrative Databases (2009), Cambridge Systematics (2007)).

> "Chicago's congestion is a big issue: there are backups at rail yards and intermodal connectors are in poor condition. The result is time lost, significant environmental impact, higher trucking fleet size and a need for more drivers."

Capacity constraints around Chicago and other major urban centers in the GLSLB are affecting transit time, cost, and reliability of transport chains, all which limit regional competitiveness. One stakeholder also rightly pointed out that the resulting congestion is leading to other negative externalities including increased emissions and other environmental and social costs, lost profitability and economic impacts, and so forth.

Ironically, it was noted by one stakeholder that "Chicago is such a major intermodal hub that it dampens the impetus to create a facility that might compete." This could in effect help alleviate some of the pressures on the Chicago region to the benefit of regional supply chains. Efforts to bypass Chicago are being spearheaded in Indianapolis, Kansas City, Memphis, and along the Meridian Speedway through Mississippi. As population shifts to the South, these load centers will also likely grow.

3.4.6 Efficiency and Competitiveness

Many of the public organizations interviewed for this study indicated that the "efficiency" and/or "competitiveness" of freight transportation systems was a major priority. However, few have concrete measures of the efficiency or competitiveness of regional supply chains. It is also notable that there exists little by way of public data or metrics on the efficiency or competitiveness of the multimodal freight transportation system in the GLSLB (most such metrics are developed by private-sector transport-chain players, including railways, trucking firms, and terminal operators, and are closely guarded).

Key Issues in Brief:

1) Little publicly-available data on efficiency and competitiveness.
2) Last mile and modal transfers source of many inefficiencies.
3) Potential marine mode could play a larger role in regional freight transportation, if barriers appropriately addressed.

For the purposes of this analysis, we have relied instead on input and comments from those consulted. Cited examples of inefficiencies in GLSLB supply chains include:

- Delays and variable wait times at land-border crossings.
- Inefficiencies in supply-chain integration at points of transfer.
- Congestion around major centers, including Chicago in particular, leading to slower transit times, higher costs, and reduced reliability, particularly for last mile moves.

One stakeholder commented on the risk to the region's competitiveness if congestion and other inefficiencies are not adequately addressed.

> "Chicago's competitiveness as a national freight hub is compromised and the consequence of worsening congestion in Chicago presents a real threat to freight system performance overall."

Another stakeholder summarized the broad implications of noted efficiency and competitiveness challenges in the GLSLB's transportation system.

> "These (multimodal transport chain) issues ultimately manifest themselves in reduced freight transportation system efficiency in terms of reduced shipment velocity and reliability, with attendant economic impacts (e.g., reduced competitiveness and potential loss of industry and jobs, increased costs for businesses and consumers), and social and environmental impacts (e.g., increased congestion and pollution)."

From a modal standpoint, shippers select modes that are best suited to the nature of their cargo and supply-chain needs, weighing a tradeoff between cost, transit time, and reliability. Generally, the marine mode offers the lowest per ton-mile cost, followed by rail and truck (not taking into account handling costs).

3.4.7 Competitiveness of the Marine Mode

Several stakeholders highlighted the potential role of marine transportation in the GLSLB multimodal freight transportation system. On the Great Lakes, the marine mode is, however, typically only competitive for heavy, bulky cargo moving longer distances (i.e., freight already moving by water). The failure of the recent container on barge Sea3 service between Hamilton and Montreal is a case in point. This service did not succeed in capturing new container traffic, despite the program's subsidization. This could change if a number of the noted barriers to the development of the marine mode are addressed appropriately. This would also make the marine mode more competitive with rail, although other barriers, including the closure of the Seaway during the winter, would remain.

3.5 Constraints and Barriers to Transport-Chain Performance in GLSLB

Modal constraints and barriers—both hard infrastructure constraints and soft regulatory or operational constraints—are fairly well understood in the GLSLB and discussed in the preceding modal sub-sections. What is perhaps relatively less well understood are multimodal and multi-jurisdictional transport-chain constraints, barriers, and related potential solutions. This section addresses some of the most significant and frequently cited barriers and constraints to the performance of the GLSLB multimodal freight transportation system.

3.5.1 Sufficiency of Data and Appropriate Performance Metrics

A major perceived gap in improving the performance of the GLSLB multimodal freight transportation system relates to the public availability of transport-chain performance measures. This hinders a full appreciation of the issues limiting transport-chain performance in the GLSLB and where measures to address performance are most warranted. Without performance data, it is nearly impossible to determine the cost benefit for transportation investments. Without performance data it is hard to pinpoint the root causes of delay in order to make the right investment in the right location. Without full understanding of the underlying performance problem, bottlenecks and chokepoints often get moved downstream to the next critical junction.

Several stakeholders underscored the need for better and more consistent performance metrics.

> "With better availability of freight data (cheaper, easier to access, disaggregated)—with better information, we could more effectively evaluate alternatives and invest more strategically in system performance."

Particularly useful performance measures would include transit time, cost, and reliability data, transportation productivity indicators and similar key performance indicators, as well as the metrics on the cost of negative externalities arising from transportation activity. Some such performance measures are developed and maintained by private operators (e.g., railways, terminal operators),

though this data is seldom made public for reasons of commercial sensitivity. Other data on logistics costs and transit times is known to large freight forwarders and shippers, although again, this data is seldom made public. One stakeholder summarized the issue as follows.

> "These (data) issues, coupled with the privately-owned infrastructure in the freight network, limit the public sector's ability to globally address performance issues in the overall freight network."

Additional research and analysis to develop and monitor transport-chain performance measures in the GLSLB and beyond would be a valuable step in identifying, managing, and planning for performance improvements in regional supply chains.

3.5.2 Barriers to Transport-Chain Integration

Several groups identified transport-chain integration issues as representing major barriers to the performance of the regional freight transportation system. Issues of transport-chain integration can be categorized as relating to modal integration as well as regional integration.

3.5.2.1 Modal Integration Issues

Lack of modal integration was cited frequently as a major barrier to the improvement of the multimodal freight transportation system in the GLSLB.

In many cases, comments pertained to issues of physical modal connections. For example, one stakeholder noted that the "limited degree of interconnectivity between modes is a weakness . . ." and cited as an example that "the otherwise (geographically) well-positioned ports of Oswego and Ogdensburg (to handle traffic moving on the Seaway) have poor rail connections." Another stakeholder noted that "there is no good connectivity between the modes. There are no intermodal container terminal facilities near the Great Lakes in Indiana."

Of particular relevance is that a significant source of delays in supply chains is related to the handoff or transfer of freight from one mode to another and the last mile. Containers, for example, often dwell at the port of entry or intermodal yard. While some have argued that dwell time can be built into an advanced form of load management, using terminals as a free warehouse, dwell times are often a function of uncertain transit times and performance. Railroads have made efforts to reduce dwell times by improving performance and also increasing penalties for loads left on the terminal for more than 24 hours. The key problem with dwell time is the risk associated with it, in terms of adding uncertainty to supply-chain transit times.

Additional comments related to other inefficiencies in the transfer of freight from one mode to another. One such example highlighted congestion around key intermodal facilities, in particular in the Chicago area. One stakeholder indicated that, "Chicago congestion is a big issue, backup at rail yards (are a problem), intermodal connectors are in poor condition." Secondary roads are often in poor condition, and turning geometry, particularly in older neighborhoods, often leads to extensive backups where left-hand or cross-traffic moves are required to enter terminals or container yards. The poor secondary road conditions contribute to equipment damage, tire failure, and missed cut-offs for train service.

Issues of modal coordination were also cited as barriers to performance. One stakeholder specifically noted a "lack of coordination and information sharing among participants (terminal operators, marine operators, rail, truck, and shippers, etc.) within the freight multimodal

transportation system." Port community systems are increasingly mitigating this issue, but it remains an important issue for overall multimodal transport-chain performance due to the high degree of industry fragmentation and the competitive nature of the business.

As a result of these and similar modal integration issues, many felt it was difficult to optimize or plan for performance improvements to the multimodal freight transportation in the GLSLB.

> "(Poor modal coordination) . . . results in an environment where it is very difficult for multimodal transportation solutions to develop, in the interest of shippers."

3.5.2.2 Regional Integration and Jurisdictional Coordination Issues

Regional and jurisdictional coordination issues were also noted by several stakeholders as a barrier to the performance of the multimodal freight transportation system in the GLSLB. As one state DOT put it, the "state is oriented to issues within its borders."

Most significant perhaps were issues of poor harmonization across state boundaries, including regulations about road size and weight limits. One stakeholder noted that, "Oversize overweight permit processes could be streamlined for multi-state use" (i.e., coordinated regulation to promote transport-chain performance). In Quebec, for instance, the vehicle truck weights are reduced in the spring (due to the thaw), yet this is not the case in Ontario, meaning that trucks moving from Quebec to Ontario and vice versa must operate with lower payloads. Another example relates to ballast water regulations, where the State of New York has taken a very different position on related requirements than other states and Canada, creating significant uncertainty for the marine industry in the Great Lakes and St. Lawrence Seaway. Border delays can also be attributed in part to jurisdictional coordination issues.

From a freight transportation planning perspective, most state DOTs and provinces are focused within their jurisdictional boundaries, as evidenced by the number of state-level freight and modal plans recently completed or currently under way in the GLSLB. There are, however, few, if any, truly overarching multimodal and multijurisdictional freight plans considered for the broader GLSLB region.

> "Better coordination with our neighbouring states and provinces, allowing for seamless travel between two or more jurisdictions, would benefit the entire industry."

Notable exceptions include the I-70 corridor initiative, undertaken jointly by Missouri, Illinois, Indiana, and Ohio (with federal funding), to look at the feasibility of dedicated truck lanes on that corridor. Although focused on mainly one mode,[8] this multijurisdictional initiative was cited by one stakeholder as representing "the only multijurisdictional (freight planning) coordination effort" in the GLSLB. Elsewhere, the I-95 and I-69 Corridor Coalition and NASCO provide other examples of attempts at multimodal, multi-coordination freight planning in the U.S.

In Canada, the federal government is working with Ontario and Quebec to develop a regional gateway and corridor strategy, which is multimodal and multijurisdictional in nature, although

[8]The study considered the impact of the measure on port and rail operations, but the initiative was focused on trucking.

U.S. agencies are not involved in this planning process (other than as stakeholders). Several stakeholders also noted a need for greater coordination across jurisdictions.

3.5.3 Lack of Mechanisms for Funding Multimodal Projects

Several stakeholders noted that there exists very little by way of multimodal funding mechanisms in the GLSLB. This appears to be particularly the case in the U.S.

> "Funding and funding policy is a barrier. Each mode is trying to optimize their own operation. Funds are still stovepiped. Need more multimodal and flexible funding options."

One stakeholder summed it up well: "Until this discrepancy is addressed, without flexibility, the only other solution would be to identify additional funding streams for multimodal freight projects, which is really not realistic in the current budget environments at both federal and state levels."

These and other similar comments underscore the perceived need for multimodal freight system planning and investment/funding as an important step to improving the performance of the GLSLB multimodal freight transportation system in the U.S. One U.S. stakeholder added that what was needed was a "federal funding process that gives higher priority to projects with regional and national significance in relation to more clearly defined national freight policy and goals—that is, federal funding for transportation that is more clearly focused on meeting economic goals (job creation, leveraging private-sector investment, increased exports and manufacturing capability)."

In Canada, the federal Gateway and Corridors Strategy initiative is one model that is being used to fund multimodal freight transportation projects. This program facilitates funding of strategic projects from a national Gateway and Border Crossings Fund. Most relevant to the GLSLB is the Ontario–Quebec Continental Gateway and Corridor initiative, which will soon announce its strategy and related multimodal freight transportation investment plans. A new Halifax to Michigan Corridor Partnership is also being contemplated to streamline international trade and exports.

3.5.4 Modal Inequality

Several stakeholders consulted spoke directly or indirectly to issues of modal inequality, particularly with respect to the marine mode. Specifically, it was felt that the host of additional costs and requirements imposed on the marine mode, including, but not limited to, cabotage restrictions, HMT, pilotage charges, lock tolls, icebreaking fees (Seaway), and numerous other regulatory barriers hinder the competitiveness of marine transportation in the GLSLB.

> "(There is not) . . . a level playing field across modes in terms of cost recovery/transfer to end users of transportation services."

From a multimodal perspective, modal inequality could be seen as preventing an optimal allocation of freight in the GLSLB multimodal transportation system (e.g., diversion of

traffic from congested roads to waterways with sufficient capacity). It is recognized that since different transport modes are under different jurisdictions and funding mechanisms, modal equality is conceptually challenging. Also, since waterway funding is generally low priority for state and municipal agencies, developing modal connections to alleviate highway or divert highway congestion to marine modes becomes out of reach financially for local support agencies.

Of course, policy makers cannot cause modal shift. Mode selection will remain a decision of shippers, making decisions primarily on the basis of the transit time, logistics cost, and reliability requirements of their respective supply chains. However, policy makers can take steps to internalize external costs of transportation (externalities) including emissions, road wear and tear, and the like, and, in doing so, promote modal switch in line with the incentives of shippers. While inertia may contribute to reducing the impacts of policies on modal shifts initially, eventually policy changes better reflecting the respective externalities of each mode should lead to long-term modal shifts.

3.5.5 Education

It was noted in consultations that there is a perceived lack of awareness about the importance of multimodal freight transportation in the GLSLB and related planning issues.

> "No one understands freight at the levels necessary. Water is underutilized, need to get everyone (public and private) at the same table. Without a common base of understanding it is hard to make progress or establish priorities. Without collaboration there is sub-optimization, waste, environmental damage, labor issues and poor asset utilization."

The education issue plays at different levels. It starts at the elected officials level since freight does not vote and those involved in the policy process too often tend to have limited understanding of the freight transport industry and its drivers.

Specific areas for greater awareness and education include:

- The role and importance of multimodal and multijurisdictional transportation linkages and supply chains.
- The role and cost metrics of intermodal transportation in linking transport chains.
- The role of the GLSLB multimodal freight transportation system, within a broader context of continental gateways and corridors.
- Drivers of shipper routing and mode selection decisions.
- The importance of coordinated multimodal, multijurisdictional freight planning and investment to promote transport-chain performance.

In terms of marine transportation, many agreed that there is a general lack of understanding of the value of marine for regional supply chains (both among policy makers and shippers), which hinders the development of the marine mode. One stakeholder summarized this succinctly: "most people are not aware of Great Lakes."

This NCFRP Project 35 study will hopefully go some way in addressing these limitations and promote further dialogue to encourage greater awareness of the GLSLB multimodal freight transportation system and planning actions to improve the system's overall performance going forward. Future multimodal research should continue to address barriers to awareness

and education of the role and importance of multimodal freight systems and barriers to their performance.

3.5.6 Labor

The current workforce in the transportation sector in the GLSLB, and indeed elsewhere in North America, is aging. This is particularly true for the trucking, rail, and marine mode, where the average age has been increasing for some time. In addition, there is a lack of new entrants into the industry. One trucking firm put it anecdotally: "This year, the average age of my truck drivers is 53. Next year, the average age will be 54." Similarly, the situation of the Great Lakes marine workforce in Canada is akin to "a burning platform," where every year the workforce gets older and closer to retirement.

There is a significant need to attract and train the workforce that will support the growing transportation needs of the GLSLB multimodal freight transportation system.

3.5.7 Concluding Comments on Barriers and Constraints

The implications of the noted barriers and constraints to the performance of the multimodal freight transportation system in the GLSLB is expected to manifest itself in increasing congestion, increased negative externalities, and reduced competitiveness for the region (increased cost and transit time, reduced reliability). In short, performance is expected to worsen, unless addressed appropriately. The implications for the economies of the GLSLB and beyond can be significant.

> "We need to invest in a higher level of freight system performance because it impacts supply chain diversity, transportation costs for businesses and consumers, GRP and GDP, U.S. trade balances, the quality of life and economic health of communities, and our country's long-term economic competitiveness on a global scale."

For the most part, the barriers and constraints noted, while notable vis-à-vis the performance of the GLSLB multimodal freight transportation system, are not specific to the GLSLB. As part of our consultation, we explicitly asked stakeholders if they felt the problems identified were specific to the GLSLB, or their respective sub-regions. Overwhelmingly, the response was "no."

> "While each city and region has its unique considerations in terms of geography, transportation infrastructure, and shipper and carrier mix and distribution, many of the basic threads are common across jurisdictions."
>
> "These issues (or variations of them) seem to be met in most multimodal corridors in industrialized countries."

In light of these comments, this study, and the opportunities and initiatives discussed in the following section, could provide some guidance for improving the performance of multimodal freight transportation beyond the GLSLB.

In terms of a way forward, several stakeholders have noted a need for a systematic and comprehensive regional and even national freight transportation plan that is multimodal and multijurisdictional in nature.

One stakeholder stressed the need to address other negative performance issues (externalities) as part of the future multimodal freight transportation planning process.

> "Need a holistic approach to multimodal freight performance planning/policy. For instance, greater emphasis on greener movement should be factored into policies to promote most efficient use of transportation system. (Need to look at regulatory environment on holistic basis—including environmental benefits, and develop policies accordingly.)"

As with the need for a greater focus on awareness and education, future research on multimodal freight transportation systems and performance would benefit from such a holistic approach to freight planning and policy.

3.6 Initiatives and Opportunities to Improve Performance of GLSLB Multimodal Freight Transportation System

There is a growing recognition among GLSLB transportation planners and policy makers that a multimodal supply-chain perspective is required to address the performance of the region's freight transportation system. Some related initiatives are underway to this end, and other related opportunities are being explored (as distinct from initiatives and opportunities that are mode specific, discussed in previous modal sections). These are discussed in this sub-section.

3.6.1 Multimodal, Multijurisdictional Freight Studies and Data

3.6.1.1 Multimodal Freight Transportation Studies

This NCFRP Project 35 study is the first broad bi-national study of the GLSLB multimodal freight transportation system. This in itself is an important initiative that will promote a broader understanding of regional multimodal freight transportation performance, issues, and barriers.

Within the GLSLB, a number of jurisdictions have undertaken regional freight transportation studies and plans. A summary of studies ongoing or underway include the following, as seen in Figure 3-46.

In addition to the state freight plans, other jurisdictions within the GLSLB have undertaken their own freight plans (e.g., municipal planning organizations (MPOs) or regional planning entities such as Metrolinx in Canada).

These regional freight plans could perhaps benefit from a broader GLSLB and even continental freight planning framework, in line with freight movements. This could help situate sub-regional freight plans (e.g., state or MPO level), within a context of broader gateways and corridors.

Freight Plan					
State/Province	**Multimodal**	**Rail**	**Marine**	**Road**	**Air**
Minnesota	Completed (2009)	Completed (2010)	N/A	Completed (2009)	In Progress
Wisconsin	Completed (2009)	Completed (2010)	N/A	Completed (2009)	Completed (2009)
Michigan	Completed (2005)	Completed (2011)	N/A	N/A	Completed (2008)
Illinois	Completed (2007)	Starting in 2011	N/A	N/A	N/A
Indiana	Completed (2007)	Completed (2009)	N/A	(Corridor Studies)	Completed (2003)
Ohio	Completed (2011)	Completed (2010)	N/A	N/A	Completed (2006)
Pennsylvania	Completed (2007)	Completed (2010)	N/A	N/A	Completed (2007)
New York	Completed (2006)	Completed (2009)	N/A	N/A	Completed (2009)
Ontario	N/A	N/A	Completed (2009)	N/A	N/A
Quebec	Completed (2008)	N/A	N/A	N/A	N/A

Figure 3-46. Summary of regional freight plans in GLSLB (Source: CPCS web search).

3.6.2 Freight Transportation Data

Data remains a major limitation for regional freight planning in the GLSLB, particularly freight transportation performance data. The availability of Freight Analysis Framework (FAF)[9] data in the U.S., and to a lesser extent Statistics Canada freight transportation data in Canada, is a step forward. Making U.S. and Canadian freight transportation data available in an integrated, consistent form and from one central repository represents an opportunity.

Freight transportation performance data (e.g., transit time, cost, reliability of alternative corridors, etc.) remains a significant gap and would be particularly valuable in informing regional freight plans.

While not specific to the GLSLB, Transport Canada is developing fluidity indicators to measure supply-chain transit times and costs for the movement of containerized imports and exports from port of loading to end market and vice versa through key gateways and corridors. The U.S. DOT is reportedly developing similar performance indicators, although we did not obtain any information on this work.

Several private-sector supply-chain actors, including carriers and freight forwarders, develop and track performance data but seldom make it public and have little incentive to do so at present. Examples include the performance metrics used by Canadian National (CN) and its supply-chain partners, which focus in particular on transit time, dwell times, and so forth, throughout the transport chain (per their Service Level Agreements [SLAs]). There is no question that such performance data, in aggregate form, would be very valuable for freight planners. It is worth investigating opportunities to access this data, and related incentives for private carriers to share this data, in particular information concerning the first and last mile of the supply chain.

3.6.3 Multijurisdictional Initiatives

A multimodal/multijurisdictional planning organization or initiative covering the full GLSLB region does not yet exist. There are however a number of multijurisdictional initiatives within the region.

[9]The Freight Analysis Framework (FAF) integrates data from a variety of sources to create a comprehensive picture of freight movement among states and major metropolitan areas by all modes of transportation. With data from the 2007 Commodity Flow Survey and additional sources, FAF version 3 (FAF3) provides estimates for tonnage and value by commodity type, mode, origin, and destination for 2007, the most recent year, and forecasts through 2040. Also included are truck flows assigned to the highway network for 2007 and 2040. Because significant changes in method affect comparability of statistics, FAF3 and FAF2 estimates may not be used together. Revised estimates of 1997 and 2002 commodity flows incorporating FAF3 methods are planned for release in the months ahead to support trend analysis. (http://ops.fhwa.dot.gov/freight/freight_analysis/faf/index.htm).

The government of Canada's Continental Gateway initiative (http://www.continentalgateway.ca), for instance, has been proving to be a useful model for improving regional freight transportation in the GLSLB, north of the border. Transport Canada is working closely with ministries of transportation in Ontario and Quebec and other regional actors to define an integrated, multimodal freight strategy for the region, and to make investments and plans accordingly. This work is guided by Transport Canada's National Policy Framework for Strategic Gateways and Corridors (http://www.canadasgateways.gc.ca/NationalPolicyFramework/national policy.html) to identify priority areas for improvement, investment, research, and analysis.

Although there are not yet comparable initiatives on the U.S. side of the border, there have been a number of regional initiatives to coordinate freight planning, typically on a modal basis, along Interstate corridors. The I-70 corridor initiative, undertaken jointly by Missouri, Illinois, Indiana, and Ohio, is an example, as is the work of the I-95 Corridor Coalition and North America's Corridor Coalition (NASCO), which reaches into the GLSLB. The I-69 corridor has been a NAFTA effort to connect auto manufacturers and parts providers on a common network between Canada and Mexico.

Other regional collaboration initiatives include the CREATE Program, a public–private partnership (PPP) that includes the City of Chicago, the State of Illinois, the federal government, and the freight and passenger railroads serving Chicago. This initiative is looking at operations improvements, grade separations, clearances, and truck route designations. It also monitors port and waterway improvements.

3.6.4 Multimodal Coordination Initiatives

A number of initiatives in the GLSLB are considering options for improving modal integration and/or modal shift.

Promoting Supply-Chain Integration. In response to the threat of new rail service regulation, freight railways in Canada have taken steps to improve service integration with other links in the supply chain, including ports and terminal operators, and to establish commercial mechanisms for ensuring higher degrees of service. This is being done through SLAs in which objective performance metrics are used to monitor performance throughout the supply chain to identify opportunities to improve performance, or otherwise to penalize poor performance.

Not unrelated, the Railway Association of Canada (RAC) commissioned CPCS to undertake a study on measures to support better supply-chain integration in North America. The outcome will be shared with member railways, supply-chain partners, and government in the coming months (see framework in Figure 3-47).

Promoting Modal Shift. Policy makers, on both sides of the border, often look to promote opportunities for modal shift where this can improve the performance of the overall freight system, reduce negative externalities from the movement of freight, or both. One stakeholder commented that:

> "Better coordination/use of other modes would greatly benefit our region—especially with a high percentage of goods on the roads—shifting to other modes may alleviate road congestion in certain areas. In particular, we have not made optimal use of (the Great Lakes) for the movement of goods and this is something that could be further explored."
>
> "A true system creates efficiencies of scale and takes advantages of the best features of each mode."

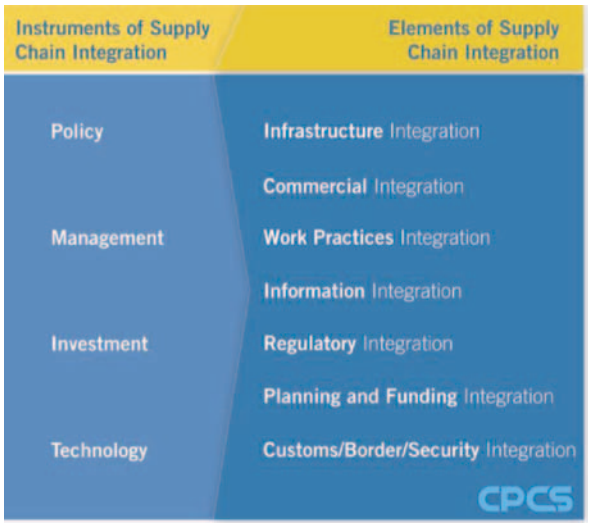


Figure 3-47. Supply-chain integration framework.

In contrast, one organization, representing shippers and carriers, noted that, "Public policy people care about modal shift. Shippers don't," underscoring the point that shippers are most concerned with some balance of transit time, cost, and reliability, not the mode used, per se.

Herein lies the key to promoting modal shift (and generating the desired policy benefits)—modal shift must provide added value to shippers, otherwise it will not happen.

To succeed in promoting sustained, long-term modal shift, public policy initiatives should be based on the premise that freight pays the full and true cost of transportation, including externalities, rather than short-term market interference (e.g., artificial incentives such as subsidies). Otherwise, once these incentives are removed, the distribution system would likely revert to its former state.

The current main inertia factors undermining a modal shift to an alternative mode are:

- Insufficient cost advantages of the alternative mode.
- Inadequate capacity, performance, and reliability. The alternative mode may not be able to accommodate the requirements of the existing distribution system, at least in the short term.
- Established distribution channels and trust between actors of the existing mode. Freight forwarders would be reluctant to use an alternative mode, even if it was potentially more advantageous, because the existing mode is well known.
- Regulatory conditions in the alternative mode may be more stringent, preventing, for instance, modal ownership.
- Lack of awareness of alternative modes of transportation.
- Risk of failure and loss of market share as result of a mode shift effort.

To identify true opportunities for mode shift, one first must determine what products may benefit from moving to the underutilized mode, as related to the supply-chain performance parameters of interest to that specific supply chain. This requires more information from shippers, which has been difficult to obtain for a host of reasons including commercial sensitivity.

There have been a number of initiatives in the GLSLB to investigate the potential value of modal shift to shippers. One such example is the Transport Canada study, "Hub and Spoke Container Transhipment Operations for the Marine Movement of Freight (Short Sea Shipping)."

Canada's Gateways and Border Crossings Fund

The National Policy Framework for Strategic Gateways and Trade Corridors will guide the development of a limited number of new gateway and corridor strategies and will help determine the projects to be funded by the Gateways and Border Crossings Fund. This $2.1 billion fund will focus on strategic trade corridors linking to international gateways. Eligible projects will include core National Highway System facilities affected by increased trade flows, inter-modal connectors and facilities, international bridges and tunnels, rail/road grade separations, shortline rail, short sea shipping, and intelligent transportation systems.

3.6.5 Funding

As noted, there is no pan-regional funding mechanism dedicated to multimodal freight transportation projects in the GLSLB specifically.

In the U.S., the recent TIGER grant process did solicit freight transportation projects, which were evaluated against national transportation priorities. In Canada, the Building Canada Fund (in particular the Gateway and Border Crossing Fund) and the Infrastructure Stimulus Fund both provide funding for projects that improve the performance of the multimodal transportation system.

3.6.5.1 The Potential for PPPs in Addressing Funding Challenges

PPPs represent a funding strategy that may help mitigate funding issues. For instance the Burlington Northern Santa Fe (BNSF) Logistic Park in Joliet was developed using a PPP model. The private sector is able to provide funding for projects where the public sector would be unable or constrained for one reason or another. Also, if the private sector is willing to invest in a transport project, it is a good indication that it is likely to be an economically sound project.

3.6.6 Infrastructure and Investment

A number of infrastructure investment projects are planned, underway, or recently completed in the GLSLB. Examples of significant projects plans (not all are funded):

- The Detroit River International Crossing.
- Detroit–Windsor rail tunnel to accommodate double stacking.
- The Heartland Corridor.
- CREATE Program investment—more than $3 billion (shared by the railroads, the State of Illinois, the U.S.DOT and the Chicago DOT).

Transport Canada is also expecting to soon announce its investment strategy for the Ontario–Quebec Continental Gateway and Corridor.

3.6.7 Education

There are a number of awareness and education campaigns promoting multimodal, multi-jurisdictional transportation planning in or connected to the GLSLB.

For instance, NASCO has developed a corridor-wide, tri-national educational consortium in an effort to further coordinate initiatives along the NASCO Corridor. The NASCO educational consortium brings together institutions that play a vital role in training the next generation of transportation innovators and providing critical studies and solutions to the ever-changing needs and requirements its corridor continues to face.

In the U.S. there are also a number of Transportation Centers, funded by the Highway Trust Fund, which support DOTs and public-sector planners. Great Lakes Maritime Research Institute (GLMRI), Mississippi Valley Freight Coalition and University of Michigan Transportation Research Institute (UMTRI), University of Toledo, and others provide academic support to the region.

Other entities, including the Southern Ontario Gateway Council, are also promoting awareness and education around the importance and need for regional freight transportation planning in the GLSLB.

3.7 Framework for Multimodal Freight Planning in the GLSLB and Beyond

The foregoing analysis and findings provide some guidance on opportunities to improve the planning process vis-à-vis the multimodal freight transportation system in the GLSLB and initiatives to improve its performance. One of the key messages to emerge from this study and from consultations with stakeholders in the GLSLB is the need for a well-informed, coordinated, and strategic approach to planning for improving the performance of the GLSLB multimodal freight transportation system.

To this end, we developed a regional multimodal freight transportation framework for consideration and discussion (Figure 3-48).

The following highlights the key components of the framework.

Need for Multimodal Freight Transportation Performance Data to Inform Planning Process. "What gets measured gets managed." At present, few organizations in the GLSLB use and track

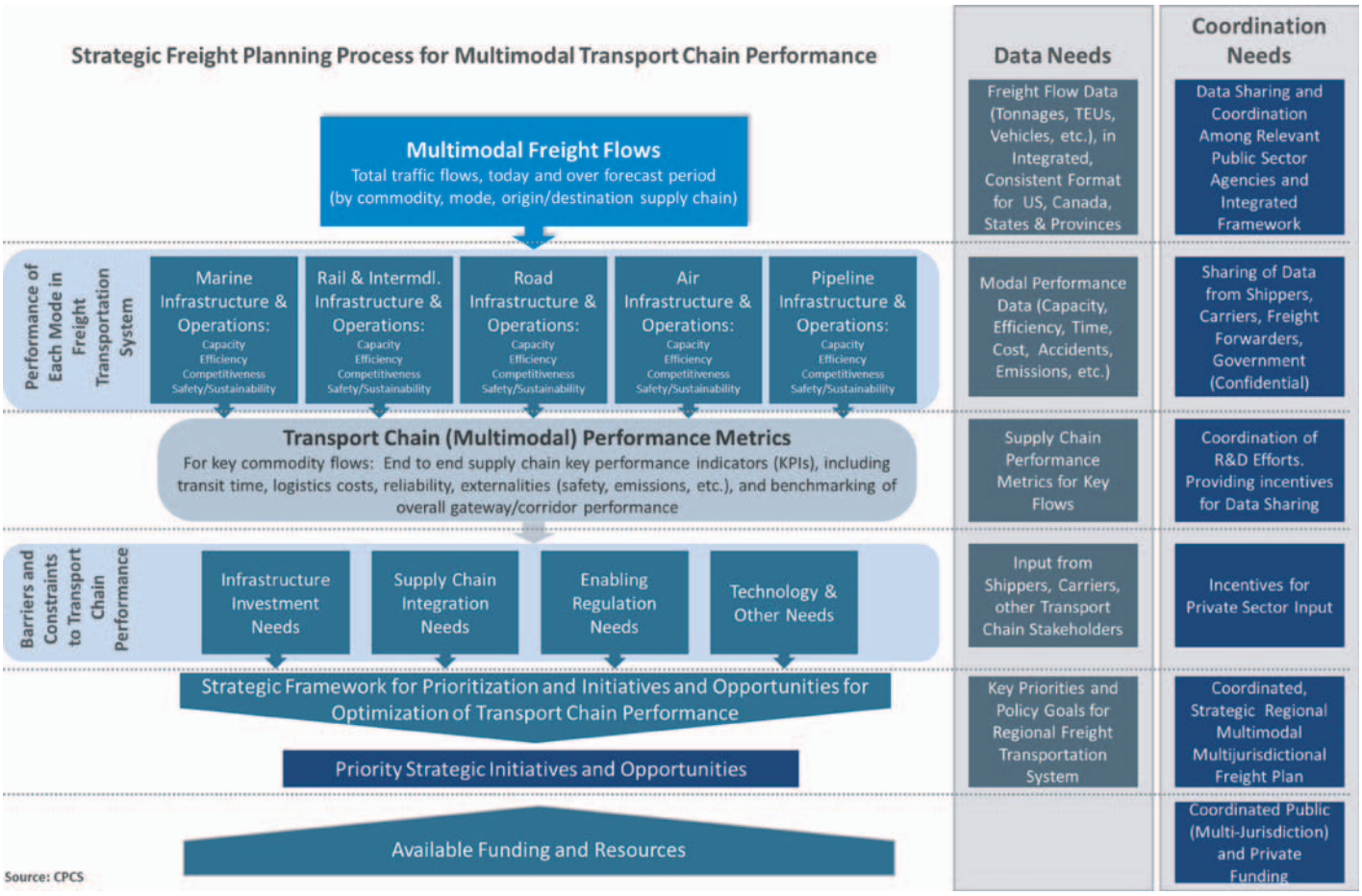


Figure 3-48. Strategic multimodal freight planning framework.

metrics on the performance of the regional multimodal freight transportation system in the GLSLB. This is in part due to limitations in data. Data on total freight flows are increasingly available publicly (e.g., FAF data in the U.S., Statistics Canada in Canada), although this data does not assess performance, per se (rather focused on volumes and throughput, etc.). Data is also available in different formats for different jurisdictions and modes, which can lead to a patchwork quilt of multimodal information. There is an opportunity to define regional and perhaps even continental freight data needs, and develop an integrated set of available data, in a consistent format, for use by transportation planners. One approach to do this would be to organize collaborative meetings among policy makers, planners, researchers, and other generators/users of freight data, from across different jurisdictions, to identify opportunities for data sharing and harmonization. Such meetings or related research could also identify data gaps or inconsistencies, which could be the focus of future research.

One stakeholder consulted for this study echoed this opportunity: "Best off if national data and regional data system was available and developed with the same methodology. There is not enough information on freight flows. Can't improve what you can't measure."

Also of importance are data and metrics on freight transportation performance. This should include key performance indicators (KPIs) on the individual components of the region's multimodal freight transportation system (e.g., KPIs for ports, railways, highways, airports, etc.), as well as multimodal freight transportation-chain performance indicators (including, in particular, metrics on transit time, cost, and reliability). Since much of this data is confidential or commercially sensitive, it will be important as a first step to define if and how relevant data can be obtained and used in a meaningful way. The forthcoming results of NCFRP Project 31, "Guidebook for Sharing Freight Transportation Data," may shed some light on this.

The development of transport-chain KPIs can also draw from ongoing work in this area, including Transport Canada's fluidity indicators and the Global Institute of Logistics' Container Terminal Quality Indicator.

Need to Assess Performance from a Multimodal and Commodity Supply-Chain Perspective. Freight moves from a particular origin to an intended destination, which can span several transportation modes and jurisdictions. The performance of the related supply chain is a function of each component of the related transportation system. If one link in this supply chain is weak and leads to delays, increased cost, or reduced reliability, this negatively influences the overall supply chain for the freight in question and can, in turn, influence the competitiveness of particular corridors.

An analysis of the performance of multimodal freight transportation systems, such as in the GLSLB, is best assessed in the context of transport chains. This does not preclude modal-specific performance assessments, but emphasizes the importance of looking at the component parts of supply chains as integrated transportation systems and their overall performance vis-à-vis the movement of freight with respect to transit time, cost, and reliability, in particular.

One approach to do this is to focus on the transport chains of the major commodities moving through the GLSLB, from origin to destination, identify any performance issues in these supply chains, and assess possible solutions accordingly.

Need for Coordination of Transport-Chain Actors (Modal and Jurisdictional). An issue with the transportation planning process in the GLSLB and elsewhere is often that those involved in the planning process are focused largely on the specific region within their respective jurisdictions or modes within their respective mandates. State and provincial transportation planners in the GLSLB, for instance are largely focused on the road sector within their borders, with relatively limited focus placed on other modes or linkages to supply chains outside their borders. This point came up frequently in consultations:

"The private sector (shippers) is interested in a national network which performs seamlessly."

"Maybe the biggest issue for National System is that carriers have no borders."

"We need a national freight policy AND we need a continental one, a continental transportation strategy. Canada and Mexico are our biggest trading partners. We need a better way to efficiently move goods and products and services."

Similarly, municipal planners are focused on municipal roads within their jurisdictional boundaries. At the federal level, departments (e.g., MARAD, FRA, etc.) or divisions therein (Transport Canada Seaway and Domestic Shipping Policy) are often mode specific and work focused accordingly. While this is understandable, there is an opportunity and need to better coordinate transportation planning work with a focus across transport chains. This coordination should be multimodal, multijurisdictional, and multicommodity in nature.

Moving forward, one or more coordinating bodies can be established to work with regional and modal agencies as well as transportation providers, shippers, and their associations to work together to identify and address barriers to the performance of key supply chains and related multimodal freight transportation systems in the GLSLB and beyond. A pan–North American body, coordinating both U.S. and Canadian interests vis-à-vis the multimodal freight transportation system, could go some way in doing this. However, it is recognized that such an initiative risks becoming unwieldy as a result of all interests and constraints involved. As one stakeholder put it, there is a "need to coordinate agenda across jurisdictions." Albeit focused on one mode, the U.S.–Canadian cooperation in the management of the St. Lawrence Seaway was identified as an example of a successful multijurisdictional cooperation program.

There is also a risk related to the definition of jurisdictions that do not match well with the functional reality of freight distribution. The GLSLB, as defined by the states and provinces bordering the St. Lawrence and the Great Lakes, is not a functional region since proximity does not mean interaction. While some of its components are highly integrated, such as southern Ontario and Michigan, others are more related to processes taking place nationally or internationally. The CanAm Border Transportation Alliance is such an example. Another salient example is Chicago, which relates more to a North American dynamic than to the GLSLB. Therefore, focusing on a series of jurisdictions could even play against integration processes being advocated.

As a way forward, one state DOT suggested that it would be good for the U.S.DOT to allow corridor development and corridor authorities. The corridor authorities could receive funds from the federal government and direct the funds to the purpose (which states don't always do upon receipt of funds).

More ambitious perhaps, one stakeholder went so far as to suggest that, "We should secure the continent at its border, not the national border." This is a concept often referred to as extending the perimeter. For example, U.S. Customs is at the Port of Halifax to clear international cargo destined for the U.S. Figure 3-49 is a map of the major freight corridors in North America, based on freight and traffic volumes.

Need for a Strategic Framework to Identify Priorities. A strategic framework can help prioritize initiatives and investment to improve the performance of the GLSLB multimodal freight transportation system. This strategic framework should be anchored to key regional priorities

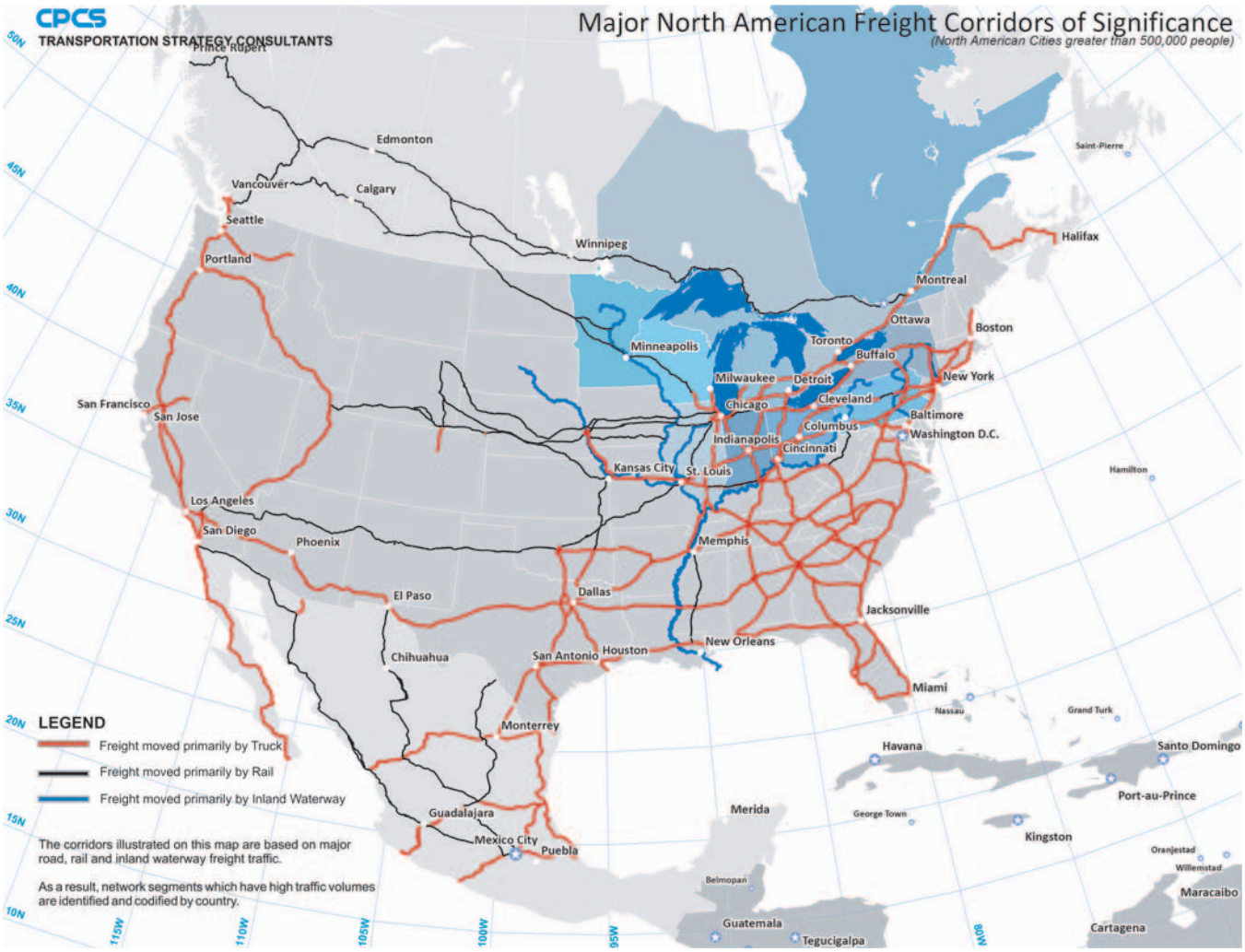


Figure 3-49. Major North American freight corridors (Source: CPCS map of U.S.DOT corridors of national significance).

and shared by all actors involved in freight transportation planning and operations. Several stakeholders consulted concurred.

> "There needs to be a multimodal transportation plan/strategy nationwide. Because freight volume will increase, we need a national plan to assure national competitiveness. Needs to include all modes."
>
> "Traditionally there is a political rather than objective, comprehensive approach to making improvements to the transportation system. . . ."
>
> "Personally, I believe there needs to be a vision for freight transportation for the U.S. This will help promote all regions (mega and otherwise) to strive for a common mission. Instead, the places that work well together will succeed and others will not. However, we are not competing with each other's regions anymore; we must compete as a nation in the global marketplace."

For instance, to guide its infrastructure priorities and related investment decisions, Transport Canada has developed a National Policy Framework for Strategic Gateways and Trade Corridors consisting of "five lenses."[10] A similar strategic framework could be used to guide initiatives to improve the performance of the multimodal freight transportation system in the GLSLB, although a national, or even continental, policy would likely be a better means of planning and improving freight transportation performance in North America.

Funding. The extent of freight transportation planning and investment in the GLSLB will be influenced by available funding, as well as funding mechanisms, policies, and cost benefit justification that validate investments. Clearly, available dollars will be a key constraint. What has proved useful in Canada in the context of funding strategic freight transportation infrastructure is a clear policy framework for prioritizing investment. The recent TIGER grant program in the U.S. could serve as a model, but dedicated for multimodal freight transportation investment, where the impacts are expected to be most significant.

One stakeholder indicated that, "The next (U.S.) federal transportation bill is the biggest opportunity. SAFETEA-LU had 'Projects of National Significance.' A continuation of this program or another program that recognizes multi-state, multimodal transportation project eligibility is essential if the public sector hopes to develop programs to advance the multinational logistics chains that we are trying to address."

3.7.1 Conclusion

The complexity of the GLSLB freight transportation system cannot be understated. It spans numerous modes, geographies, and jurisdictions. It serves a wide variety of commodity and supply chains. In such a complex system, making informed, fact-based policy decisions can be particularly challenging.

The multimodal freight transportation planning framework and needs discussed in this section are ambitious and in many respects represent a departure from the status quo approach to freight transportation planning in the GLSLB. They nevertheless may be a useful framework for addressing a number of the issues, barriers, and constraints noted by stakeholders consulted vis-à-vis freight transportation planning in the GLSLB. While the Great Lakes are currently a weak factor supporting the cohesion of the region (they are actually more a constraint that imposes road and rail bottlenecks), they may play a greater role in the future, particularly if this future involves substantially higher energy prices.

The headline from a recent conference on best practices in multimodal freight transportation planning underscores the potential for such an approach: "Benchmarking, collaboration could turn silos into orchestra (Transportation Summit 2011: Best Practices Shaping Global Logistics, Vancouver).

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[10]Five Lenses:

1) **International commerce strategy:** Gateway and corridor strategies must help align Canada's major transportation systems with the country's most important opportunities and challenges in global commerce;
2) **Volumes and values of national significance:** Gateway and corridor strategies must have, at their core, systems of transportation infrastructure that carry nationally significant trade volumes and values;
3) **Future patterns in global trade and transportation:** Gateway and corridor strategies must be forward-looking, addressing major trends in international transportation. Long-term planning is essential, but must be based on empirical evidence and analysis;
4) **Potential scope of capacity and policy measures:** Gateway and corridor strategies must have systems of transportation infrastructure at their core, but also go further to address interconnected issues that directly impact how well the system works and how well Canada takes advantage of it; and
5) **Federal role and effective partnerships:** For the federal government, gateway and corridor strategies must be grounded in both concrete responsibilities and real partnerships with other governments and the private sector.

The freight planning framework presented is unlikely to be realistic in the short term, but may set useful goalposts that could guide incremental improvement to the regional multimodal freight transportation system planning process going forward. As one of the stakeholders put it:

> "There is no revolutionary change. Performance is essential at the margin."

3.7.2 Communication Plan

Given the multitude of stakeholders and interests in the GLSLB multimodal freight transportation system, a communications plan plays a key role in disseminating the findings of this report to those who can best make use of it. Accordingly, the NCFRP Project 35 Communications Plan intends to:

- Inform stakeholders of potential system benefits as a result of joint action.
- Inspire collaboration and participation on a systematic approach for improvement.
- Create national awareness of an underutilized transportation system.
- Promote the use of the research and data for future uses.

The overall communication approach is to provide content for newsletters or member communication updates that is broadly targeted toward the specific audience profile of the three groups of key stakeholders: the public sector, educators and trade associations, and system users. Such communications will highlight most relevant research findings and will provide links and information on obtaining more detailed NCFRP Project 35 research. Further, numerous opportunities exist to connect with stakeholders at annual or regional meetings and conferences. This included a presentation of the NCFRP Project 35 findings at the TRB Annual Meeting in Washington, D.C., in January 2012 as well as at a number of other regional transportation conferences in the GLSLB.

3.7.3 Future Research

A number of areas for future research have been identified as part of this NCFRP Project 35 study of the multimodal freight transportation system in the GLSLB. As a point of departure, greater clarity is needed on specific regional/national/continental transportation policy objectives so that corresponding research goals and needs can be established. A strategic framework can then help establish key areas of research focus. The development of such a framework will require significant consultation, collaboration, and political commitment.

Then, more research is needed to better understand and measure the performance of freight transportation with respect to individual key supply chains in the GLSLB and beyond. This will require new approaches for acquiring, processing, and analyzing data, and the development and tracking of relevant key performance indicators (KPIs) that can, in turn, inform policy and investment decisions.

Based on our consultations, significant research work could be undertaken, focused in three intertwined areas: data development and sharing, collaboration and coordination, and the development of a strategic framework to guide these efforts and freight transportation planning (Figure 3-50).

Of course, further research and analysis to address the modal barriers and constraints identified in this report will continue to be important. But more research on multimodal and

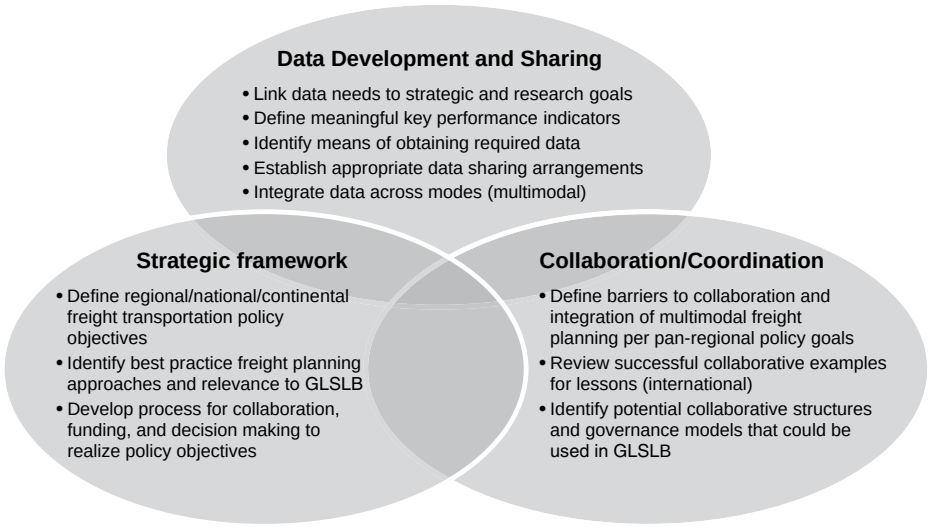

Figure 3-50. Future research in selected areas.

supply-chain–specific performance matters is particularly needed to inform a coordinated approach to strategic policy and investment decisions that are in line with regional, national, and continental transportation policy objectives. Further, greater input is needed in future research on and from the users of the regional multimodal freight transportation system, including shippers and carriers.

Acronyms/Abbreviations

AAR	Association of American Railways
AIS	Aquatic Invasive Species
BCO	Beneficial Cargo Owner
BNSF	Burlington Northern Santa Fe
BTS	Bureau of Transportation Statistics
CN	Canadian National
CP	Canadian Pacific
CPCS	CPCS Transcom Limited
CSA	Canadian Shipowners Association
CSX	CSX Transportation
Data	treated as a singular mass noun, to conform with common usage
DC	District of Columbia
DOT	Department of Transportation
DRIC	Detroit River International Crossing
EBTC	Eastern Border Transportation Coalition
EDRG	Economic Development Research Group
FAF	Freight Analysis Framework
FHWA	U.S. Federal Highway Administration
FRA	Federal Railroad Administration
GDP	Gross Domestic Product
GIS	Geographic Information System
GLMRI	Great Lakes Maritime Research Institute
GLSLB	Great Lakes–Saint Lawrence Basin
GLSLS	Great Lakes–St. Lawrence System
GLSLSS	Great Lakes–St. Lawrence Seaway System
GNR	Great Northern Route
GRP	Gross Regional Product
HMT	Harbor Maintenance Tax
JIT	Just-in-time
KPI	Key Performance Indicator
MARAD	U.S. Maritime Administration
MI	Michigan
MPO	Municipal Planning Organizations
NASCO	North America's Corridor Coalition
NCFRP	National Cooperative Freight Research Program
NHS	National Highway System
NY	New York
NYSDOT	New York State Department of Transportation

PPP	Public-Private Partnership
RAC	Railway Association of Canada
RFID	Radio-frequency identification
RORO	Roll-on/roll-off
SLA	Service Level Agreement
TC	Transport Canada
TIGER	Transportation Investment Generating Economic Recovery
TRB	Transportation Research Board
UMTRI	University of Michigan Transportation Research Institute
U.S.	United States
USACE	US Army Corps of Engineers
U.S.DOT	United States Department of Transportation
VCR	Vehicle Capacity Ratio (number of vehicles/capacity)

APPENDIX A

Selection of Literature Reviewed

Study Team Reference #	Reference
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8	CanAm Connections Study, WSA, 2008.
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Study Team Reference #	Reference
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31	Northern Minnesota and Northwest Wisconsin Regional Freight Plan.
32	Ohio-Ontario Lake Erie International Freight Ferry Feasibly Study, CPCS, 2009.
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34	Pennsylvania Transportation Institute, "Analysis of the Great Lakes/St. Lawrence River Navigation System's Role in U.S. Ocean Container Trade," August 2003.
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56	Wisconsin Truck Size and Weight Study 2008.
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APPENDIX B

Stakeholders Consulted

United States	
Organization	**Consultation Completed?**
US Federal	
US DOT	✔
Federal Highway Administration	✖
Federal Maritime Administration (MARAD)	✔
Federal Railroad Administration	✖
Former FRA Administrator	✖
US Coast Guard	✔
US State DOTs	
Chicago DOT	✔
Illinois DOT	✔
Indiana DOT	✔
Michigan DOT	✔
Minnesota DOT	✖
New York State DOT (1 of 2)	✔
New York State DOT (2 of 2)	✖
Ohio DOT	✔
Ohio Rail Development Commission	✖
Wisconsin DOT	✖
US MPOs	
Bay Lake RPC	✔
CMAP	✔
Detroit Region	✔
Duluth–Superior Metropolitan Interstate Council	✔
East Central WI RPC	✔
Greater Buffalo–Niagara Regional Transportation Council	✔
Michigan Area Council of Government	✔
Mid-Ohio Regional Planning Commission (MORPC)	✖
Northeast Ohio Areawide Coordinating Agency, Cleveland (NOACA)	✔
Northwestern Indiana Regional Planning Commission	✔
Southeast Michigan Council of Governments	✔
Southeastern Wisconsin Regional Planning Commission (SEWRPC)	✖
Toledo Metroplitan Area Council of Governments (TMACOG)	✖

Twin Cities Metropolitan Council	✖
West Michigan Shoreline Regional Development Commission	✔
Ports	
American Great Lakes Ports Association	✔
Burns Harbor, IN	✖
Chicago	✔
Cleveland-Cuyahoga Port Authority	✖
Detroit	✖
Duluth–Superior	✖
Green Bay	✔
Lorain Port Authority	✖
Manitowoc	✔
Marinette	✔
Milwaukee	✔
PennPORTS	✔
Port Huron	✖
Port of Oswego	✖
Toledo-Lucas County Port Authority	✔
Other Organizations	
American Association of State Highway and Transportation Officials	✔
Bucyrus	✖
Connexus Indiana	✔
Council of Great Lakes Governors	✖
Environmental Law and Policy Center (Rail Advocacy)	✖
Great Lakes and St. Lawrence Cities Initiative	✖
Great Lakes Commission	✖
International Air Cargo Association - Midwest Chapter	✖
Michigan Port Collaborative	✖
Midwest High Speed Rail	✖
Midwest Shippers Association	✔
Minnesota Rail Association	✔
Will County Center for Economic Development (Joliet Rail Complex)	✔
Wisconsin Trucking Association	✔

Canada	
Organization	**Consultation Completed?**
Canada Federal	
Transport Canada - Gateways and Corridors	✔
Transport Canada - Seaway Domestic Shipping Policy	✔
Canadian Provinces	
Ministry of Transportation of Ontario	✔
Ministry of Transportation of Quebec	✔
Canadian Municipalities	
Brampton / Vaughan	✔
Durham	✖
Hamilton	✔
Mississauga	✖
Montreal	✖
Peel	✔
Sault Ste. Marie	✖
Thunder Bay	✔
Windsor	✔
Ports	
Montreal Port Authority	✔
Toronto Port Authority	✖
Hamilton Port Authority	✖
Thunder Bay Port Authority	✔
Other Organizations	
Metrolinx	✔
Railway Association of Canada	✔
Southern Ontario Gateway Council	✔
Association of Canadian Port Authorities	✔
Canadian Shipowners Association	✔
St. Lawrence Seaway Management Corporation	✔
CSL	✖
Armateurs du St. Laurent	✔
Thunder Bay Community Economic Development Commission	✔
Ontario Trucking Association	✖

APPENDIX C

Validation Invitation List

United States
US Federal
U.S. Department of Transportation Maritime Administration (MARAD)
Federal Railroad Administration
Federal Highway Administration
Army Corps Buffalo
Army Corps Detroit
Army Corps Chicago
US Coast Guard
US State DOTs
Minnesota DOT
Wisconsin DOT
Michigan DOT
Indiana DOT
Chicago DOT
Illinois DOT
Ohio DOT
Ohio Rail Development Commission
New York DOT
US MPOs
Duluth–Superior Metropolitan Interstate Council
Twin Cities Metropolitan Council
Bay Lake Regional Planning Commission
Chicago Metropolitan Agency for Planning
Michiana Area Council of Governments
Northwestern Indiana Regional Planning Commission
West Michigan Shoreline Regional Development Commission
Toledo Metropolitan Area Council of Governments
Northeast Ohio Areawide Coordinating Agency, Cleveland
Mid-Ohio Regional Planning Commission
Greater Buffalo–Niagara Regional Transportation Council
Chicago Metropolitan Agency for Planning
Indianapolis Metropolitan Planning Organization
West Michigan Shoreline Regional Development Council
Southeast Michigan Council of Governments
Bay City Transportation Study
Genessee County Metropolitan Planning Commission
Southwest Michigan Planning Commission
Saginaw MPO
Bay County Planning Michigan
Rochester, NY Metropolitan Planning Organization
Mid-Ohio Regional Planning Commission
Akron Metro Transportation Study
Eastgate Regional Council of Governors
Erie Transportation Study
Southwestern Pennsylvania Commission

Mercer County RPC
Southeastern Wisconsin Regional Planning Commission
East Central Wisconsin Regional Planning Commission
Bay Lake Regional Planning Commission
Brown County Planning Commission
U.S. Ports
Duluth–Superior
American Great Lakes Ports Association
Green Bay
Manitowoc
Milwaukee
Marinette
Chicago
Burns Harbor, IN
Detroit
Port Huron
Toledo-Lucas County Port Authority
Lorain Port Authority
Port of Oswego
Cleveland-Cuyahoga Port Authority
Regional and Bi-national
Council of Great Lakes Governors
Highway H2O
Can-Am Business Council
Great Lakes and St. Lawrence Cities Initiative
Great Lakes Commission
Michigan Port Collaborative
American Association of State Highway and Transportation Officials
Will County Center for Econ Dev (Joliet Rail Complex)
Midwest High Speed Rail
Environmental Law and Policy Center (Rail Advocacy)
International Air Cargo Association - Midwest Chapter
MI Rail Assoc
Conexus Indiana
North America's Corridor Coalition
Gateways and Corridors Coalition
Trade Associations
Lake Carriers' Association
National Coal Trans Association
Transportation, Elevator and Grain Merchants Association
National Mining Association
Motor and Equipment Manufacturers Association
Minnesota Trucking Association
Wisconsin Motor Carriers Association
Illinois Trucking Association
Indiana Motor Truck Association
Michigan Trucking Association
Ohio Trucking Association
State Trucking NY
Penn Motor Truck Association
Ontario Trucking Association
Association du Camionnage du Quebec
Midwest Energy Association
Canadian International Freight Forwarder Association
Canadian Shipowners Association
Railway Association of Canada
Council of Supply-Chain Management Professionals
National Industrial Transportation League

Academic and Think Tanks
Great Lakes Maritime Research Initiative
Brooking-Great Lakes Initiative
Northeast-Midwest Institute
Great Lakes Transportation Enterprise Institute
Mid-America Freight Coalition
Canada Federal
Transport Canada
Canadian Provinces
Ministry of Transportation of Ontario
Ministry of Transportation of Quebec
Canadian Municipalities
Mississauga
Brampton / Vaughan
Montreal
Hamilton
Windsor
Thunder Bay
Durham
Sault Ste. Marie
Canadian Ports
Association of Canadian Port Authorities
Montreal Port Authority
Toronto Port Authority
Hamilton Port Authority
Thunder Bay Port Authority
Other Organizations
Metrolinx
Southern Ontario Gateway Council
St. Lawrence Seaway Management Corporation
Armateurs du St. Laurent
Thunder Bay Community Economic Development Commission

Canada
Canada Federal
Transport Canada
Canadian Provinces
Ministry of Transportation of Ontario
Ministry of Transportation of Quebec
Canadian Municipalities
Mississauga
Brampton / Vaughan
Montreal
Hamilton
Windsor
Thunder Bay
Durham
Sault Ste. Marie
Canadian Ports
Association of Canadian Port Authorities
Montreal Port Authority
Toronto Port Authority
Hamilton Port Authority
Thunder Bay Port Authority
Other Organizations
Metrolinx
Southern Ontario Gateway Council
St. Lawrence Seaway Management Corporation
Armateurs du St. Laurent
Thunder Bay Community Economic Development Commission

APPENDIX D

Stakeholder Consultation Guide

National Cooperative Freight Research Program (NCFRP), Project 35
"Multimodal Freight Transportation within the Great Lakes–Saint Lawrence Basin" [11]

RESEARCH OBJECTIVES

The objectives of the research are to i) describe the current multimodal freight transportation system and its performance in the Great Lakes–Saint Lawrence Basin (GLSLB), ii) define the economic impact of the freight transportation system on regional, U.S. and Canadian economies, and iii) identify opportunities and constraints to improving the performance of the multimodal freight transportation system in the Basin to meet future freight flows and maximize the economic potential of this system for the region and broader national economies. For more information, see:
http://144.171.11.40/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=2923.

CONSULTATION GUIDE

This consultation guide is intended to facilitate consultations with federal, state, provincial, MPOs, and other municipal stakeholders in the U.S. and Canada with an interest in the performance of the multimodal freight transportation system in the GLSLB.

Consultations will take place by telephone, email and in person, as appropriate. All responses will remain confidential, and will not be attributed, unless permission to quote is otherwise granted.

PART A—CONSULTATION RECORD

Organization name:	
Participating representative(s) name and title:	
Representative contact details (telephone and email):	
Permission to quote or otherwise reference in study report?	
Consultation completed by / date	

[11] This study has been commissioned by the Transportation Research Board (TRB), as part of its *National Cooperative Freight Research Program (NCFRP) for Fiscal Year 2010. CPCS Transcom Limited (CPCS) lead this study, in association with the Great Lakes Maritime Research Institute, the University of Toledo, Economic Development Research Group, Prime Focus and Sustainable Ports.*

PART B—INTEREST, ROLE AND AUTHORITY IN FREIGHT TRANSPORTATION SYSTEM IN THE GLSLB

1. What is your organization's interest, role and/or authority vis-à-vis the performance of the freight transportation system in the GLSLB?

2. What are the principal freight modes that your organization concentrates on? Of these, how do they rank in order of importance with respect to your organization's interests and jurisdiction?

3. Does your organization have, use, or track performance metrics or guidelines with respect to the performance of the multimodal freight transportation system in the GLSLB? What are these metrics or guidelines? Can you provide a copy of relevant material?

4. Do you feel that your organization has sufficient data to inform freight transportation performance issues in the GLSLB (Yes/No)? If not, what data would be required to better inform performance improvement initiatives?

PART C—ISSUES AND BARRIERS TO CURRENT PERFORMANCE OF MULTIMODAL FREIGHT TRANSPORTATION SYSTEM IN THE GLSLB

5. What do you view as the major issues or barriers to the performance of the multimodal freight transportation system in the GLSLB (modal and/or multimodal perspectives useful)?

6. How do these issues and barriers manifest themselves in poor or sub-optimal freight transportation performance, and how does this impact your jurisdiction/mandate/ industries/constituents, specifically (please use examples, as relevant)?

7. Do you see these issues and barriers as being unique to your region/jurisdiction, or are they associated with the wider multimodal transportation system?

8. From your perspective, what are the broader implications of these issues and barriers for the long-term performance of the multimodal freight transportation system in the GLSLB?

PART D—STRATEGIES, POLICIES AND PLANS TO ADDRESS PERFORMANCE ISSUES

9. Please describe any strategies, policies and other initiatives that your organization is undertaking with relevance to the future performance of the multimodal transportation system (e.g., Freight Plans). Who is responsible for developing these strategies, policies and initiatives? Can you share any relevant information/plans?

10. What specific investment plans is your organization undertaking to improve the performance of the multimodal freight transportation system in the GLSLB (or subset thereof)? What are the anticipated impacts and benefits from these investments?

11. Is your budget adequate to address the specific multimodal freight transportation performance barriers/constraints, as relevant to your organizations/authority/jurisdiction (Yes/No)? What were the approximate funding levels last year for related investments/initiatives?

12. How do you collaborate with other organizations or authorities in improving and/or removing barriers to the performance of the multimodal freight transportation system in the GLSLB?

PART E—OTHER OPPORTUNITIES AND CONSTRAINTS TO IMPROVING PERFORMANCE OF FREIGHT TRANSPORTATION SYSTEM IN GLSLB

13. What other opportunities do you see to improve the overall performance of the multimodal freight transportation system in the GLSLB? How can these opportunities be realized? Who should have a role in this (if beyond your organization's capabilities or mandate)?

14. What constraints exist to the development of initiatives to improve the performance of the multimodal freight transportation system in the GLSLB (e.g., regulatory barriers, policy barriers, financial barriers, environmental barriers, etc.)? How do these constraints manifest themselves in relation to performance improvements?

15. Do you think that there is adequate R&D focused on performance improvements in the GLSLB (Yes/No)? What programmatic funds address multimodal freight transportation performance R&D in the GLSLB? Please be specific.

16. Do you think that a discussion of a national freight transportation plan would help reduce barriers and constraints to the performance of the multimodal freight transportation system in the GLSLB? (Yes/No) If so, how?

APPENDIX E

Webinar Follow-Up Survey

National Cooperative Freight Research Program (NCFRP), Project 35:
"Multimodal Freight Transportation Within the Great Lakes–Saint Lawrence Basin"

Study Objective: The objectives of the research are to describe the current multimodal freight transportation system and its performance in the Great Lakes–Saint Lawrence Basin (i.e., Minnesota, Wisconsin, Michigan, Illinois, Indiana, Ohio, Pennsylvania, New York, Ontario, and Quebec), including the economic impact of the freight transportation system on regional, U.S., and Canadian economies, and to identify opportunities and constraints in the Basin for meeting future freight flows. For more information on NCFRP Project 35, see:
http://144.171.11.40/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=2923.

Validation of Findings

To help us validate the study's messages and conclusions, we'd appreciate it if you could take a moment to complete the brief questionnaire below. Responses will be kept confidential and will not be attributed.

Your responses below are based on (check as applicable):
[ ] A review of the Interim Report Summary, only
[ ] A review of the Interim Report, in full
[ ] Participation in the Webinar

Questionnaire

1. Do you concur with the major findings and conclusions?

   Yes No

   If no, please explain:

2. If you were consulted as part of this study, do you feel that your input and professional perspective was accurately captured?

   Yes No

3. Are the findings and conclusions in the Interim Report sufficiently supported?

   Yes No

   If no, please identify what might be missing

4. Are there specific areas of research which you feel have been overlooked?

   Yes No

   If no, please explain:

5. Do you feel this report accurately depicts the state of Bi-national planning efforts between U.S. and Canada?

   Yes No

   If no, please explain:

6. Do you agree with the recommendations for future research?

   Yes No

   What other areas of future research do you feel would be important?

7. Other comments:

If you would like to receive a copy of the NCFRP Project 35 Final Report once published, please provide your contact details below:

Name:
Title:
Organization:
Email address:

Who else would you recommend that the Final Report be distributed to, once published?

Email address:
Email address:
Email address:
Email address:
Email address:

Are there any upcoming events which might include a speaker from our research team to cover this topic? If yes, please include contact information.

Name:
Title:
Organization:
Email address:

Related comment:

Abbreviations and acronyms used without definitions in TRB publications:

AAAE	American Association of Airport Executives
AASHO	American Association of State Highway Officials
AASHTO	American Association of State Highway and Transportation Officials
ACI–NA	Airports Council International–North America
ACRP	Airport Cooperative Research Program
ADA	Americans with Disabilities Act
APTA	American Public Transportation Association
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATA	American Trucking Associations
CTAA	Community Transportation Association of America
CTBSSP	Commercial Truck and Bus Safety Synthesis Program
DHS	Department of Homeland Security
DOE	Department of Energy
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
HMCRP	Hazardous Materials Cooperative Research Program
IEEE	Institute of Electrical and Electronics Engineers
ISTEA	Intermodal Surface Transportation Efficiency Act of 1991
ITE	Institute of Transportation Engineers
NASA	National Aeronautics and Space Administration
NASAO	National Association of State Aviation Officials
NCFRP	National Cooperative Freight Research Program
NCHRP	National Cooperative Highway Research Program
NHTSA	National Highway Traffic Safety Administration
NTSB	National Transportation Safety Board
PHMSA	Pipeline and Hazardous Materials Safety Administration
RITA	Research and Innovative Technology Administration
SAE	Society of Automotive Engineers
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (2005)
TCRP	Transit Cooperative Research Program
TEA-21	Transportation Equity Act for the 21st Century (1998)
TRB	Transportation Research Board
TSA	Transportation Security Administration
U.S.DOT	United States Department of Transportation