

Great Lakes and St. Lawrence Region Transportation Trends, Issues and Opportunities

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Multimodal Transportation Strategy for the Great Lakes and St. Lawrence Region

The importance of the Great Lakes and St. Lawrence Region cannot be overstated: home to 107 million people, 51 million U.S. and Canadian jobs, and generating US\$5.8 trillion in annual GDP, and over \$232 billion in U.S.-Canadian trade.

The Region's multimodal transportation system - comprising an extensive network of highways, regional and urban roads, railroads and rail terminals, airports, marine ports and inland waterways, pipelines, and transit infrastructure and related service – is central to the economic competitiveness and prosperity of the Region and the quality of life of its inhabitants.

Most Great Lakes states and provinces have developed long range transportation plans and modal plans to support their growth. What is lacking is an integrated multimodal transportation vision and strategy for the whole region, addressing both passenger and freight transportation priorities.

The present work – aimed at developing a Multimodal Transportation Strategy for the Great Lakes and St. Lawrence Region - seeks to address this gap.

Report 2

This Report is the second in a three-part series that together will inform the Multimodal Transportation Strategy for the Great Lakes and St. Lawrence Region. It identifies the most significant transportation trends, issues and opportunities facing the Region.

Acknowledgments

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Opinions

Unless otherwise indicated, the opinions herein are those of CPCS and the Council of the Great Lakes Region and do not necessarily reflect the views of the funders of this work.

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Executive Summary

The most significant transportation trends, issues, and opportunities facing the Great Lakes and St. Lawrence Region include:

Known knowns: Transportation pressures and issues that are well understood; their implications can reasonably be foreseen.

- **Increasing urban congestion.** The growing population base in the Region – expected to increase from 107 million today to over 133 million by 2050, and the increasing concentration of the Region’s population in urban and suburban centers, will contribute to increasing pressure on urban transportation infrastructure and services.
- **Rail infrastructure capacity constraints.** The Region’s rail network is congested, particularly around major rail hubs - Chicago in particular. Protecting corridors and land for future rail and intermodal capacity expansion is needed. The use of freight railroad-owned rail corridors by intercity and commuter rail services is also adding pressure to the Region’s rail network and contributing to declining passenger rail on-time performance. This is likely to worsen as passenger rail operators look to increase service frequencies to meet the demands of urban, suburban and intercity travelers. VIA Rail’s proposed high-frequency rail project seeks to respond to these pressures by shifting passenger rail service between Toronto, Ottawa and Montreal onto a dedicated passenger corridor.
- **Aging infrastructure.** The Region’s roads, bridges, locks, dams and other trade-enabling infrastructure are among the assets that are badly in need of rehabilitation. The cost to rehabilitate aging infrastructure will be significant – likely in the tens or even hundreds of billions of dollars. But the cost of continued underinvestment – increased costs for users, decreased reliability and safety, and infrastructure failure – will surely be greater. These costs also represent a risk to future connectivity and trade within the Region, with the broader continent, and with the world.
- **Institutional and regulatory fragmentation.** Beyond the two national governments and the ten states and provinces that border the Great Lakes and St. Lawrence River, there are thousands of municipalities and other agencies with a hand in influencing the Region’s transportation system. The institutional and regulatory fragmentation has resulted in many barriers to the efficient movement of people and freight including modal connectivity issues, poorly coordinated planning and investments, and regulatory inconsistencies. The inconsistent application of border rules and processes at different ports of entry also frustrate trade and mobility in the Region.
- **Technology reshaping transportation decisions.** Real time trip routing, travel time and incident reporting apps, ridesharing and other technology-enabled sharing economy platforms, Big Data, and new e-commerce supply chain models are enabling better decisions about transportation, mobility, planning and investment. These and other emerging technologies present tremendous opportunities for mobility in the Region.

Known unknowns: Emerging factors understood to be significant, and that necessitate preparedness; their true implications for the Region’s transportation system remain unclear.

- **New and emerging technologies.** Automated and driverless vehicles will likely become the norm - eventually. Their implications will revolutionize mobility and how transportation systems are designed and operated. But what this future actually looks like remains unclear, as is the appropriate infrastructure planning and investment response. Other emerging technologies, including

drones, 3-D printing, and virtual reality may also be game changers. Their long-term implications for the Region's transportation system and mobility also remain unclear. Governments are often behind the curve in anticipating and enabling these and other technologies. Smart City Challenge-like initiatives can be useful to push earlier adoption of technologies and new thinking on transportation planning, investment, and operations.

- **Climate change.** Global temperatures are rising, resulting in changes in weather patterns, more floods, droughts, and more frequent instances of other severe weather events. Though future implications for the Region remain unclear, they could range from increasingly fluctuating water levels on the Great Lakes (as is already occurring) and changes to the Seaway navigation season, to reconfigured transportation networks if, for example, low-lying coastal port zones such as in the Gulf of Mexico become negatively impacted by increasing water levels and storms.
- **Changing trade patterns and protectionism.** NAFTA modernization and the changing discourse surrounding globalization will play out in the coming months and years. These are likely to have important implications for industries in the Great Lakes and St. Lawrence Region, and by extension, Regional transportation flows and transportation infrastructure needs. Automation of manufacturing processes and to a lesser extent nearshoring will also be game changers for trade, but the extent of their impacts in the long term are unclear.

Unknown unknowns: The host of things that a transportation strategy for the Great Lakes and St. Lawrence Region needs to be ready for and resilient to; positioning will be key to adequately responding.

The Region must prepare itself for success in the new economy and position itself to respond to game changers and disruptors associated with the fourth industrial revolution. But this is easier said than done when planning and investing in infrastructure that often has a useful life measured in decades. Nevertheless, a number of questions are worth considering to help position a regional multimodal transportation strategy for an unknown future, including:

- Will ridesharing and automated vehicles mark the end of personal car ownership?
- Will mobility mean more than the physical transportation of people and things?
- What will trade in the future be like and what corridors/modes will be needed?
- How will we pay for transportation infrastructure and services?
- Will the Region's borders continue to have practical significance?

Finding answers to these questions is less important than considering their potential implications to help make the Region's transportation system resilient and adaptable to an unknown future.

Key Considerations for a Multimodal Transportation Strategy

Transportation strategies and plans of past have largely been based on linear trends and projections. It is unlikely, given the many noted trends, issues, opportunities and unknowns, that the future will be similarly linear. This necessitates a different approach. The Regional Multimodal Transportation Strategy should enable transportation system resilience and adaptability, and provide users with more and better mobility options and connections. To this end, the Strategy should leverage technology, innovation and new data sources. There will be a greater need for collaboration – across jurisdictions, across modes, and across public and private sectors – to move faster, more nimbly and to leverage each's strengths. Lastly, the Strategy should be bold and able to inspire a common vision for the Region's transportation system. But it will also need to be practical, not rely solely on public funding, and provide a clear basis for progress.

Report 2

Building the Foundation for a Regional Multimodal Transportation Strategy

This report is the second in a three-part series that together will inform a multimodal transportation strategy for the Great Lakes and St. Lawrence Region (Regional Transportation Strategy). The first report, issued on December 1st, 2016, defines the economic context and rationale for a Regional Transportation Strategy. This second report synthesizes the key transportation trends, issues and opportunities that face the Region. It also sets the stage for the third report, which will define the Strategy itself and implementation considerations.

Transportation is an enabler of economic activity and social connectedness

It shapes and influences how the economy is organized, where businesses locate and invest, and how we trade. It also influences where we choose to live, work and play. In short, the importance of transportation – and mobility more broadly - can't be overstated.

But as much as transportation shapes economies and societies, transportation infrastructure, services and systems can come under pressure. Growing and evolving demand for transportation, aging or inadequate infrastructure, outdated regulations, and social, political, and environmental factors are among these pressures.

The highly connected and integrated Great Lakes and St. Lawrence Region (Region), which in many respects owes its present day form to transportation connections, is not immune to these pressures. Many such pressures are in fact particularly acute in the Region, creating barriers to mobility, and by extension, barriers to Region's growth and prosperity.

Consultations with senior private and public sector executives and leaders in the Region supported by other research and analysis, revealed the top pressures facing the Region's transportation system as well as associated trends, issues and opportunities.

These can generally be categorized as:

- **Known knowns:** Transportation pressures and issues that are well understood, and which have relatively linear patterns; their impacts and implications can reasonably be foreseen.
- **Known unknowns:** Emerging factors understood to be significant, and that necessitate preparedness; their true implications for the Region's transportation system remain unclear.
- **Unknown unknowns:** The host of things that a regional multimodal transportation strategy for the Great Lakes Region needs to be ready for and resilient to; positioning will be key to adequately responding.

The most important trends, issues and opportunities falling under each of these categories are summarized in this report, along with their implications for the Region and for a forward-looking regional multimodal transportation strategy.

Known Knowns

Among the most significant “known knowns” creating challenges for the Region’s transportation system are increasing congestion and capacity constraints, particularly around major urban centers and transportation hubs, aging infrastructure, institutional and regulatory fragmentation resulting in barriers to transportation system efficiency, planning and investment, as well as new technologies. Each theme is outlined below.

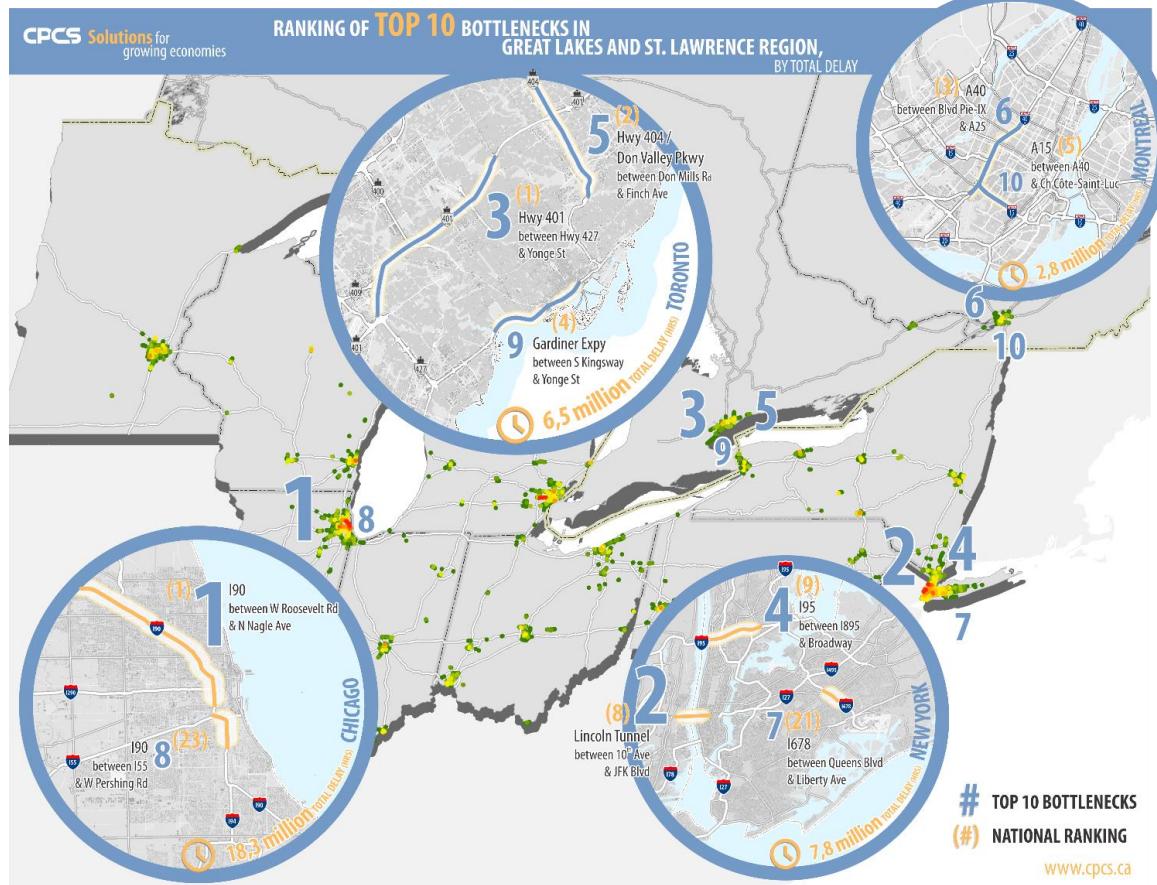
Many Parts of the Region’s Transportation System are Capacity Constrained

Urban Congestion is Getting Worse

Those living in the Region’s urban centers understand this challenge all too well: bumper to bumper traffic on major highways and urban arteries, overcrowded commuter trains, transit buses and metro systems, particularly during morning and afternoon peak periods.

Recent CPCs studies for the American Highway Users Alliance and the Canadian Automotive Association revealed that the Region is home to the top U.S. bottleneck (in Chicago) and 8 of the top 10 Canadian bottlenecks, including Canada’s top bottleneck (in Toronto). The cost of roadway congestion – including lost time and productivity, stress, and increased fuel use – impact both passengers and trucks. Congestion also contributes to increased emissions.

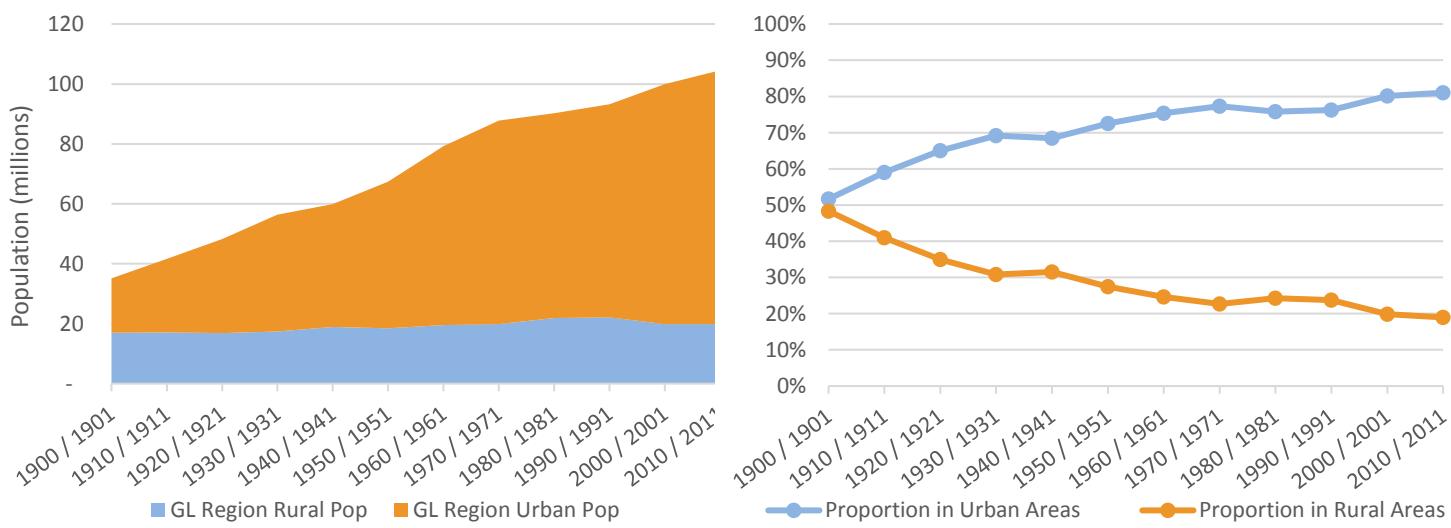
Figure 1: Top Great Lakes and St. Lawrence Region Bottlenecks



The problem of urban congestion in the Region is not going away and has been getting worse. Total passenger vehicle miles traveled on roads as well as transit ridership levels have been on the rise since 2011 (though still below pre-recession levels). Over 740 billion vehicle miles are traveled each day on roads in U.S. Great Lakes states alone.¹

At least three factors will contribute to increased pressure on urban transportation infrastructure in and around the Region's cities: 1) the growing population base in the Region – expected to increase from 107² million today to over 133 million by 2050³, 2) the growing number of individuals who drive to work alone⁴, and 3) the increasing concentration of the Region's population in suburban and urban centers. This has led to the revitalization and gentrification of some formerly run-down industrial neighborhoods, such as in Cleveland and Toronto, creating new economic opportunities. But it is also creating new mobility challenges.

Figure 2: Increase in Regional Population (left) and the Share of the Population Living in Urban Centers (Right)



Source: U.S. Census (year ending in 0) / Statistics Canada (years ending in 1)

Note: Definition of "urban", as used by the U.S. Census and Statistics Canada has changed since 1900, though does not impact the message above

Urban congestion on one part of the transportation system can have multimodal impacts. For example, congestion on Highway 401 in Toronto (top Canadian bottleneck) constrains the reliability of passenger trips to Toronto Pearson airport to catch a flight. Plans for the Toronto Pearson Regional Transit Centre, led by the Greater Toronto Airports Authority, seek to improve transit options, ease congestion around the airport, and improve mobility in the region.

The aging demographic in the Great Lakes and St. Lawrence Region will also put new kinds of demands on urban transportation systems. In particular, growing elderly populations will need means of independent mobility, when driving personal cars becomes no longer possible.

¹ CPCS analysis of FHWA Highway Statistics, 2015

² 2016 population data for U.S. Great Lakes States and Canadian Great Lakes Provinces is based off the U.S. Census Bureau and Statistics Canada.

³Great Lakes Province Population Projections: Statistics Canada provides population forecasts for Quebec and Ontario from 2017-2038. Population growth is assumed to be equal to overall Canadian growth rates from 2039 to 2050. Great Lakes State Population Projections: Population growth in Great Lakes States is assumed to be equal to overall U.S. population growth due to a lack of state population projections.

⁴ U.S. Department of Transportation, Beyond Traffic 2045

Rail Infrastructure is Capacity Constrained

The Region's rail network is also congested – around major rail hubs, in urban areas, and Chicago in particular. The Chicago Region is North America's largest and most important rail hub and home to ten separate railroads – including commuter and intercity passenger and freight railroads – operating on shared infrastructure. When things don't work properly in Chicago, the impact can back up to other parts of the rail network - leading to delays and increased costs.

Public and private sector rail system owners, operators and others embarked on the decade-plus long Chicago Region Environmental and Transportation Efficiency (CREATE) Program to collaboratively plan and improve the system in the City of Chicago for all users by investing in rail line capacity, rail-rail and rail-highway grade separations and other operational improvements. However, funding challenges notwithstanding, in recent years rail stakeholders have recognized that fixing the Chicago bottleneck will not fully solve the problem; there are other shared rail infrastructure needs outside and leading into the City that also need attention, spurring development of the Chicago Gateway and Indiana Gateway projects.⁵

"One of the reasons for our Chicago Gateway project was to bring public and private parties together, regardless of state borders. The rail congestion issues, like the networks themselves, exist across state lines and need to be considered on a regional and national basis."

- Amtrak

There is also a lack of intermodal rail and inland port capacity around Great Lakes and St. Lawrence Region transportation hubs, including the Greater Toronto Hamilton Area and Chicago. Fueled by the growth of urban boundaries, these communities require expanding freight rail and inland container port capacity. Without this critical infrastructure, these communities will not live up to their economic growth potential. Moreover, more goods will have to be transported by truck, which will add to congestion – further constraining economic growth. There are significant challenges in making this type of infrastructure investment, including lack of adequate appropriately zoned corridors and industrial land, encroachment on available corridors and industrial land, cumbersome regulatory review and permitting processes, and public resistance to transportation-related development. This local public opposition can have the unintended consequence of curbing the overall Region's and Nation's growth and competitiveness on a global stage and adds to the existing road congestion throughout the Region.

"A lone train stopped in Chicago can force other trains to stop or slow as far away as Los Angeles or Baltimore. It's a ripple effect – everything in my system backs up."

- Scott Haas, Vice President for UPS

(Source: Amtrak Blue Ribbon Panel Report)

⁵ Report of the Amtrak Chicago Gateway Blue Ribbon Panel, Amtrak, (2015)

The Challenge of Shared Rail Corridors

In many parts of the Region, commuter and intercity passenger rail services run on rail infrastructure owned and operated by freight railroads, further adding capacity pressures to the rail system.

VIA Rail, for example, which has seen both the absolute number of passengers as well as total passenger-miles increase in Ontario and Quebec (notably on the busy Toronto-Ottawa-Montreal Corridor (TOM))⁶, runs on the busy CN main line between Toronto and Montreal. The challenges associated with running on track predominantly owned by freight railroads include reduced on-time-performance and challenges in adding services frequencies. These are the primary reasons VIA Rail has been advocating for the development of a dedicated higher frequency rail (HFR) corridor between Toronto, Ottawa and Montreal.

Also of note, the U.S. Federal Railroad Administration (FRA) is embarking on a passenger rail planning study for the Midwest Region. Initial discussions with the Midwest Interstate Passenger Rail Commission indicated that this study will identify passenger rail pressures and issues for the Region.

Commuter rail service has similarly added pressure to rail networks in and around major centers in the Great Lakes and St. Lawrence Region. Although commuter rail ridership in the Region has been relatively flat in recent years (except for GO in Toronto, which has seen significant growth), freight service on many lines used by commuter operations has been increasing in response to market demands. Capacity pressures and operational conflicts can be particularly acute during peak morning and afternoon commuter periods, into and out of downtown cores where many rail operations often converge. Collaboration between commuter rail operators and freight railroads, and the purchase of trackage from freight railroads (e.g. Go in Toronto, AMT in Montreal) have contributed to improved commuter rail service.

Surface Transportation Capacity Constraints Likely to Worsen

A previous study by CPCS for the U.S. Transportation Research Board on the Great Lakes multimodal freight transportation system⁷ compared present day road and rail capacity constraints to projected 2040, assuming steady state traffic forecasts and no additional capacity investments. This theoretical comparison makes the point that pressures on capacity are expected to increase over the next twenty-plus years. These constraints are likely to be most acute around major urban transportation hubs where there is intense competition for land use. Freight railroads will make investments to ensure appropriate capacity. Protecting corridors for future capacity expansion needs, and moving forward with the Gordie Howe International Bridge between Detroit, Michigan and Windsor, Ontario, are two priorities identified by Regional stakeholders to help address surface capacity constraints in the Region.

⁶ By contrast, Amtrak ridership and passenger-miles in Great Lakes states has been on the decline.

⁷ NCFRP Report 17, Great Lakes-St. Lawrence Basin Multimodal Freight Transportation System (2012)

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Region Trends, Issues and Opportunities

Figure 3: Road and Rail Capacity Constraints in the Great Lakes and St. Lawrence Region Likely to Worsen

CPCS Solutions for
growing economies

Comparing Land Capacity Constraints in the Great Lakes St. Lawrence Region Road and Rail Capacity Constraints



LEGEND

ROAD AND RAIL NETWORKS

— Unconstrained Road

— Unconstrained Rail

LAND CAPACITY CONSTRAINTS

— Road Capacity Constraint (VCR exceeding 100%)

— Rail Capacity Constraint (LOS E or F)

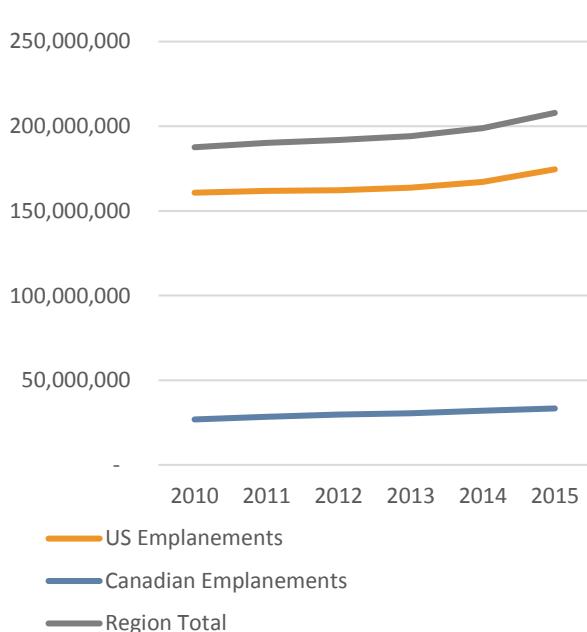
Source: CPCS, adapted from NCFRP, Report 17: Multimodal Freight Transportation System with the Great Lakes St. Lawrence Basin

Other Transportation Capacity Challenges

Transportation infrastructure capacity pressures in the Region are not limited to road and rail. Increasing air passenger travel through Great Lakes and St. Lawrence Region, as well as increasing air cargo volumes, are leading to congested airports – particularly at major air hubs including Chicago O'Hare and Toronto's Pearson Airport.

Beyond crowded airports – particularly at and around U.S. Great Lakes Region air hubs – one of the implication has been declining on-time performance and reliability of air service in many Region airports, including some of the Region's largest. Detroit and Minneapolis airports, for example, have seen their on-time performance decrease between 2011 and 2015, by 20% and 10%, respectively.

Figure 4: Great Lakes St. Lawrence Region Passenger Enplanements (2011-2015) (Left)
Top Airport Enplanements and On-Time Performance (2011-2015) (Right)



Airport	2015 Enplanements	% Change in Enplaned Passengers	% Change in Annual Delay Times
Chicago O'Hare	36,305,668	14%	-8%
NYC JFK	27,782,369	17%	6%
Toronto Pearson	19,775,712	23%	N/A
Minneapolis	17,634,273	11%	10%
Detroit	16,255,520	3%	20%
Philadelphia	15,101,349	1%	-26%
NYC LaGuardia	14,319,924	19%	18%
Chicago Midway	10,830,850	19%	1%
Montreal	7,367,059	12%	N/A
All others	44,354,749	-35%	N/A
Regional Total	207,896,605	9%	N/A

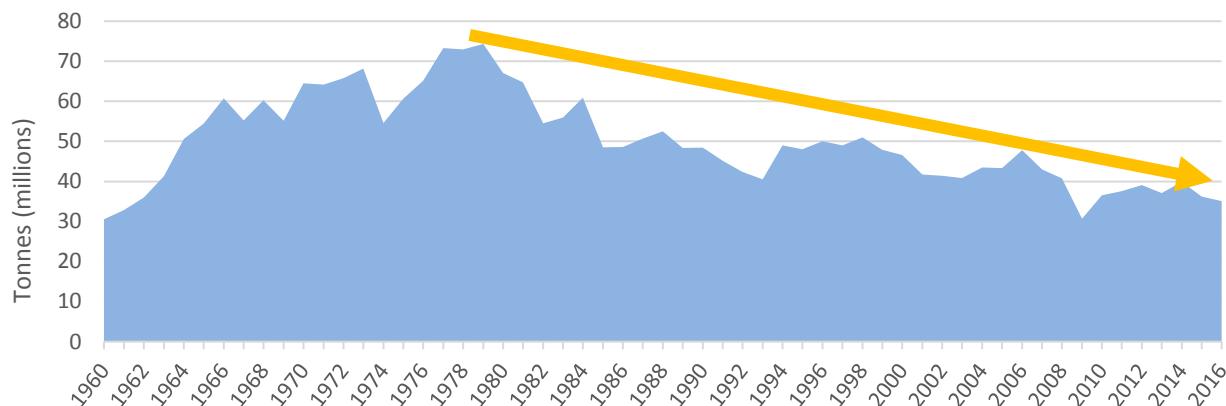
Source: CPCS analysis of FAA Passenger Boarding and All-Cargo Data, Statistics Canada, Air Carrier Traffic at Canadian Airports (51-203-X), BTS Airline On-Time Statistics and Delay Causes

Intermodal connection issues to and from airports were also highlighted as a challenge. As one stakeholder noted, airports are not destinations. More must be done to provide passengers with improved and more seamless connections to/from airports and their ultimate destinations. The efficient flow of people and goods is vital to ensure the sustainable and unhindered growth of any region. For example, road congestion in the Greater Toronto Area and Southern Ontario at large threatens to dampen the significant economic benefits that Toronto Pearson's growth brings to the region. The airport is well on its way to reaching mega hub status, a term reserved for an elite group of airports that are highly connected to a large proportion of the world's GDP and benefit from a high degree of international connecting passengers. The Toronto Pearson Regional Transit Centre is in part a means of ensuring that both the region and the airport continue uninterrupted along a strong growth trajectory well into the future.

The Maritime Transportation System in the Region has Significant Available Capacity

In contrast to capacity constrained road, rail and air transportation, the maritime mode in the Great Lakes and St. Lawrence Region – which largely handles bulk traffic such as iron ore, grain, coal and limestone – is underutilized. The long-term trend has been one of decreasing traffic volumes in many parts of the system as traffic through the St. Lawrence Seaway – the key connection between the Great Lakes and the Atlantic Ocean – demonstrates. By most accounts the Seaway, as well as many Great Lakes ports, including the Ports of Cleveland and Thunder Bay, are operating below their available throughput capacity. Seasonal issues notwithstanding, they are open and ready for business.

Figure 5: Total Traffic Through the St. Lawrence Seaway (Millions of metric tonnes)



Source: CPCS analysis of historic traffic data from: St. Lawrence Seaway Management Corporation

Available capacity on the Great Lakes maritime transportation system could be better utilized for freight transportation and could, to some extent, help alleviate surface transportation capacity constraints in the Region, where there is an appropriate business case.

But, the decision to use the maritime mode is driven by the owners of the freight (shippers), who make mode choice and routing decisions based on logistics cost, transit time and reliability considerations. To shift freight to the maritime mode in the Region necessitates a clear and commercial value proposition with respect to competing modes. In particular, this means reducing the cost of maritime transportation, among other structural barriers.

Currently, there are many interests, regulations and inefficiencies that impose costs on the maritime system, hindering its cost competitiveness. The high cost of pilotage, high (unionized) port terminal handling costs, and cabotage regulations that restrict competition, are among the factors that drive up the cost of maritime transportation. The many organizational interests in the Great Lakes maritime system challenge attempts at collaboratively working to reduce costs for the shippers that are the ultimate users. There is significant frustration with the slow pace or progress in addressing the drivers of high maritime transportation costs.

"We've been talking about these [cost] issues forever, but nothing seems to change".

-Maritime sector stakeholder

If the marine transportation system is to become a more competitive transportation option and contribute to transportation system resilience in the Region, marine costs must come down.

Opportunities to address other structural barriers to the competitiveness of the maritime mode, such as the seasonal closure of the Seaway from late December to mid-March, may also warrant new approaches.

Infrastructure in the Region is Aging and in Need of Rehabilitation

Years of Underinvestment is Increasing the Cost of Infrastructure Use and Creating Risks

The American Society of Civil Engineers (ASCE) periodically develops a report card on U.S. infrastructure that includes all transportation modes. In 2013 – the latest report - infrastructure scored a “D+”, with associated rehabilitation investment needs of \$3.2 Trillion (USD) by 2020 at the national level. A similar Canadian study also underscored the poor and declining state of roads and bridges.⁸ Another survey of infrastructure quality – globally – has seen U.S. and Canadian infrastructure quality decrease relative to international jurisdictions.⁹

Though not specific to the Great Lakes and St. Lawrence Region, the latest ASCE infrastructure report estimates that the average American family will lose \$1,060 each year in personal disposable income due to deficient and unreliable transportation by the year 2020.¹⁰

Freight sectors are similarly impacted with higher operating costs (which ultimately gets passed on to customers).

Infrastructure failure presents an even greater cost. The collapse of the I-35 Bridge in Minneapolis during rush hour in 2007, killing 13 people and injuring close to 150, is a sad example of the cost and risk of underinvestment.

The risk of failure of the Poe Lock at Sault St. Marie (Soo Lock), or failure of other locks and dams on the inland waterway system – more than half of which are over 50 years old – could also cripple those industries that are reliant on low-cost water transportation. A U.S. Department of Homeland Security report found that a 6-month failure-related shutdown of the Poe Lock would plunge the U.S. into recession, close factories and mines, halt auto and

“We’re using almost 100 percent more tires to produce the same mileage of transportation...Why is that? Because the road infrastructure has so many potholes in it, it’s tearing up tires faster than before.”

- FedEx Chairman and CEO Fred Smith

(Source: U.S. House Transportation and Infrastructure Committee)

⁸ Canadian Infrastructure Report Card (2016)

⁹ World Economic Forum, cited in The Infrastructure that Matters Most, The Canadian Chamber of Commerce

¹⁰ Report Card for America’s Infrastructure, ASCE (2013)

appliance production in the U.S. for most of a year, and result in the loss of some 11 million jobs across the nation.¹¹ The impacts on Canada, though not studied, could also be disastrous.

The cost to rehabilitate aging infrastructure in the Great Lakes and St. Lawrence Region will be significant – likely valued in the tens or even hundreds of billions of dollars. But the cost of continued underinvestment will surely be greater.

Institutional and Regulatory Fragmentation

The Great Lakes and St. Lawrence Region is a highly integrated market. But it is also plagued by institutional and regulatory fragmentation. Beyond the bi-national nature of the Region, and the eight U.S. states and two Canadian provinces that border the Great Lakes and the St. Lawrence River, there are thousands of municipalities and other agencies with a hand in influencing the Region's transportation system. The institutional and regulatory fragmentation has resulted in many barriers to the efficient movement of people and freight through the Region. Specific examples include:

Modal Connectivity and Systems Integration Challenges

Historically, the transportation system has been viewed as a collection of individual modal networks – each serving its own purpose and with silo-ed priorities. That legacy approach, based on institutional constructs and missions, has not provided a seamless experience for users of the system, and is today outdated. The integration of modes of transportation has been noted by many as problematic in parts of the Region.

For transit users, mobility has been constrained or frustrated due to the piecemeal approach to system development. The poor integration of ticketing and fare systems across certain commuter and transit operations, as well as poor physical connections from one mode to another, are typical examples.

¹¹ The Perils of Efficiency Impacts of an Unexpected Closure of the Poe Lock, U.S. Department of Homeland Security (2015)

Freight transportation is similarly subject to modal connectivity issues in parts of the Region. These connectivity issues can be physical (e.g. poor or lacking rail access to a marine facility, or poor road connectors to rail facilities) or regulatory (e.g. lack of harmonizing regulations between states and nations).

One Great Lakes region freight stakeholder noted 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”.

(Source: NCFRP Report 17)

Inefficiencies and Inconsistencies at the Border

Nearly all consultations noted that better coordination on border crossings and infrastructure is needed. In many cases border processes and the application of rules differ by port of entry, adding confusion and inefficiencies to border crossings. One stakeholder representing the Region’s manufacturers noted that coordinating not only on infrastructure projects, but also on operations – such as number of booths available at crossings – is essential. In the air sector, pre-clearance facilities and processes, as are in place at airports in Toronto, Montreal and Ottawa, have greatly improved the flow of people, goods and investments.

A Call to Improve Border Crossing Infrastructure and Processes

“To move people, natural resources, and goods more efficiently across the 49th parallel, Canada can improve the physical infrastructure and border-crossing process. In the manufacture of cars, for example, delays at the U.S. border can add hundreds of dollars to a vehicle’s cost because components often cross the border several times before completion. To reduce congestion at key crossings, we could pursue investments in joint border-monitoring stations or in terminals at remote locations.”

Source: Canadian Advisory Council on Economic Growth, Positioning Canada as a Global Trading Hub

Regulatory Inconsistency Adding Cost and Challenges to Movement of Freight

Transportation sector regulatory structures in the Region are largely mode-specific – contributing to modal integration challenges. This historic structure doesn’t reflect the modern reality of multimodal freight hubs. Modal regulations also often differ across jurisdictions. Most notably, road transportation regulations are largely set and governed at the state and provincial level. This has in many cases led to inconsistent regulations across the Region. A typical example is truck size and weight regulations, which can vary greatly from one state or province to another. A recent CPCS study for the U.S. Transportation Research Board on Oversize and

Overweight (OSOW) Freight Transportation revealed that the level of border “friction” caused by inconsistent regulations and permitting requirements across U.S. Great Lakes states is more problematic than in most other parts of the U.S.¹²

Through the U.S.-Canada Regulatory Cooperation Council (RCC) the two nations continue to work together on regulations to enhance economic competitiveness while maintaining high standards when it comes to health, safety, and the environment.¹³ The 2016 RCC Work Plans reflect review of regulatory activities in the areas of connected vehicles, motor vehicle standards, rail safety, transport of dangerous goods, aviation, marine safety & security, locomotive emissions, and alternative fuel use in transportation, among many others.

During stakeholder consultations it was noted several times that regulatory harmonization efforts are positive. However, many noted that more needs to be done. A parallel dialogue to the work of the RCC at the state and provincial levels would help drive further alignment. One stakeholder emphasized that it is critical that the regulations reflect a “common sense” and harmonized approach.

While a thoughtful process is required to develop regulations, industry has remarked that in many ways government moves too slowly and businesses are left waiting.

Regulatory Coordination Through Beyond the Border Initiative

Stakeholders remarked that many good steps are being taken by the joint US-Canada “Beyond the Border” Initiative which details a shared vision and actions towards economic competitiveness and security. Positive steps taken as part of this initiative:

- Harmonized the requirements for U.S. Customs-Trade Partnership Against Terrorism (C-TPAT) and Canada’s Partners in Protection (PIP) and developed a joint enrollment web portal to make the application into both programs faster and easier; members now receive Free And Secure Trade (FAST) benefits to make cross-border trade even faster.
- Published three Border Infrastructure Investment Plans that detail major infrastructure upgrades at land border crossings and identify certain crossings as priorities for future investment.

While the Beyond the Border work notes that it may feed into future U.S. border infrastructure prioritization discussions (e.g. how projects are conceptualized and prioritized for infrastructure investment), this has not yet occurred.

¹² NCHRP Report 480, Oversize/Overweight Freight Transportation (2016)

¹³ US-Canada Regulatory Cooperation Council, U.S. Department of Commerce, International Trade Administration

Limited Coordination in Planning Across Jurisdictional Lines

As one stakeholder commented, today each stakeholder “does its own thing”. Federal, state/province and municipal governments each plan, design, fund and build projects and establish regulations with limited coordination with other levels or neighboring jurisdictions. There is likewise a lack of coordination with respect to project permitting. Coordination is getting better, but often happens after key decisions have been made and priorities established, resulting in a slow, and often ineffective way forward.

In some areas, collaboration is occurring, but that too can slow the process of decision-making, in particular where consensus-based decisions are desired. In the Region, there is a threat of invasive species (Asian carp) entering the Great Lakes which could potentially destroy the Great Lakes ecosystem. This crisis has been on the Region’s radar for over a decade. Determining a solution and taking action cannot wait another decade. One stakeholder noted that the U.S. Army Corps of Engineers (the lead agency) is well-meaning, but their process is too rigid and long to be effective in solving the problem.

The slow progress on the development of the Gordie Howe International Bridge is another case in point. The project first received approval close to a decade ago, but has been mired in legal and funding challenges. A former governor of Michigan consulted for this study noted that there has been widespread ignorance of the need for a second bridge and of the benefits to be gained from more efficient regional integration.

When they met in February 2017, Prime Minister Justin Trudeau and President Donald Trump noted that they “look forward to the expeditious completion of the Gordie Howe International Bridge.”

Technology has Reshaped Transportation

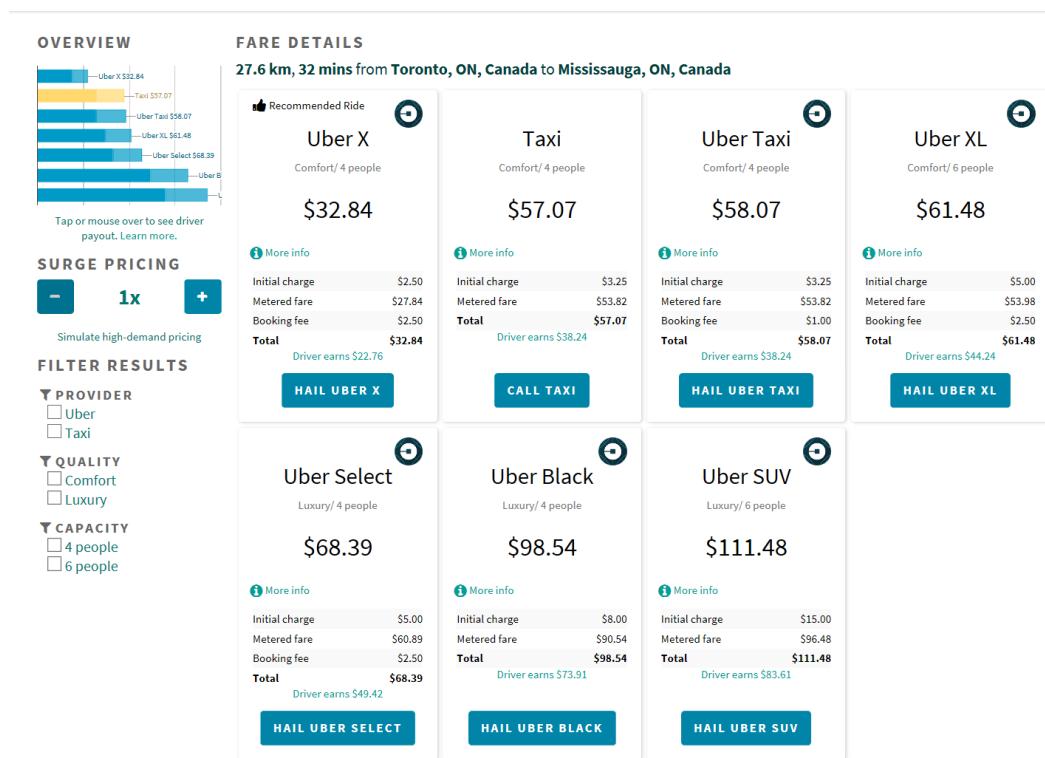
Technology has been a game changer in how we move and make transportation decisions. Specific examples include:

- **Real time trip routing, travel time and incident reporting apps.** Gone are the days of paper maps and hoping for a congestion free commute. Apps, such as Google maps and Waze provide real-time information to drivers on routing, journey times, traffic conditions, and alternative routes among other relevant information. Though particularly beneficial for drivers, these technologies help spread demand over existing roadway capacity, increasing road system productivity. Departments of Transportation, in some cases, are leveraging these technologies as a better and cheaper alternative to instrumenting their roadways.
- **Ridesharing and carpooling.** Ridesharing has become an option for urban and rural areas alike in the Region via services like Uber and Lyft. And options such as UberPOOL, UberBLACK and other variations of the service allow the passenger to request specific vehicle features and pricing parameters based on their preferences. These “sharing economy” models provide more options and related information for passengers. Want to get from Toronto, ON to Mississauga, ON? Pick an option:

Multimodal Transportation Strategy for the Great Lakes and St. Lawrence Region | Report 2

Region Trends, Issues and Opportunities

Figure 6: Ride Guru App



Source: Ride Guru

- **Better information about transit.** We now know when the next bus is coming thanks to better transit information platforms. Transit agencies, collecting volumes of data, have been recognizing the value of making this data public. The Chicago Transit Authority, for example, shares its real-time feeds, along with extensive ridership information by station and GIS files on the City of Chicago Open Data Portal, helping others leverage this data to make better decisions about transportation, planning, real estate development, among other uses.¹⁴

The implications of these and similar technologies for the Region's transportation system are many. As recently noted by the Canadian Advisory Council on Economic Growth, improved data on transportation services can help passengers make better, more informed decisions about how to get from A to B. Freight interests can make better supply chain decisions. And public agencies – at all levels – can make better, evidence-based transportation planning, operations and investment decisions faster, more cheaply, and with greater reliability.

These and other technologies also help make better use of existing transportation

A small increase in ridesharing, enabled by new technologies, can help save \$9 billion in Toronto alone.

(Source: Unappointed Council on Transportation Infrastructure Investment)

¹⁴ Open Data: Challenges and Opportunities for Transit Agencies A Synthesis of Transit Practice, TRB (2015)

infrastructure capacity, increasing infrastructure productivity and reducing the need for costly investments in new capacity.

Technology has also revolutionized many freight sectors. The impacts of e-commerce are well known. A growing number of people in the Great Lakes and St. Lawrence Region now prefer to order products online from e-commerce retailers rather than drive to traditional brick and mortar stores. This is not new, and will likely continue at an increasing pace.

Behind the scenes, some of the largest companies that provide consumer goods, like Amazon, Walmart and others, have found creative ways to use technology more effectively to manage/control their operations in response to consumer demands. They've done this both in terms of streamlining their supply chains, and also to move away from the model of dropping off packages at individual doorsteps which has a high cost in terms of physical assets and labor requirements.

Amazon: From E-Commerce Retailer to Logistics Company

Amazon is using supply chain insights gained through years of data collection and analysis on customer trends and preferences to move away from its dependence on traditional carriers, such as UPS and FedEx, to deliver its products – and to bring its entire supply chain in-house. In recent weeks, Amazon has announced that it will establish a dedicated air cargo hub in the Region (greater Cincinnati, OH) and lease up to 40 cargo planes to comprise a dedicated fleet of airplanes to complement its dedicated fleet of 4,000 semi-trailers to meet consumers' e-commerce demands.

With more packages being delivered every day, Amazon is placing itself in control of its entire supply chain, including last-mile delivery. For example, in cities across North America, Amazon has introduced "delivery lockers" that provide safe and convenient self-service package drop-off/pick-up locations. These locations not only are aimed at reducing package theft, but also have the potential to minimize the number of doorstops/truck trips drivers must make.

Electric Vehicles and Alternative Transportation Fuels

Just a decade ago, fully electric cars were measured in the hundreds.¹⁵ Today, there are likely millions (there were 1.25 million in 2015). The electrification of cars, buses and freight delivery vehicles is also underway in the Great Lakes and St. Lawrence Region.

Some have predicted that all new road vehicles – buses, cars, vans, trucks and others – will be entirely electric by 2030. Both the Dutch government and the Norwegian government are considering a ban on gas-powered car sales (allowing only electric vehicle sales) beginning by 2025. And, Germany is becoming the first major country to set an official deadline for a ban on

¹⁵ Global Electric Vehicle (EV) Outlook 2016 - Beyond one million electric cars, International Energy Agency (2016)

gas-powered cars; the mandate will require all new cars registered in the country to be emissions free by 2030.¹⁶

Though the Great Lakes and St. Lawrence Region is behind Europe in the deployment of electric cars, the number of electric cars on Regional roads and highways is increasing. Some regional governments are also advancing plans to electrify transportation in the Region. The Province of Quebec is among the jurisdictions that is implementing an aggressive plan to expand the electric car network. It has committed to investing over \$400 million over five years to install over 800 charging stations and offers a range of incentives to encourage electrification of vehicles. The Province has projected that there will be over 100,000 electric cars on Quebec roads within the next five years. In its broad vision document, *Transportation 2030*, the Canadian federal government, has similarly indicated an intent to invest in electric car charging.

Other lower emitting transportation fuels are also gaining use and acceptance in the Region. Some truck companies have been converting part of their fleets to liquefied natural gas (LNG). A notable example is Robert Transport along Highway 401 between Montreal and Toronto. Transit buses have also been integrating vehicles than run on lower emitting fuels. One of the key challenge with broader adoption of alternative transportation fuels including LNG and compressed natural gas (CNG) is the lack of adequate fueling (i.e. supply side) infrastructure along the existing transportation network.

¹⁶ All new cars mandated to be electric in Germany by 2030, eletrek.co, June 14, 2016

Known Unknowns

Among the most significant “known unknowns” that are likely to shape the Great Lakes and St. Lawrence Region’s transportation system are future applications of emerging technologies, including, in particular, automated vehicles, climate change, and changing trade patterns and policies.

Continuing Impact of Innovation and Technology on Mobility

In many respects, we have already seen the benefits of new technologies in shaping how people and things move through the Region, and how transportation decisions are informed (known knowns). Yet, much remains unknown about the implications of other emerging technologies. Specific examples include:

Smart Technology

The proliferation of smart technology – smartphones, wearable devices, as well as the rise of the “Internet of Things” – sensors and actuators embedded in physical objects that are linked through wired and wireless networks – will continue, providing increasing information connectivity. Around 99.4% of objects that will one day be part of the “Internet of Things” are, today, unconnected, and 50 billion things are expected to be connected to the Internet by 2020, including 20 percent of all vehicles.¹⁷ The implications of smart technology on transportation in the Great Lakes St. Lawrence Region in the future remains in many respects unknown. For instance, will our need for mobility be decreased by “virtual” connectedness?

Driverless Vehicles

Autonomous and driverless vehicles are here and will unquestionably become integrated components of transportation systems for both freight and passenger users in the not too distant future. Nearly a dozen companies are currently testing driverless cars, such as Google (Waymo), Tesla, General Motors (Cruise), Ford and others.

Much has already been written on the potential safety benefits of driverless vehicles. For many, this would also allow an option to “drive” alone when otherwise impossible – a promotional video shows how a blind person helped test drive Waymo¹⁸. Driverless vehicles will also provide better mobility options for those that can’t or shouldn’t drive – for example, the Region’s growing elderly population, or tired, distracted or intoxicated riders.

Driverless vehicles will also likely revolutionize ridesharing, and perhaps even transit. In cities around the U.S., Uber is testing driverless cars for ridesharing. Uber has recently announced a

¹⁷ Intelligent Connectivity for Seamless Urban Mobility, Arup with Qualcomm (2015)

¹⁸ Waymo, waymo.com

partnership Daimler to develop self-driving cars with the mission of reducing traffic accidents, freeing up vast lots currently used to park the world's billion-plus cars, and cutting congestion.¹⁹

For freight, (semi-)autonomous trucking is being spearheaded by a handful of companies including Volvo, Daimler, Peloton and others, and fully autonomous trucking is on the near-term horizon. This concept, as applied to freight, uses wireless vehicle-to-vehicle technology to enable the driver of a lead truck to control the speed (and braking) of the truck behind. It is expected that truck "platooning" will provide trucking industry benefits in terms of fuel savings (reduced wind resistance).

Governments are responding to the emergence of automated and driverless vehicles, albeit much more slowly than advancements in the technologies themselves. The U.S. National Highway Traffic Safety Administration (NHTSA) has published a proposed rule requiring all new vehicles to have vehicle-to-vehicle (V2V) communication capabilities (to be in effect in 2019). This would enable manufacturers to phase the technology into their fleets over a few years, with all new vehicles being required to talk to each other by 2023.²⁰

The Province of Ontario has recently (January 2016) launched a pilot project to test the use of automated vehicles on Ontario's roads.

(Ontario Ministry of Transportation)

Challenges in terms of regulatory and liability environments as well as broader questions of how infrastructure will need to respond are key outstanding issues which will influence the pace of introduction of automated and driverless vehicles in the Great Lakes and St. Lawrence Region.

Other Disruptive Technologies with Potentially Significant Implications for Transportation

Amazon and UPS are testing delivery drones for light package delivery in select markets. Vespa is testing "robot servants" to follow the "master" with up to 40 pounds of "stuff."²¹ Starship Technologies is likewise developing small self-driving robotic package delivery vehicles. These and other means of delivering products are emerging and regularly piloted.

Additive manufacturing (or 3D printing) has also emerged as an alternative to the physical flow of certain products. 3D printing is best used for custom, small batch products, and is increasingly common in specialized applications or as an alternative to maintaining inventories of specialized product components. Today, the aerospace and medical industries are successfully using the technology to produce custom devices (such as knee implants, hearing aids and heart valves) on demand for just-in-time delivery, significantly reducing inventory costs. Entrepreneurs are also innovating on MakerBot machines by developing their own prototypes. Companies like UPS are further enabling this by providing these machines at many of their locations.²² UPS has also co-invested in larger scale 3D printing farms, which at the very least suggests that the logistics industry is aware of the potentially disruptive nature of 3D printing for specialized parts

¹⁹ *Uber and Daimler Join Forces on Self-Driving Cars*, Uber, January 31, 2017

²⁰ Federal Register, Docket number NHTSA-2016-0126

²¹ *This robot will carry your stuff and follow you around*, MIT Technology Review, Feb. 2, 2017

²² *UPS To Launch On-Demand 3D Printing Manufacturing Network*, UPS.com, May 18, 2016

logistics. One stakeholder remarked that they are already seeing supply chains shorten through the introduction of 3D printed products. In some sectors, 3D printing is replacing Just in Time (JIT) with “Real Time” (RT) inventory.

It remains unclear if and how these technologies will move the needle on how goods are delivered, or otherwise obtained in the Region, but new approaches are bound to emerge and become more widely adopted if these can demonstrably reduce supply chain costs and costs to end users.

Climate Change

The Earth's average temperature has risen by 1.5°F over the last hundred years, and is projected to rise another 0.5 to 8.6°F over the next century. These small changes in average temperature translate to big changes in weather – more floods, droughts, and more frequent and severe storms and other weather events.²³

These changes in the environment are likely to become more noticeable in the coming years. The Great Lakes and St. Lawrence Region will almost certainly be impacted, as will its transportation system, though exactly how and to what extent, remains unclear.

Impacts could range from increasingly fluctuating water levels on the Great Lakes (as is already occurring) or changes to the Seaway navigation season, to higher agricultural outputs in the Region – an important freight sector that depends on both the climate and Lake and Seaway infrastructure to compete in the Global marketplace. Transportation networks and supply chains could be reconfigured if, for example, low-lying coastal port zones such as in the Gulf of Mexico become negatively impacted by increasing water levels and storms. Warming waters may spur the growth of toxic algae, as has been occurring in Lake Erie, or leave shores, breakwaters and other marine infrastructure more vulnerable to increased erosion.

In any case, the unknowns associated with climate change will increase risk to infrastructure and necessitate increasing considerations of resiliency in transportation plans, investments and operations so that transportation can adapt to whatever climate change might throw at the Great Lakes and St. Lawrence Region.

Since transportation in the Region generates approximately one-quarter of all greenhouse gas emissions (GHG) which are understood by many to be a leading cause of climate change,²⁴ governments in the Region are reacting by promoting lower emitting means of transportation. Quebec's noted vehicle electrification plans, as well as the Province of Ontario's plans to electrify the GO commuter rail service are likely related responses, as are federal plans to “green” transportation, as

GHG emissions from transportation have increased by about 17 percent since 1990, largely due to increased demand for travel and historic inefficiencies of the vehicle fleet.

(U.S. Environmental Protection Agency)

²³ U.S. Environmental Protection Agency

²⁴ U.S. Environmental Protection Agency

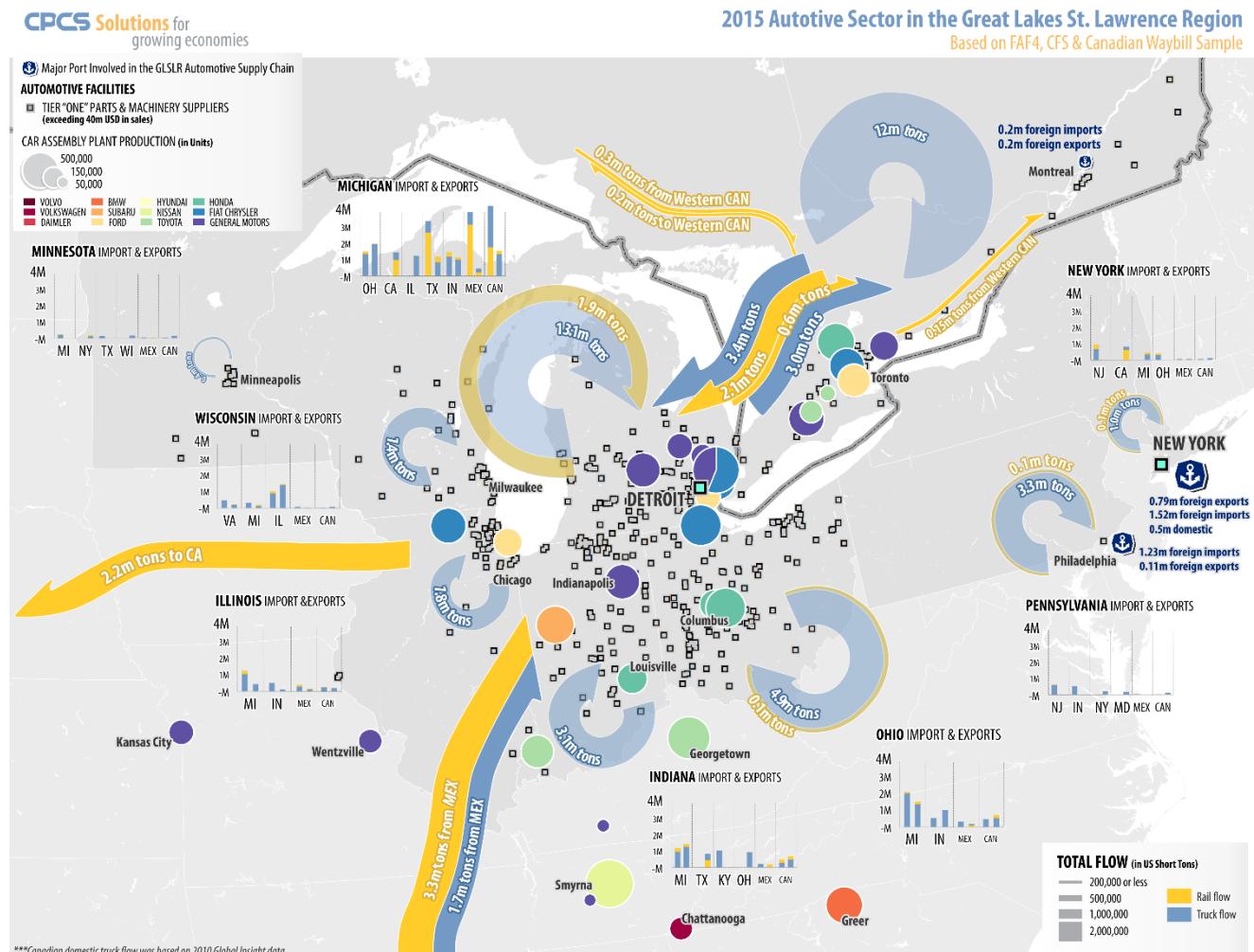
outlined in Transport Canada's Transportation 2030 vision. On the U.S. side of the border, Michigan, Ohio, and Illinois are among the top states in terms of green-tech patenting, focused on new technologies in battery power, hybrid systems, and fuel cells.”²⁵

Through a combination of regulations, new technologies and commercial considerations, other transportation services providers, including truck, air, rail and marine carriers in the Region, are also reducing their emissions.

Changing Patterns of Trade

The Great Lakes and St. Lawrence Region has long been an integrated trading region, perhaps most notably exemplified by the Region's highly integrated automotive industry.

Figure 7: Great Lakes and St. Lawrence Region Automotive Sector



²⁵ Larry Gigerich, "What's Driving Today's Location Decisions in the Auto Industry?"

But at least three factors are likely to result in changes to Regional trading patterns, with resulting implications for transportation:

Evolving Trade Policies

Virtually every stakeholder consulted in the development of this Report – and on both sides of the U.S.-Canada border - raised concerns about evolving trade policies and their implications for the future of trade between the U.S. and Canada in the Great Lakes Region. The anticipated “tweaking” of the North American Free Trade Agreement (NAFTA) and pressure on automotive manufacturers to produce cars for the U.S. market in the U.S. are among the items that could have broad ramifications for trade in the Region. Some have similarly noted concerns about the potential “thickening” of the border.

A recent report by the Canadian Advisory Council on Economic Growth has recommended improving and nurturing deeper trading relationships and private and public sector networks in North America to counter or otherwise mitigate the economic risks associated with evolving regional and global protectionist policies.²⁶

Changing Pacific Trade

Enabled in particular by the low cost of container transportation, and driven primarily by the low cost of labour in Asia, and in China in particular, a significant share of Great Lakes and St. Lawrence Region manufacturing has shifted production to Asia. This is not new and has been going on for decades. The freight transportation system in the U.S. and Canada has responded by strengthening West-East linkages between coastal ports (particularly on the West Coast) and inland markets, including in the Great Lakes and St. Lawrence Region.

But there are at least three factors that are likely to influence the pattern of trade with Asia. First, steadily increasing wage rates in China are pushing production westward to lower cost jurisdictions such as Vietnam and Bangladesh. This is resulting in a greater share of Asian trade with North America routing through the Suez Canal to North America’s East Coast, rather than over the Pacific to North American West Coast ports. As an inland market, the Great Lakes and St. Lawrence Region has not been particularly challenged in adapting to this shift. Second, with the increasing prominence of automation in manufacturing, the advantage of low-cost labour is for many sectors not what it has been in the past, resulting in a diminished need to shift manufacturing to lower cost within Asian countries. Third, the U.S., under President Trump, has signaled a shift away from trade with Asia, as exemplified recently by its withdrawal from Trans Pacific Partnership negotiations. This could lead to a decrease in U.S. trade flows to the Great Lakes Region from the coasts.

Canada should seek new, preferential trade arrangements with large and fast-growing nations, especially in Asia, and more specifically with China, Japan and India.

Source: Canadian Advisory Council on Economic Growth, *Positioning Canada as a Global Trading Hub*

²⁶ Advisory Council for Economic Growth, *Positioning Canada as a Global Trading Hub* (February 2017)

In part to respond to evolving U.S. trade policies, Canada may seek to expand and nurture deeper trade links with Asia. This is among the recommendations of the Canadian Advisory Council on Economic Growth. This could lead to increasing east-west trade patterns for the Canadian Great Lakes and St. Lawrence Region.

Impact of Nearshoring and Automation

Some have suggested that “nearshoring,” that is, shifting production from Asia to locations closer to home markets will result in a resurgence of manufacturing jobs in the Great Lakes and St. Lawrence Region.

Though production may in some cases be shifting back from Asia to North America, this is unlikely to mean that jobs lost to Asian manufacturers will return in their same numbers to the Region. Two factors in particular are worth noting. First, many of the jobs initially lost, are coming back in the form of automated manufacturing processes, requiring a fraction of the jobs used to make the same products. This trend will no doubt continue, but the true long-term implication to the Great Lakes and St. Lawrence Region remains somewhat unclear. Second, an important share of production has been “nearshored” to Mexico, rather than back to the Great Lakes and St. Lawrence Region. This is certainly the case in the automotive industry. How this will play out in the context of a renegotiation of NAFTA remains to be seen, though it is likely that this will result in more jobs on the U.S. side of the border in the Great Lakes and St. Lawrence Region and elsewhere over the next few years.

Unknown Unknowns

If history is any indicator, the Region should prepare itself for significant game changers and disruptors. What these may be is anyone's guess. The best forecasters are notorious for getting projections severely wrong. Crystal balling and scenario planning have merit in helping the Region plan for unknown unknowns. But decisions still need to be made.

For this Part 2 Report, and the forthcoming Multimodal Transportation Strategy for the Great Lakes and St. Lawrence Region, we define below a set of questions for consideration. These are general and not comprehensive, but frame some of the reflections that should inform this Strategy.

Questions for an Unknown Future

How will people and freight move in the Region?

- Will ridesharing and automated vehicles mark the end of personal car ownership and what does this mean for public transit use and investment?
- Will “mobility” mean more than the physical transportation of people and things?

How will the Region trade?

- How and with whom will the Region trade, and what will the Region's most important transportation gateways, corridors, and hubs look like?
- Will the Region's borders continue to have practical significance?

How will transportation infrastructure and service in the Region interact with the natural and build up landscape?

- Will climate change necessitate the relocation of transportation assets and built up areas?
- How will passengers, freight and neighborhoods interact?

How will transportation and mobility in the Region be governed?

- How will we pay for mobility, transportation infrastructure and services?
- How will regional cooperation work across institutions, agencies and stakeholders?

The key is not so much in searching for answers to these questions as much as to consider how to make the Region's transportation system resilient and adaptable to an unknown future.

Key Consideration for a Regional Multimodal Transportation Strategy

Beyond the known knowns and various unknowns described in the previous sections, what key considerations should guide a multimodal transportation strategy for the Great Lakes Region? Several key considerations emerged from discussion with Region stakeholders:

Planning can no longer be based on linear assumptions

Historic transportation system planning that assumed linear growth won't be appropriate going forward. There are simply too many non-linear factors at play – technology, climate change, shifting trade policies, among other knowns and unknowns. This will necessitate a different approach to transportation policy development, planning and investment, and by extension, a different kind of transportation strategy than may have been more typical in the past.

The Region's transportation system will need to be resilient and adaptable. This is all about "options".

Given the many unknowns facing the Region and its transportation system, resilience and adaptability need to be built into a future Regional multimodal transportation strategy. This is tricky when planning and investing in infrastructure that often has a useful life measured in decades.

Key to system resilience and adaptability are enabling more, and better transportation **options** for passenger and freight movement – that is, the users of the system. These options should be provided via a variety of modes, routings, price points and travel time thresholds. Actions that will help make the most of existing transportation options – and to make them more competitive – will be key to resilience.

Increasing system redundancy is a related option, though very expensive. The related question is who is prepared to pay for redundancy? Another key consideration for resilience is the speed at which projects get reviewed, approved and permitted.

The Strategy should leverage technology and data

New technologies are helping reinvent how people and things move. Technology is also generating better data that can be used to inform transportation decisions, planning and

investments. Opportunities to leverage technology and data, and to enable the development of more and innovative technology and data should be central to the Strategy.

The Strategy should assume constrained public funding

It would be too easy to call for increased transportation funding to address the Region's transportation challenges and opportunities. Yes, both the U.S. and Canadian federal governments have announced unprecedented infrastructure investment plans over the next few years (US\$1 trillion in the U.S. and over C\$180 billion in Canada), and yes, the Strategy should, to the extent possible, seek to align with government funding priorities. Yet, making a long term Regional Transportation Strategy largely contingent on public funding would likely handicap the Strategy. Government funding – at all levels - is subject to too many competing funding needs and political pressures. The Strategy should look to ways of achieving intended outcomes through lower cost options and alternative funding sources.

The Strategy will need to be collaborative and reflect common ground

This is easier said than done, particularly in a Region involving so many jurisdictions and institutional interests. Trust needs to be built among Regional stakeholders to create a sense that all participants can pursue their interests with a view to contributing to some common objective. It will also require that each's interests can be satisfied. Political leadership that sees the long-term benefits of collaboration can help bring parties together and sustain joint action. But it makes collaboration much more fragile and subject to disruption if political priorities change. The Council for the Great Lakes Region may be a neutral place to convene such a collaborative dialogue to ensure its sustainability and long-term progress.

The Strategy should seek to leverage the strengths of public and private sectors

The role of addressing transportation challenges and setting the future course for transportation has in the past in large part fallen within the purview of public sector actors - policy makers, planners and regulators – at different levels of government. But many of the solutions to tomorrow's transportation challenges and opportunities are being led by private sector players, including less traditional transportation stakeholders such as the Googles, Ubers, and Wazes of the world. A Strategy for the Great Lakes and St. Lawrence multimodal transportation system should recognize and leverage what both public and private stakeholders can bring to the table, and provide a means of facilitating the development and implementation of transportation solutions. The Smart City Challenge and similar initiatives can be useful for public-private collaboration and new thinking on transportation planning, investment and operations.

Smart City Model

In 2015, the U.S. Department of Transportation (USDOT) launched the Smart City Challenge to encourage cities and other public agencies to collaborate with the private sector on how an integrated, first-of-its-kind smart transportation system could use data, applications, and technology to help people and goods move more quickly, cheaply, and efficiently. Canada has recently announced a similar initiative.

Columbus, OH was selected for the Smart City Challenge and was awarded a US\$40 million grant to implement new technologies, including connected infrastructure, electric vehicle charging infrastructure, an integrated data platform, autonomous vehicles, and more. This award has already crowded in over US\$ 100 million in private funding. For example, Vulcan, Inc. is providing an additional \$10 million grant to the effort, and a wide range of other industry partners are providing Columbus with technology to help implement its plan, including NXP® Semiconductors, Amazon Web Services, Mobileye, Autodesk, Alphabet's Sidewalk Labs, AT&T, and DC Solar. Columbus.

Strategy should be bold, but practical

The multimodal strategy needs to set the vision and course for future actions and be bold. At the same time, the strategy should be practical and build on the resources already in place, including better utilizing existing infrastructure, as well as leveraging new technologies and other private sector innovations that are already in the transportation landscape. The Strategy must be forward-looking and, in line with being resilient (flexible), must set a course that does not preclude any future opportunities.

In short, the Multimodal Transportation Strategy for the Great Lakes and St. Lawrence Region will need to differ from transportation strategies of the past.

Next Steps:

This report, the second of three that will inform the Multimodal Transportation Strategy for the Great Lakes and St. Lawrence Region, is provided for comment and discussion.

The third report, will put forward a Strategy for addressing priority issues and opportunities, as well as policy, planning, funding, financing and operational considerations to move the Strategy forward.

Once the Strategy has been validated with relevant stakeholders, a single consolidated report, synthesizing the three component reports of this study, will be developed.

The Multimodal Transportation Strategy for the Great Lakes and St. Lawrence Region will be formally released at the Great Lakes Economic Forum occurring in Detroit-Windsor from April 24-26, 2017.