7 – Chapter 7: Freight Transportation Trends, Issues, and Forecasts

Several major trends and issues impact freight flow volume, routing, and the economic value of the commodities shipped in Wisconsin over the near- and long-term.

Overview of Chapter 7

- This chapter provides an overview of global, national, and Wisconsin-specific freight trends and issues that helped to shape the Wisconsin State Freight Plan.

This chapter provides an overview of global, national, and state freight trends and emerging issues that shaped the development of freight-related policies in the Wisconsin State Freight Plan (SFP).

7.1 Changing Global Economy

The changing and expanding global transportation system has and will continue to dramatically affect Wisconsin's transportation system and economic growth. This is particularly the case for North America because of the scale and scope of production, distribution and consumption taking place, and the large distances involved. Global trade routes for several major industries flow through Wisconsin on roadways, railroads, and waterways. This section identifies global freight-related trends and emerging issues that may influence freight movement in Wisconsin.

This section focuses on three areas influencing global freight movement:

- Shipping Patterns – The identification of patterns of the physical process of transporting freight (commodities, merchandise goods, and cargo) via roadways, railroads, waterways, air, and pipeline.
- Containerization – A system of intermodal freight transport using intermodal shipping containers.
- Trade Agreements – Agreements reached between two or more sovereign nations that dictate the terms of the acceptable exchange of goods and services between the parties.

Shipping Patterns

Prior to 2006, the majority of Asian goods entering North American markets were imported through west coast ports and then moved via double-stack intermodal trains to the Midwest and eastern United States markets. The San Pedro Bay ports of Los Angeles and Long Beach dominated this trade, in part because of a large local consuming market that complemented volumes destined for inland markets (Figure 7-1). Other domestic ports in Oakland, Seattle, and Tacoma also handled significant volumes of imports and exports.

However, labor disruptions and ongoing congestion at these ports prompted shippers and consignees to search for alternatives that diversify the risk of importing the majority of freight through San Pedro Bay. Among structural changes, the two most important results are the expansion of the Panama Canal and the build out of the Canadian Port of Prince Rupert.

Figure 7-1: Shipping Routes between Asia and the United States East Coast Markets

Source: Panama Canal Authority

Panama Canal Capacity Expansion

The Panama Canal expansion project, also called the Third Set of Locks Project, doubled the capacity of the Panama Canal in 2016. Key expansion components include the creation of a new traffic lane and the ability to accommodate more and larger ships. The increase in the size and depth of the locks will enable most of the larger container ships to use the canal and will more than double its throughput capacity.

Panama Canal Capacity and Expansion

Prior to expansion, about 14,000 vessels per year could transit the canal. These container ships (cargo ships that carry intermodal containers using a technique called containerization), classified as "Panamax" vessels, could carry approximately 4,500 twenty-foot-equivalent units (TEUs) of cargo.[1]

The original locks were about 110 feet wide. Between 2007 and 2016, one-third of the locks were reconstructed. The expanded canal began commercial operation in June 2016. The new locks allow transit of larger, "New-Panamax" ships, which have a cargo capacity of about 12,500 TEUs. In addition to larger ships, the expansion allows for about 2,000 additional trips per year.[2]

A portion of the imported/exported freight currently moving through western United States ports, bound for or originating in the east coast, may bypass the western ports entirely. Instead, the cargo would be diverted through the Panama Canal, thus avoiding the cross-country overland journey. Several United States east coast and Gulf of Mexico ports are dredging their harbors to accommodate the larger ships and to capture some of the potential increase in container cargo activity. Two-thirds of the United States population lives east of the Mississippi River, and up to 70 percent of containers imported through United States Pacific Northwest ports in the past decade were destined for the Midwest and eastern seaboard. In the near term, there will be substantial changes as international shipping lines try to manage their excess capacity as larger ships are put into service targeting the Asia to Europe trade.

[1] Hofstra University, "Comparative Characteristics of the Panama Canal Expansion."
[2] Ibid.

Although the amount of trade shifting from west coast ports to the all-water route through the Panama Canal is uncertain, it will increase competition for market share between the west coast ports. Excess port terminal capacity on the west coast of North America will put pressure on port and terminal operators' pricing power. Terminal operators will be driven towards increased productivity as a means to lower their operating costs, so they can hold their market share or attract new shipping lines.

For Wisconsin, passage through the Panama Canal means that the state's agricultural goods, as well as oil and natural gas from the upper Midwest, will have a dramatically shorter trip from the Gulf Coast to ports in eastern Asia. This could also increase demand for shipping by railroads that move cargo from the Midwest south toward the Gulf.

Port of Prince Rupert

First served by rail in 1914, the Port of Prince Rupert in British Columbia, Canada has experienced major growth over the past two decades led by the opening of the Fairview Container Terminal in 2007. The Canadian government, Province of British Columbia, Canadian National Railway (CN), and Prince Rupert Port Authority have funded projects at the port in anticipation of greater demand.[3,4,5] Its location on the coast of British Columbia allows cargo ships from northern Asia to unload two days earlier than the next closest location on the North American Pacific coast, speeding vessel cycle times and productivity.

The Port of Prince Rupert has highly efficient rail connections and 95 percent of imported containers leave Prince Rupert by rail.[6] CN has invested in its main line from Canada's west coast to Chicago, making improvements to allow for faster and more reliable service. Using CN's primary corridor through Wisconsin, containers are moved via expedited double-stack trains to Harvey, Illinois (just south of Chicago), Memphis, and New Orleans.[7] This inbound service was designed with an emphasis on speed to expedite the transport of consumer freight. The average transit time for moving containers from Prince Rupert to Chicago is just over four days.[8] Additionally, according to the *Journal of Commerce*, it cost less to ship a container from Asia to Chicago through Prince Rupert versus other West Coast ports.[9]

In 2013, the Prince Rupert Port Authority and CN proposed expanding its existing Fairview Container Terminal in Prince Rupert Harbor to increase the facility's capacity of 500,000 twenty-foot equivalent units (TEUs) per year. Completed in August 2017, the Port of Prince Rupert's expansion will accommodate 1.3-1.4 million TEUs per year.[10]

CN has aggressively sought "matchback" (return) traffic for containers on this lane, especially grains. This strategy was important in the company's agreement to establish the Chippewa Falls intermodal facility.[11,12] Unused westbound capacity could provide a cost-effective shipping option for other Wisconsin exporters, provided that service model with CN and the affiliated steamship lines continues to operate efficiently. Of note, Wisconsin

[3] Government of Canada, "Major Investment in Prince Rupert Port Expansion." (April 15, 2005).
[4] Market Wired, "Canada and Prince Rupert Port Authority Announce Three New Infrastructure Projects." (November 28, 2009).
[5] Port of Prince Rupert, "Joint Infrastructure Investment Unlocks Growing Canadian Trade Opportunities." (May 19, 2015).
[6] Port of Vancouver, "Container Traffic Forecast Study - Port of Vancouver, 2016."
[7] Journal of Commerce, "CN aims to replicate Prince Rupert model with Mobile." (July 24, 2015).
[8] Port of Prince Rupert, "Rail Connectivity."
[9] Journal of Commerce, "More Asian imports drip away from US West Coast."
[10] CanadianShipper.com, "Port of Prince Rupert completes Fairview Terminal expansion." (August 29, 2017).
[11] Journal of Commerce, "Match-Back Key to Growth in US Containerized Agricultural Exports." (September 20, 2013).
[12] Chippewa Herald, "Chippewa Falls rail terminal opens world markets to area businesses." (January 27, 2016).

shippers are likely to be in direct competition with shippers in other states and the western Canadian provinces for "matchback" operations.

St. Lawrence Seaway

The Saint Lawrence Seaway is a system of locks, canals, and channels in Canada and the United States that permit ocean-going vessels to travel from the Atlantic Ocean to the Great Lakes, as far inland as the western end of Lake Superior.

Great Lakes and Seaway shipping generates $18.1 billion in business revenue annually in the United States.[13] International changes have affected shipping through the Seaway. Europe is no longer a major grain importer, and big United States export shipments are now going to South America, Asia, and Africa. These destinations make Gulf and west coast ports more critical to 21st-century grain exports.

Containerization

Containerization involves loading non-bulk cargo into large shipping containers, which are then transferred between modes – truck, train, or ship – without unloading the cargo. Instead of being sorted and shipped separately in smaller groupings from the point of origin, the cargo is combined into one shipment and sorted when the container reaches its destination. Among the many advantages of containerization are standardization (containers can be shipped globally), flexibility (contents can include bulk or finished goods), and cost (up to 20 times less than bulk transport).[14] As shown in Table 7-1, of all the United States' containerized cargo that is bound for or is received from foreign countries, about two-thirds is routed through just five large United States coastal ports. Of those five ports, the twin Ports of Los Angeles and Long Beach handle over 40 percent of the total.

Containerization Trends
Forecasts indicate a continued upward trend of container traffic. Globalization of markets is influencing the increase in container traffic. A surge in container traffic places new demands on container or intermodal terminals, such as adding facility capacity and reorganizing transport schemes ('hub-and-spoke') at the facility. Hub-and-spoke refers to the collection site of containerized cargo (intermodal facility) from its point of origin (the tips of the spokes) and transport from the intermodal facility to a central processing facility (the hub). The shipment is then either warehoused or distributed directly from the heart of the network.

As an example, after arriving in the United States, containerized cargo is then shipped by rail to cities, such as Chicago, where the containerized cargo is loaded onto a truck. The containerized cargo is then transported to its final destinations in Wisconsin.

[13] Great Lakes St. Lawrence Seaway System, "The Economic Impacts of the Great Lakes - St. Lawrence Seaway System." (October 18, 2011).
[14] Hofstra University, "Advantages and Drawbacks of Containerization."

Table 7-1: 2006-2011 United States-Foreign Container Trade by United States Port (millions of metric tons)

Port	2006	2007	2008	2009	2010	2011	*% Change '06-'11*
Los Angeles/ Long Beach, CA	66.5	69.7	69.8	57.5	66.2	69.2	3.9%
New York, NY	27.8	29.9	31.9	27.8	31.5	34.3	23.3%
Savannah, GA	14.5	17.1	18.7	15.7	19.6	20.7	43.5%
Houston, TX	16.3	17.6	17.4	16.3	17.0	19.6	20.2%
Seattle/Tacoma, WA	17.6	18.9	17.9	15.3	17.8	18.1	2.7%
San Francisco, CA	11.4	11.7	11.8	11.6	12.9	13.7	20.3%
Norfolk, VA	11.9	12.3	12.9	10.5	11.1	11.4	-4.4%
Charleston, SC	11.2	11.3	10.9	7.7	9.3	10.0	-10.7%
Miami, FL	9.3	8.8	8.3	7.6	8.2	8.7	-6.9%
New Orleans, LA	5.5	6.0	537	5.2	5.7	7.3	31.7%
Top 5	142.7	153.2	156.7	132.6	152.1	161.9	13.4%
Top 10	192.2	203.3	206.2	175.1	199.3	213.0	10.8%
Total, Container	**220.6**	**231.6**	**235.1**	**200.6**	**227.4**	**242.8**	**10.0%**
Total, Non-Container	**1,160.0**	**1,144.3**	**1,141.4**	**1,001.4**	**1,078.0**	**1,100.3**	**-5.1%**

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

Some commodities, agricultural products in particular, which have traditionally been shipped in bulk, are shifting to containerized transport. A good example is grain for international destinations. The trend is to load containers directly at the production site to eliminate the expense of transloading from trucks to ships. As identified in Chapter 5, *Wisconsin's Transportation System Assets*, to support Wisconsin's freight movements in terms of tonnage, the state has many access points for shipping via truck and water. There is a significant amount of freight tonnage that is shipped through the state by rail. This can create a challenge for shippers that wish to access rail. In many cases, shippers have to rely on other modes, such as trucking, to ship freight to truck-rail intermodal facilities where rail can be accessed, unless shippers have an opportunity to utilize short line or regional railroads, which can be used to connect to Class I railroads.

Recent Developments for Container-on-Barge

In 2014 and 2015, the United States Department of Transportation's (DOT) Maritime Administration designated the Upper Mississippi and Illinois Rivers as the M-55 and M-35 Marine Highways, connecting Chicago and Minneapolis to New Orleans. These routes are being evaluated for new container-on-barge service being developed by communities along the rivers. The Illinois, Iowa, Minnesota, Missouri, and Wisconsin transportation departments have primary responsibility for implementing activities on the M-35 Marine Highway Route, with the administrative assistance of the Upper Mississippi River Basin Association (UMRBA).

In fall 2016, the United States DOT's Maritime Administration awarded a $96,000 planning grant to the City of St. Louis Port Authority, along with three partners: Inland Rivers Ports & Terminals, Inc. (IRPT), Mississippi Rivers Cities & Towns Initiative (MRCTI), and UMRBA to support planning efforts focused on the development of containerized shipping along the Mississippi River, between New Orleans, LA, Minneapolis, MN, and Chicago, IL. With a twenty percent match shared among the St. Louis Port Authority, MRCTI, IRPT, and UMRBA, the total money available is $120,000.

The America's Marine Highway Program, administered by the United States DOT, was authorized in 2007 to achieve full integration of marine highway vessels and ports into the nation's surface transportation system, ensuring that reliable, regularly scheduled, competitive, sustainable services are routine choices for shippers.

Trade Agreements

Global production and distribution are affected by international trade agreements, quotas, and tariff restrictions. The dynamics of the global marketplace have driven the formation of numerous large regional trading blocs, including the European Union (EU), the ASEAN Free Trade Area (AFTA), and the North American Free Trade Agreement (NAFTA).

The United States currently has free trade agreements in force with 20 countries, which accounted for $12.6 billion (56 percent) of Wisconsin's exports in 2015. Since 2005, exports from Wisconsin to these markets grew by 57 percent, with NAFTA countries, South Korea, Peru, Chile, and Australia showing the largest dollar growth during this period.[15]

NAFTA

NAFTA is an agreement between Canada, Mexico, and the United States. The agreement went into effect on January 1, 1994. A major goal of NAFTA was to lower total costs (i.e. distribution and logistics costs) of North American businesses exporting goods within the North American market. NAFTA eliminated many barriers to trade and investment between the United States, Canada and Mexico. Most United States-Canada trade was already duty-free when the agreement was signed. Some of NAFTA's most significant changes occurred between Mexico and the United States. Specifically, the implementation of NAFTA brought the immediate elimination of tariffs on more than one-half of Mexico's exports to the United States and more than one-third of United States exports to Mexico. NAFTA eliminated all tariffs on goods qualifying as North American under its rules of origin. For most goods, existing customs duties were eliminated immediately or phased out after five or ten years after implementation. For certain sensitive items, such as United States agricultural exports, tariffs were phased out over a fifteen-year period. NAFTA also sought to eliminate non-tariff trade barriers and to protect the intellectual property rights on traded products.

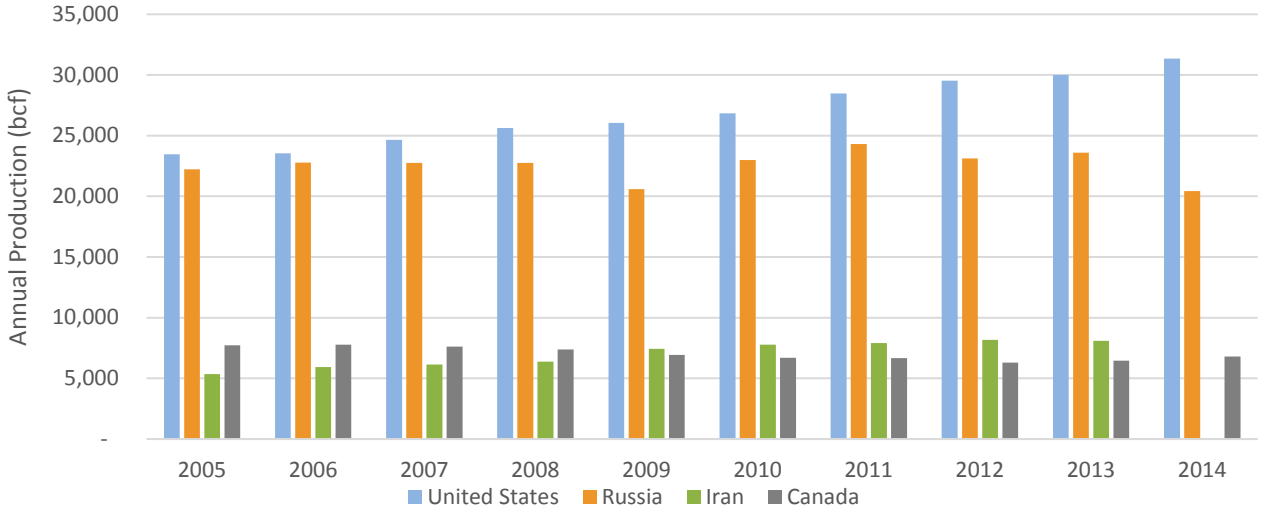
As discussed in Chapter 4, *Economic Context of Freight on Wisconsin's Transportation System*, in 2013 approximately 44 percent of Wisconsin's exports went to Canada and Mexico. Wisconsin's strong trade ties to Canada and Mexico can be attributed to trade agreements, transportation linkages and manufacturing relationships. Canada, which accounts for about one-third of Wisconsin's international shipments, continues to be Wisconsin's top export destination. Mexico's share of Wisconsin's exports has grown in recent years. Wisconsin's exports to Mexico increased by nearly five percent in 2015, and now accounts for approximately 13 percent of Wisconsin's international shipments. This is up from 12 percent in 2014 and 11 percent in 2013.

7.2 Growth in Energy Production

The United States has been at the center of increased production of natural gas and oil over the past ten years following the increased use of hydraulic fracturing (fracking) to extract oil and natural gas from shale formations. Figure 7-2 and Figure 7-3 show the growth trend and the position of the United States as a world leader in the gross production of natural gas and petroleum. United States production has increased by 33 percent from 2005 to 2014 and in 2014 the United States accounted for over 20 percent of the world's gross production of natural gas.

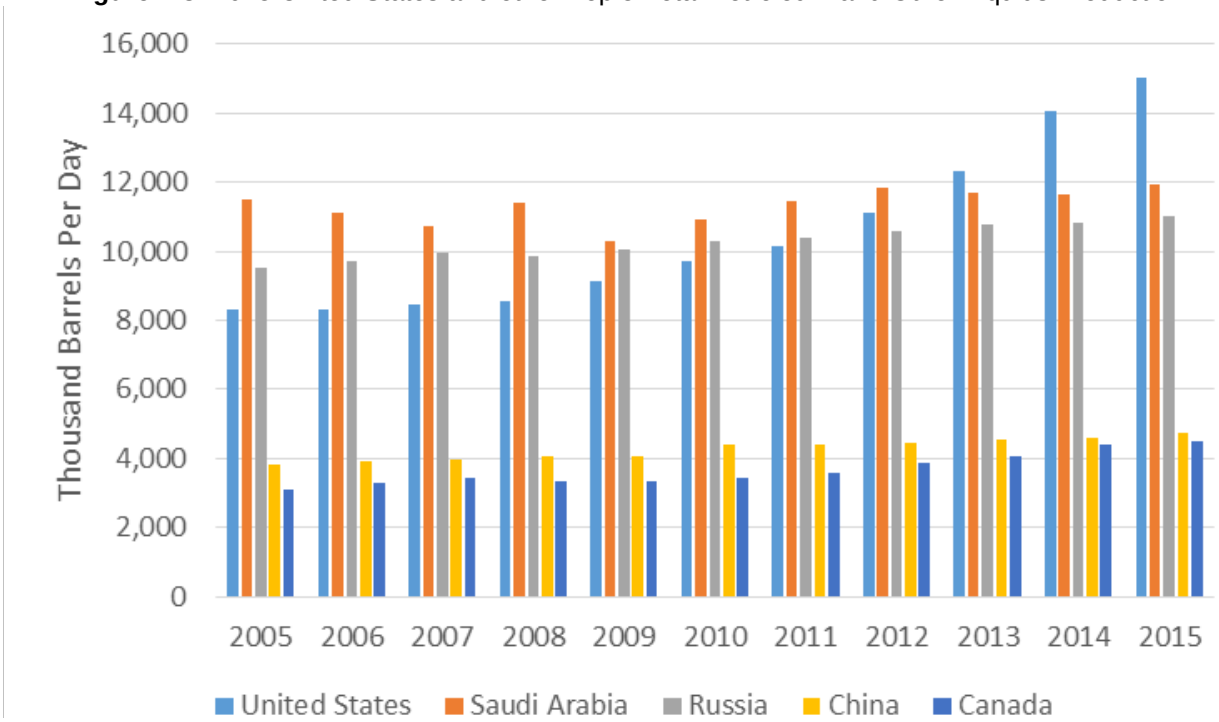
[15] U.S. Department of Commerce, International Trade Administration, "Wisconsin Exports, Jobs, & Foreign Investment." (October 2016).

Figure 7-2: Natural Gas Production (Billion Cubic Feet)



Source: CPCS, "Wisconsin State Freight Plan - Wisconsin Pipelines: Draft Final Report." (February 2016).

Figure 7-3: 2015 United States and other Top 5 Total Petroleum and Other Liquids Production



Source: CPCS, "Wisconsin State Freight Plan - Wisconsin Pipelines: Draft Final Report." (February 2016).

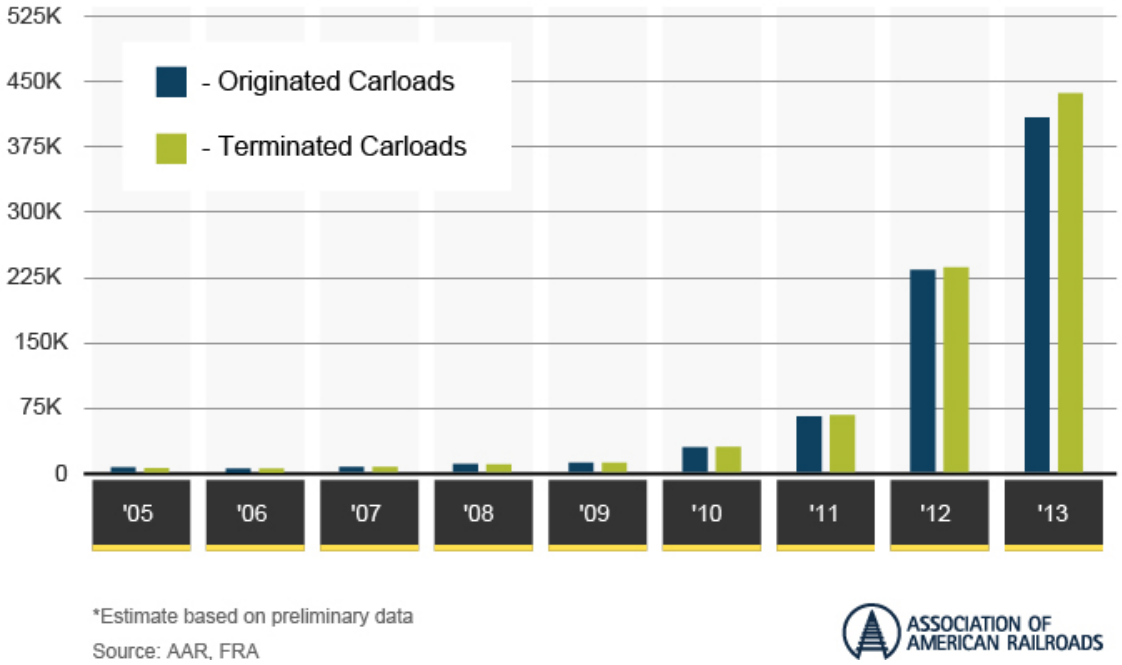
Fracking has resulted in large amounts of gas and oil being extracted in the Midwest and Upper Great Plains, particularly from the Bakken region of North Dakota, Montana, and parts of Canada. This has produced greater freight traffic in two ways: product being shipped from the region and materials used for fracking (i.e., sand and chemicals) being shipped to the region.

Much of these freight movements to and from the area are by rail, due to production increasing at a rate that exceeds the capacity and availability of the nation's pipelines. In the first half of 2014, between 60 percent and 70

percent of the more than 1 million barrels per day of oil produced in North Dakota was transported to refineries by rail.[16] Destinations for oil include oil refineries on the east coast (Pennsylvania and Delaware) and the Gulf Coast (Louisiana and Texas).

As shown in Figure 7-4, in 2009 rail shipments of crude oil on United States Class I railroads amounted to fewer than 25,000 carloads per year nationally. By 2013, shipments had increased to nearly 450,000 carloads. Additionally, crude imports by rail from Canada to the United States increased more than 20-fold since 2011.

Figure 7-4: 2005-2013 Number of Crude Oil Carloads on United States Class I Railroads



In terms of Wisconsin, Class I railroads are most likely to ship oil from the Bakken region through (overhead) Wisconsin. From an oil refining standpoint, only one oil refinery operates in Wisconsin. Indiana-based Calumet Specialty Products (Calumet Superior Refinery) owns the former Murphy Oil refinery in Superior, Wisconsin. It receives western oil via the Enbridge pipeline system, and its primary products are fuels, such as gasoline, and blacktop material. Calumet Superior Refinery has aggregate crude oil throughput capacity of approximately 45,000 barrels per day (bpd).

Hydraulic Fracturing

Hydraulic fracturing (fracking) has been active in the United States for decades, but since 2005 its use has become more sophisticated and cost-effective when combined with horizontal drilling techniques. The combination of these two technologies has been at the forefront in the extraction of gas and oil from deposits outside of the traditional Gulf States and Alaska regions.

In addition to the outputs of the fracking process, the inputs, namely sand, also require the use of Wisconsin's transportation infrastructure. The increased use of hydraulic fracturing technologies requires substantial amounts of a special type of sand used in the process. Deposits of this silica or "frac sand" are common in certain parts of Wisconsin, making the state the primary source of the sand in the nation. Before 2006, there were fewer than six

[16] Oilprice.com, "Oil Shipments By Rail Declining." (July 20, 2015).

industrial sand mining operations in the state. As of May 2016, there were a total of 128 industrial sand facilities conducting either mining, processing, or rail loading operations in Wisconsin, most of which are directly related to the frac sand industry.[17] The transport of frac sand may involve several modes. Where facilities are not co-located, trucks transport sand from mines to processing plants and intermodal shipping facilities. From there, trains or barges ship the sand long distances. Processed sand is generally shipped to the end user via rail.

Natural Gas as a Transportation Fuel

Compressed Natural Gas (CNG) is a readily available alternative to gasoline that is made by compressing natural gas to less than one percent of its volume at standard atmospheric pressure. Consisting mostly of methane, CNG is odorless, colorless, non-corrosive, and has lower air emissions than gasoline.[18] Although vehicles can use natural gas as either a liquid (LNG) or a gas (CNG), most vehicles use the gaseous form compressed to pressures above 3,100 pounds per square inch. CNG vehicles have been introduced in a wide variety of commercial applications, including commercial motor vehicles, taxi cabs, UPS delivery vans, postal vehicles, transit buses, waste management trucks, and school buses. Natural gas is produced both worldwide and domestically at relatively low cost and is cleaner burning than gasoline or diesel fuel. CNG and LNG are being explored and adopted by both the trucking and railroad industries.

CNG is a legitimate option for investment as future projections show prices remaining steady. Typically, trucking companies will add CNG vehicles to their fleet allowing for greater diversification and the ability to switch between diesel and natural gas for higher-mileage routes, depending on the lower-cost option.

Additional reasons for CNG investment may include branding opportunities for a “greener” fleet, greater stability over fuel prices, and possible competitive advantages with businesses, customers, and/or suppliers that favor natural gas fleets. However, making the move to natural gas requires companies to invest more upfront. The return on that investment comes from the savings on the fuel cost. Additionally, creating the infrastructure needed for long-haul trucking is another challenge deterring the adoption of CNG. LNG faces similar challenges, such as establishing public LNG fuel stations every 400 miles on major truck corridors. LNG market penetration will advance slowly in the near term due to these hurdles.

Railroads are also beginning to adopt technology that will allow locomotives to run on natural gas in addition to diesel, primarily LNG rather than CNG. Retrofitting existing machines to burn a mix of diesel and natural gas is the quickest and easiest way to adopt the new technology, and will offer advantages to using natural gas alone. The diesel can provide the spark needed to ignite natural gas without redesigning engines, and the diesel helps provide horsepower. Advantages include reducing emissions and reducing fuel costs for the railroads.

Since 2011, the use of CNG and LNG has been increasing (see Table 7-2) in Wisconsin. In 2013, on-road diesel consumption was 726 million gallons and on-road gasoline consumption was 2.47 billion gallons in the state. Recognizing the growth in CNG and LNG consumption, more and more gas stations in the state are selling CNG and LNG fuel. However, only 60 gas stations provide CNG and LNG as fuel.[19]

[17] Wisconsin Department of Natural Resources, “Locations of industrial sand mines and processing plants in Wisconsin.”
[18] CNGNOW!, “What is CNG?”
[19] Wisconsin State Energy Office, “Natural Gas for Transportation Roundtable.”

Table 7-2: 2013 Wisconsin Alternative Motor Fuel Consumption (Millions of Gallons)

	2011	2012	2013
CNG	0.55	1.42	3.64
LNG	0.00	0.09	0.22

Source: Wisconsin State Energy Office

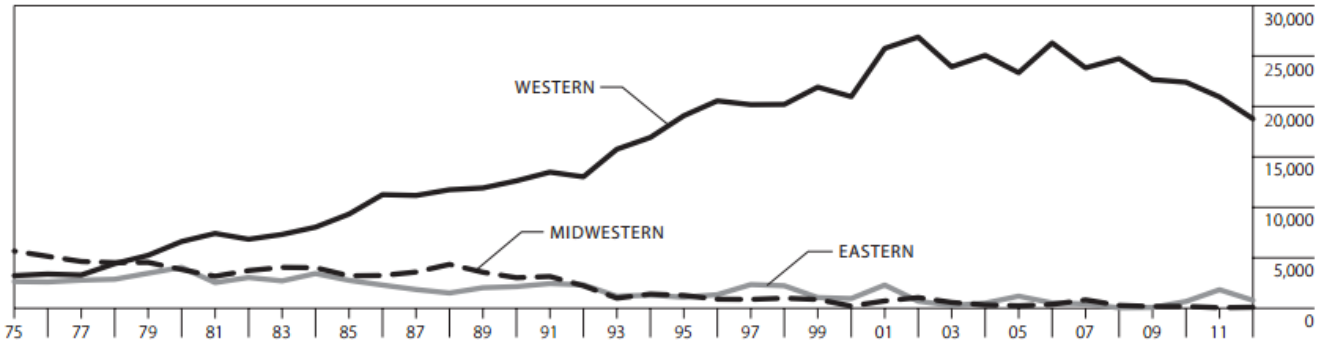
Coal Movement by Rail and Ship

Coal supplied more than 50 percent of Wisconsin's net electricity generation in 2016.[20] It is moved from mines to coal-powered power plants predominantly by rail and ship. Two trends are impacting the traditional routing of those shipments: 1) the increased use of coal from deposits in the Powder River Basin, and 2) conversion of coal-powered electricity-generating plants to other energy sources.

There has been continual growth in traffic from the Powder River Basin coal fields in Wyoming and Montana over the past 30 years. The Basin's lower-sulfur coal has gained market share as federal and state environmental laws have sought to reduce the effects on air quality caused by coal-burning plants. This has resulted in changes to the supply chains, with less coal moving out of Pennsylvania and West Virginia. The Powder River Basin now supplies around 40 percent of the nation's roughly one billion tons-per-year total coal use.[21] It is responsible for the electricity that lights one-fifth of the nation's homes and businesses.

Wisconsin's experience with Powder River Basin coal mirrors that of much of the country. Coal from western states is Wisconsin's largest inbound rail commodity. It includes trans-loaded volumes moved by ship from the Port of Superior to power plants bordering the Great Lakes, and tonnage delivered to Wisconsin's power plants by rail (see Figure 7-5).

Figure 7-5: Coal Deliveries to Wisconsin Power Plants, by Region of Origin



Source: Wisconsin State Energy Office, "2013 Wisconsin Energy Statistics Book"

As new domestic supplies of abundant and relatively inexpensive natural gas are developed, demand for coal from western states may be reduced in the future. Other factors that could affect demand for coal include further development of alternative energy sources (solar, wind, geothermal, etc.) and improvements in the electric grid, which may reduce the need for electricity produced by fossil fuel-fired power plants.

The resultant loss of coal traffic could have a dramatic financial impact on the large western railroads, particularly the Union Pacific and BNSF. Conversely, the main line capacity freed up by such a change would position these

[20] U.S. Energy Information Administration, "Wisconsin State Energy Profile."
[21] U.S. Energy Information Administration, "Annual Coal Report 2015 - Coal Production and Number of Mines by State and Mine Type, 2015 and 2014."

railroads to more aggressively pursue domestic intermodal markets that are seen today as too short haul or marginal in profitability. Railways' relative fuel efficiency is seen as a powerful tool in capturing truck volumes.

United States natural gas prices have been consistently lower than other major manufacturing countries in recent years, which provides a competitive advantage to the nation's energy-intensive industries.[22] This is driving new investment in plants that use natural gas as their energy source. As companies invest to capitalize on lower energy costs, heavy manufacturing is likely to grow, with outbound rail and waterway freight transportation access a key to siting these plants. As these conversions become more widespread, the resulting decreases in coal demand will impact rail and port traffic.

7.3 Changing United States Economy

The United States transportation system moved an average of approximately 54 million tons of freight per day in 2012, valued at nearly $48 billion. After recessionary declines in 2008 and 2009, the tonnage and value of freight moved in 2012 exceeded the previous highs reached in 2007 by just over four percent.[23] The value of freight moved is forecast to increase faster than its weight, rising from $882 per ton in 2007 to $1,377 per ton in 2040, adjusted for inflation. United States exports and imports are forecast to make up an even greater share of freight flows, reaching 19 percent (up from 11 percent in 2007) of the tonnage and 31 percent (up from 19 percent in 2007) of the value by 2040.[24]

United States exports totaled a record of nearly $2.3 trillion in 2013, which is a 44 percent increase in the dollar value of exports from the most recent low point in 2009. Adjusted for inflation, exports increased by 27 percent over this time period.[25] In addition, nearly 30 percent of gross domestic product (GDP) growth in recent years has been the result of export growth. This is particularly impressive given that exports of late have accounted for nearly fourteen percent of GDP.[26] Jobs supported by total exports were 11.3 million in 2013. Also, the United States' population is projected to increase from 314 million in 2012 to 400 million in 2050, an increase of 27 percent.[27] The expansion of the economy and projected increases in population will result in increased stress on the transportation system. The following section discusses the trends impacting the United States economy and their impact on freight transportation nationally and in Wisconsin.

Intermodal Shipment of Goods

Intermodal (sometimes referred to as "multimodal") refers to the shipping of goods using more than one transportation mode. The classic forms of rail intermodal transportation are truck trailer-on-flatcar (TOFC) and container-on-flatcar (COFC). The largest concentrations are on routes between Pacific Coast ports and Chicago (sometimes passing through Wisconsin), between California and Texas, and between Chicago and New York. Other typical mode pairings include truck to ship and rail to ship. Some of these transfers involve containers, while others are bulk products like coal or grain. Freight providers are becoming more multimodal and are developing strategic alliances across modes, which has the effect of increasing demand for efficient intermodal connections and near-constant supply chain optimization.

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[22] BP, "Energy economics > Statistical Review > Natural gas > Natural gas prices."
[23] Federal Highway Administration, "Freight Facts and Figures 2013."
[24] Ibid.
[25] U.S. Department of Commerce, "The Role of Exports in the United States Economy." (2014).
[26] Ibid.
[27] U.S. Census Bureau, "An Aging Nation: The Older Population in the United States." (May 2014).

Global supply chains have driven freight handling and logistics innovations to increase efficiencies and reliability. Examples include just-in-time delivery, radio frequency identification (RFID) tags, computerized inventory management systems at warehouses, global positioning system (GPS) delivery tracking from origin to destination, and third-party logistics (3PL) providers.

Domestic Containers

A growing emphasis on energy efficiency, sustainable transport, and transportation's effects on the environment has led many states to explore possible strategies to shift highway truck traffic to rail. In response, the nation's large railways have expanded their offerings for movement of domestic intermodal freight, including large, multi-lane service contracts with some of the nation's largest trucking firms. For example, Wisconsin-based Schneider National is one of the country's largest users of rail intermodal services.

The railways' engagement with domestic intermodal traffic is heavily targeted to corridors that exceed 1,000 miles, with traffic moving in containers rather than standard over-the-road trailers. Double-stacked containers maximize payload per train. The operation of the cranes and other elements of the rail/highway interface at the intermodal ramps are expensive. As a result, the long-haul cost-efficiencies of rail movement must be significant to produce an economically feasible service package to the targeted clients.

Wisconsin suffers major impacts from freight shippers moving goods over its highway system to access large railroad intermodal facilities in Chicago. Freight traffic destined for both east and west coasts, Minnesota, and the Dakotas often travels east by truck on I-94 and I-90 through Wisconsin before it is transferred in Chicago (considered overhead traffic). 2012 data suggests that almost 30 percent of tonnage and almost 45 percent of the value of freight traveling in Wisconsin is overhead traffic, originating and destined for points outside the state.

Carrier Level of Service

Changes in the production, purchasing, and consumption habits of consumers have changed the way freight carriers must operate. The following provides an overview of key trends impacting freight carriers.

Just-in-Time Delivery

In the past, manufacturers maintained large inventories in warehouses. Today, most goods are produced based on consumer demand and delivered just-in-time (JIT) for the next phase of production or consumption, thereby minimizing the time required to source, handle, produce, transport, and deliver products in order to meet customer requirements. By eliminating warehousing costs and reducing inventory carrying costs, efficiency and productivity have increased. JIT is also an inbound manufacturing strategy that helps to regulate material flow to manufacturing plants and other production facilities. This strategy seeks to minimize inventory investment by scheduling delivery of raw material or components to the point where they are needed, at the precise time they are required.

Therefore, trucks (as well as rail cars and ship containers) have become "mobile warehouses" residing on the transportation system. JIT shipping practices have created a greater reliance on a transportation system that provides predictable travel times, but have also made supply chains more vulnerable to disruptions by suppliers or along transportation routes.

E-Commerce

E-commerce continues to grow more rapidly across the country than overall retail growth. United States e-commerce sales increased by roughly seventeen percent from 2012 to 2013, while total retail sales only increased

by 4.2 percent.[28] This trend is shifting freight distribution towards more point-to-point shipments from warehouses to homes, and this will create more short trips in urban areas via parcel trucks. To meet the increasing consumer demands for quicker product delivery, nationwide distribution centers will become smaller, but there will be more of them and they will be located closer to major metropolitan areas. Companies will demand efficient, reliable and safe systems to transport merchandise on a predictable timetable. Distribution centers that are smaller in size and larger in number will allow for precise delivery schedules.

There will continue to be significant pressure on shippers and goods receivers to lower inventory costs. Retailers and manufacturers will continue to streamline their processes, dropping smaller amounts at more frequent intervals at stores and factories. This will drive ever-increasing demand for on-time truck deliveries in very short appointment windows (to the minute). This level of service will depend on reliable highway freight corridors in congested urban areas.

Urbanization

Urban truck deliveries will grow faster than other freight modes due to the development of high-density urban population centers. Land-use regulations preventing large trucks from entering cities will put more small trucks into operation in urban areas. Shippers will implement operational strategies to improve reliability. For example, retail distributors' delivery hours to urban centers will continue to shift to off-peak (midnight to 5 a.m.) hours. This is unlikely to decrease congestion in the peak morning delivery hours as the total number or truck trips are expected to grow.

Megaregions

Megaregions of the United States are clustered networks of American cities, the population of which currently ranges or is projected to range from about 57 to 63 million by the year 2025.

The Great Lakes Megalopolis (Figure 7-6) consists of the group of North American metropolitan areas which surround the Great Lakes region and Saint Lawrence Seaway. It lies mainly within the Midwestern United States but extends into western Pennsylvania and Upstate New York, as well as Southern Ontario and the southern part of Quebec in Canada. It is the largest and most populated megalopolis in North America.

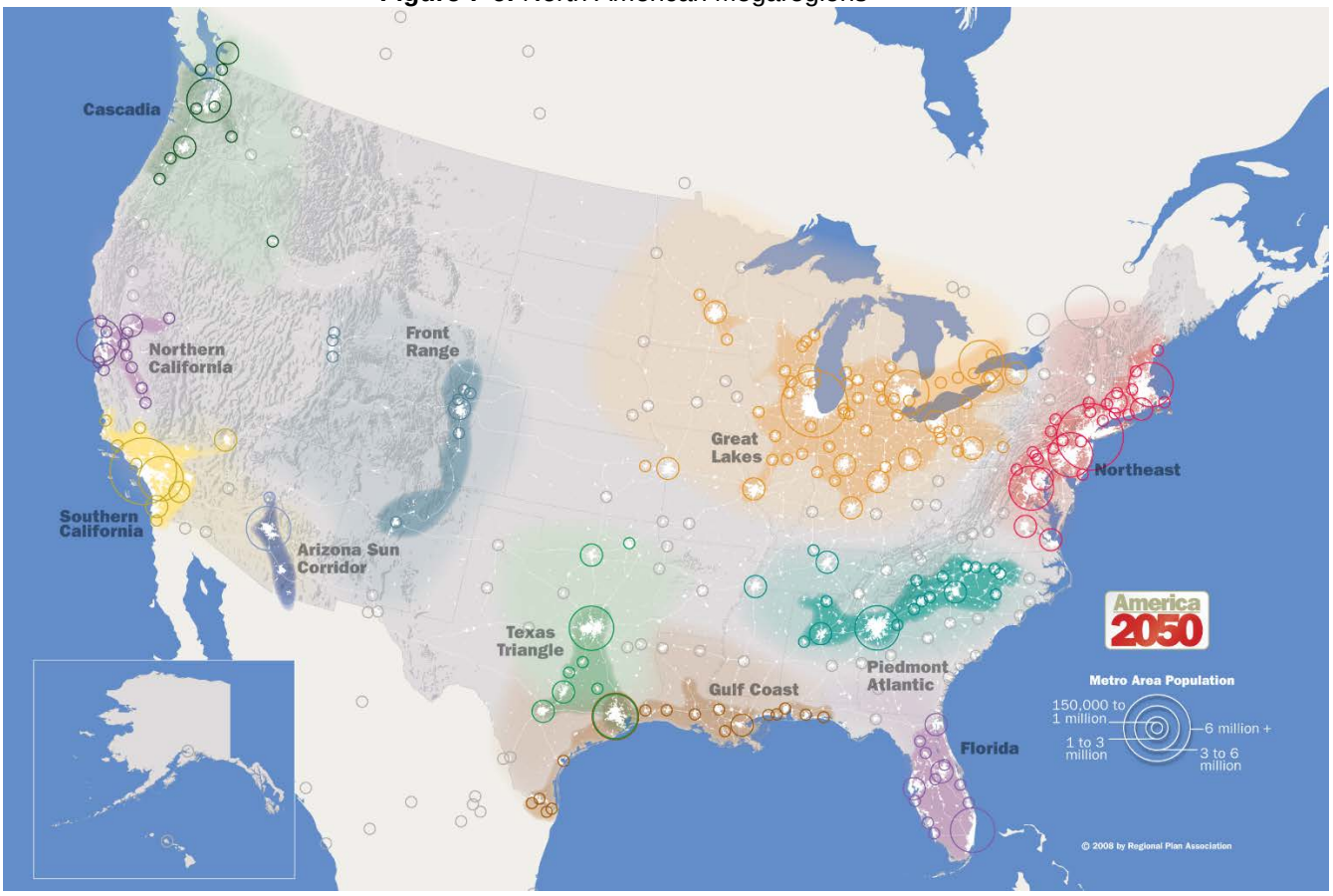
The cities of the Great Lakes Megaregion are more dispersed in a "hub and spoke" network. At the geographic and economic center of this network is Chicago. Behind only New York, Chicago has the second densest business district in the nation with more than a half million jobs "downtown."[29] The Great Lakes Megaregion has four of the top 25 cities in population, including Chicago, Detroit, Minneapolis, and Milwaukee.

At its most inclusive, the region cuts a wide swath from the Twin Cities in Minnesota to Pittsburgh, Pennsylvania and Rochester, New York. On the Canadian side, it extends as far east as Quebec City. Further south, the region is commonly considered to include Kansas City, Missouri; Cincinnati, Ohio; Indianapolis, Indiana; Louisville, Kentucky; and Columbus, Ohio. Within this broad region, there is a smaller core area that includes Chicago, Illinois; Detroit, Michigan; and Pittsburgh, Pennsylvania. The larger region, including fringe areas, had an estimated population of about 59 million as of 2011. It is projected to reach a population of approximately 65 million by 2025. The

[28] eMarketer, "Total US Retail Sales Top $4.5 Trillion in 2013, Outpace GDP Growth." (April 10, 2014).
[29] Demographia, "United States Central Business Districts (Downtowns), 3rd Edition." (March 2014).

population centers of Chicago, Minneapolis-Saint Paul, Milwaukee, Madison, Fox Cities, and Green Bay are located within the Great Lakes Megalopolis.[30]

Figure 7-6: North American Megaregions



Source: Regional Plan Association, "America 2050 - Megaregions."

7.4 Wisconsin Modal Trends, Issues, and Forecasts

Wisconsin businesses conduct international trade with a large number of countries, exporting goods throughout the world. Global trade routes for several major industries flow through Wisconsin on roadways, railroads, and waterways. The state's ability to respond and adapt to the transportation system demands remains critical.

Understanding the driving forces that could significantly affect state's freight dependent industries over the next 20 years provides decision makers data to anticipate and invest in improvements that enable economic growth in Wisconsin. For example, implementation of positive train control and tracking the potential for expanded use of autonomous and connected vehicles will have an impact on the transportation system. This section investigates modal trends that suggest indicators of each mode's status relative to freight movement.

As identified in Chapter 4, *Economic Context of Freight on Wisconsin's Transportation System*, GDP is an indicator of economic vitality and is an economic statistic measuring the value of the goods and services produced by the state economy over a given time period. According to the United States Bureau of Economic Analysis (BEA),

[30] Regional Plan Association, "America 2050 - Megaregions."

Wisconsin's GDP was $281.6 billion in 2013, ranking it 20th by state, at about 1.7 percent of the nation's total GDP.[31] Addressing transportation trends may enhance economic productivity in Wisconsin, which could influence the state's GDP.

Forecasts for Freight in Wisconsin

By 2040, the movement of freight in Wisconsin is projected to grow 74 percent across all transportation modes in terms of tonnage. Freight forecasting, for the purposes of this plan, is the process of estimating future commodity tonnage, future commodity value, and future transportation affects relative to commodities.

This chapter provides the context for freight today and anticipated freight traffic in 2021 and 2040. The forecasts display changes to flows, freight partners, locations, and commodities, detailed by highway, railroad, water, and air freight modes. This information provides an understanding of anticipated growth across modes. Forecasts, along with several other factors developed in the freight plan, help provide the context to develop policies, strategies, and investment recommendations to proactively address future freight needs. The decisions made today about mode choice are based on factors such as cost, congestion, and transportation business models, among others. As these and other factors change over time, there are changes in the supply chain decisions that can impact the commodities transported, modes used and flow patterns.

The following section provides an overview of the two modeling tools used in the development of the freight forecasts presented in this chapter.

- **Transearch Database –** this database from IHS Inc. provides forecasts for commodity tonnage and value. The database includes commodity origins and destinations at the Wisconsin county level and at the BEA[32] zone level outside of Wisconsin. IHS Inc. uses an economic, trade and industry forecasting model to develop the database estimates.
- **WisDOT's Statewide Travel Demand Model (TDM) –** created by WisDOT, this model provides forecasts for trucks on Wisconsin roadways. The database estimates the tonnage productions based on the employment within the traffic analysis zone (a geographic area used in traffic modeling that is based on census data) level in Wisconsin, and at a larger aggregate zone level outside of the state using estimated trip attraction rates from Transearch.

[31] U.S. Bureau of Economic Analysis, "Annual Gross Domestic Product (GDP) By State."
[32] The Bureau of Economic Analysis Economic Areas, often called BEA regions, are groupings of U.S. counties into 179 regions for statistical purposes. These are periodically updated, most recently in 2004.

Transearch Database

The Transearch database provides freight forecasts for the year 2040, by transportation mode, commodity tonnage and value, and origin and destination location.[33] Forecasts for 2040 provide an understanding of future growth relative to the 2013 base year. The Transearch database utilizes a multitude of mode-specific data sources to create a picture of the nation's freight traffic flows on a market-to-market commodity basis. The Transearch database is created using:

- The Annual Survey of Manufacturers (ASM), which provides sample estimates of statistics for all manufacturing establishments with one or more paid employee, and was used to estimate production levels by state and industry
- The Surface Transportation Board (STB) Rail Waybill Sample, which is used to develop all market-to-market rail activity by industry
- The Army Corps of Engineers Waterborne Commerce Database, which is used to develop all market-to-market water activity by industry
- Federal Aviation Administration (FAA) Enplanement Statistics and airport-to-airport cargo volumes

The determination of zonal detail in the Transearch data is based on commodity exchanges between regions at the BEA geography encompassing the entire United States, Canada, and Mexico. Over 200 commodities are classified, exchanged, and forecast in the Transearch model. When developing this data for use, WisDOT has assumed that trending data has been captured by the metrics within the model itself.

For example, Transearch trip attraction data was used as a primary input to the statewide Travel Demand Model. Transearch's county-to-county market detail is developed through the use of Global Insight's Motor Carrier Data Exchange inputs and Freight Locator database of shipping establishments. The Motor Carrier Data Exchange provides information on actual market-to-market trucking industry movements. The Freight Locator database provides information about the specific location of manufacturing facilities, along with measures of facility size (both in terms of employment and annual sales), and a description of the products produced.

WisDOT Statewide Travel Demand Model (TDM)

In addition to Transearch data, detailed employment information by location and industry sector figure prominently in the use and application of the state's TDM. WisDOT uses the TDM to estimate future-year truck travel on Wisconsin's roadways and to evaluate transportation policies, plans, programs, and projects. By quantifying the passenger and freight traffic flows along Wisconsin's roadways, the TDM determines how changes in the economy, investments, or traffic operations affect roadway demand and system performance. The output from the WisDOT statewide TDM, in conjunction with Transearch data, was used to develop the highway freight forecasts.

Forecasts from both Transearch and the WisDOT Statewide TDM will be used, along with several other factors developed in the freight plan, to provide the context for developing policies, strategies, and investments to proactively address future freight needs.

[33] Wisconsin Department of Transportation, Transearch database.

Statewide Travel Demand Model Inputs and Outputs for Freight
The Wisconsin statewide TDM was developed using a variety of data sources including: • Transportation network characteristics • Business locations (including the origins and destinations of commodities) • Commodity flows • Household information • Number and type of jobs The TDM input data influences how the TDM functions when it is run to develop outputs. Changing the inputs will change the outputs. Changing the inputs and comparing them to the outputs of the TDM allows WisDOT to assess transportation system demands and new infrastructure. Freight outputs can include: • Percent truck • Growth in truck volumes relative to total vehicle volumes • Origin and destination tables for truck freight • Commodity assumptions on specific roadways

The following section provides the context for overall freight flows in Wisconsin. It includes total commodity forecasts, for each transportation mode, showing changes over time.

The forecasts presented here assume a horizon year of 2040 consistent with the context of the long-range freight plan-year horizon. At the same time, the FAST act requires state freight plans to address a five-year forecast period. As such, select data is presented for the five-year component of this freight plan – 2021.

Commodity Flow Forecasts

Transearch 2040 Multimodal Forecasts

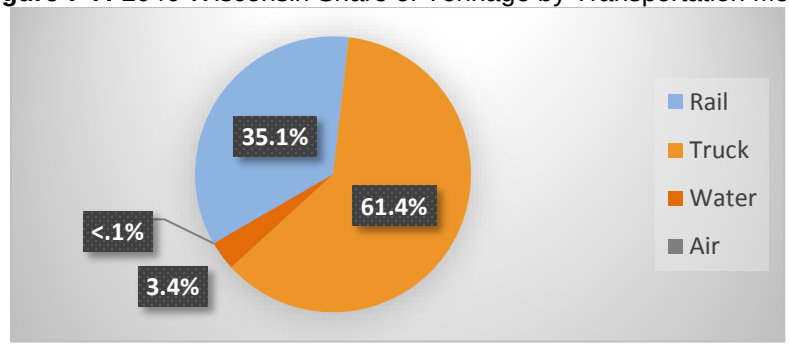
As previously mentioned, Wisconsin freight tonnage is forecast to increase 74 percent across all transportation modes from 2013 to 2040 (Table 7-3), with the economic value of this freight increasing more than 134 percent (Table 7-4). As shown in Table 7-3 and Table 7-4, over one billion tons of freight is estimated to move statewide in 2040 with an approximate value nearly $1.5 trillion.

Table 7-3: 2013-2040 Wisconsin Commodity Tonnage Forecast

Mode	2013 Tons	2021 Tons	2040 Tons	% Change in Tons, 2013-2021	% Change in Tons, 2021-2040	% Change in Tons, 2013 - 2040
Rail	206,923,449	249,791,581	351,603,396	20.72%	40.76%	69.92%
Truck	341,103,976	421,927,066	613,881,906	23.69%	45.49%	79.97%
Water	28,318,795	30,076,586	34,251,339	6.21%	13.88%	20.95%
Air	104,838	183,546	370,477	75.08%	101.84%	253.38%
Other[34]	105,137	135,803	208,634	29.17%	53.63%	98.44%
Total	**576,556,194**	**702,114,582**	**1,000,315,752**	**21.78%**	**42.47%**	**73.50%**

Source: 2013 IHS Transearch Database

Figure 7-7: 2040 Wisconsin Share of Tonnage by Transportation Mode



Source: 2013 IHS Transearch Database

[34] The "Other" mode category largely represents flows where the mode is either mixed, and therefore not a single mode, or the mode cannot be completely determined based on the reported information.

Table 7-4: 2013-2040 Wisconsin Commodity Value Forecast (000s Dollars)

Mode	2013 Value	2021 Value	2040 Value	% Change in Value, 2013-2021	% Change in Value, 2021-2040	% Change in Value, 2013-2040
Rail	$179,228,925	$243,758,096	$397,014,876	36.00%	62.87%	121.50%
Truck	$445,668,962	$629,567,308	$1,066,325,879	41.26%	69.37%	139.30%
Water	$2,197,422	$2,554,337	$3,402,009	16.24%	33.19%	54.80%
Air	$10,436,239	$15,242,492	$26,657,344	46.05%	74.89%	155.40%
Other	$167,173	$238,137	$406,675	42.45%	70.77%	143.30%
Total	**$637,698,721**	**$891,360,369**	**$1,493,806,782**	**39.78%**	**67.59%**	**134.20%**

Source: 2013 IHS Transearch Database

Transportation Mode Split

As outlined in Table 7-3, by 2040, freight tons will grow across all transportation modes. The total share of freight tons per mode in 2040 percentages is reflected in Figure 7-7. Truck tonnage will grow 80 percent (Table 7-3) relative to 2013, and its overall share of freight across all modes will be over 60 percent. Rail tons will grow 70 percent and will constitute 35 percent of the total tons across modes. Despite a 21 percent increase in water tonnage from 2013 to 2040, water's mode share of total freight tonnage will be small at 3.4 percent in 2040. Although air has the largest projected percentage increase in tonnage (253 percent), it will constitute less than 0.1 percent of Wisconsin's total freight tonnage. Total truck tons continue to increase faster than other modes and a larger percentage of freight will move on truck over other modes.

Table 7-5 through Table 7-8 display the tonnage forecasts for each mode and for each of the following commodity flow types[35]:

- **Outbound Freight Tonnage –** commodities originating in Wisconsin and terminating in another state or country
- **Inbound Freight Tonnage –** commodities originating in another state or country and terminating in Wisconsin
- **Intrastate Freight Tonnage –** commodities that both originate and terminate in Wisconsin
- **Overhead Freight Tonnage –** commodities moving through Wisconsin, having neither an origin nor termination within the state

[35] *Originating* freight refers to freight beginning its trip at a given location. *Terminating* freight refers to freight ending its trip at a given location.

Table 7-5: 2013-2040 Outbound Tonnage

Mode	2013 Outbound	2021 Outbound	2040 Outbound	% Change, 2013-2021	% Change, 2021-2040	% Change, 2013-2040
Rail	24,738,407	30,998,186	45,865,160	25.30%	47.96%	85.40%
Truck	98,183,043	125,477,934	190,303,301	27.80%	51.66%	93.80%
Water	19,015,241	20,454,088	23,871,350	7.57%	16.71%	25.50%
Air	48,830	110,243	256,100	125.77%	132.30%	424.50%
Other	2,577	5,595	12,762	117.10%	128.11%	395.20%
Total	**141,998,097**	**177,046,046**	**260,308,674**	**24.69%**	**47.02%**	**83.30%**

Source: 2013 IHS Transearch Database

Table 7-6: 2013-2040 Inbound Tonnage

Mode	2013 Inbound	2021 Inbound	2040 Inbound	% Change, 2013-2021	% Change, 2021-2040	% Change, 2013-2040
Rail	57,938,271	60,702,738	67,268,348	4.77%	10.82%	16.10%
Truck	80,180,520	95,840,807	133,033,987	19.53%	38.81%	65.90%
Water	9,288,121	9,603,760	10,353,402	3.40%	7.81%	11.47%
Air	46,873	61,273	95,474	30.72%	55.82%	103.69%
Other	102,559	130,207	195,872	26.96%	50.43%	90.98%
Total	**147,556,345**	**166,338,786**	**210,947,083**	**12.73%**	**26.82%**	**43.00%**

Source: 2013 IHS Transearch Database

Table 7-7: 2013-2040 Intrastate Tonnage

Mode	2013 Within State	2021 Within State	2040 Within State	% Change, 2013-2021	% Change, 2021-2040	% Change, 2013-2040
Rail	3,380,956	4,001,573	5,475,537	18.36%	36.83%	62.00%
Truck	111,979,389	138,039,165	199,931,134	23.27%	44.84%	78.50%
Water	15,432	18,737	26,587	21.42%	41.89%	72.30%
Air	9,136	12,030	18,903	31.68%	57.13%	106.90%
Other	-	-	-	-	-	0.00%
Total	**115,384,913**	**142,071,505**	**205,452,161**	**23.13%**	**44.61%**	**78.10%**

Source: 2013 IHS Transearch Database

Table 7-8: 2013-2040 Overhead Tonnage

Mode	2013 Overhead	2021 Overhead	2040 Overhead	% Change, 2013-2021	% Change, 2021-2040	% Change, 2013-2040
Rail	120,865,815	154,089,085	232,994,350	27.49%	51.21%	92.80%
Truck	50,751,024	62,562,123	90,613,484	23.27%	44.84%	78.50%
Water	-	-	-	-	-	0.00%
Air	-	-	-	-	-	0.00%
Other	-	-	-	-	-	0.00%
Total	**171,616,839**	**216,651,208**	**323,607,835**	**26.24%**	**49.37%**	**88.60%**

Note: Overhead air freight is not tracked because aircraft traveling through a state's airspace is not tracked. Overhead water freight does not exist in Wisconsin since there is no single body of water that traverses the entire state.
Source: 2013 IHS Transearch Database

Inbound tonnage is not expected to grow as much as other flow types. The largest increase (88.6 percent) is expected to be seen in overhead (pass-through) shipments. Also, Table 7-5 to Table 7-8 show that trucks are Wisconsin's predominant mode of freight transport for inbound, outbound, and internal flows. Wisconsin's Interstate highways currently carry the largest proportion of freight tonnage and will continue to in the future. These facts highlight the primary importance of roadway infrastructure to freight transportation in Wisconsin.

Rail, Truck, Port/Harbor, Pipeline, and Air Freight Forecasts

The commodity forecasts for specific freight transportation modes in Wisconsin will be discussed in each of the next few sections. The forecasts include future summaries for highway, rail, port/harbor, pipeline, and air:

- 2040 forecasted commodity tonnage
- 2040 forecasted commodity value
- 2040 forecasted daily trucks
- Forecast percent change in tons/value, 2013-2040
- Forecast percent change in trucks, 2013-2040
- Percent change in originating tonnage, 2013-2040
- Percent change in terminating tonnage, 2013-2040
- Percent change in total tonnage by commodity, 2013-2040

In accordance with the FAST Act, state freight plans must include a five-year forecast period. In response, forecasts are provided to the year 2021. However, because the year 2040 is the planning horizon of the Wisconsin State Freight Plan, the forecasts also extend from the year 2013 to the year 2040.

7.5 Wisconsin Rail Trends, Issues, and Forecasts

The following section briefly describes critical trends and issues, as well as forecasts impacting rail transportation in Wisconsin.

Trends in Railroad Regulation

United States railroads operate in a legal and regulatory environment that is distinct from most other enterprises. Railways have powers of eminent domain, granted by Congress, to acquire rights of way and extend their operations. Facilities needed to support railway operations are similarly held by the courts to be largely exempt from local zoning and regulatory controls. Labor relations in the railroad industry are governed under the Railway Labor Act, which triggers a federal review and possible public intervention whenever major labor disputes threaten significant disruptions to either freight or passenger service.

Positive Train Control

The Rail Safety Improvement Act of 2008 mandated that Positive Train Control (PTC) be implemented across a significant portion of the nation's rail industry by December 31, 2015. PTC is required on Class I railroad main lines that handle poisonous-inhalation-hazardous materials and any railroad main lines over which regularly scheduled intercity passenger or commuter rail services are provided. PTC is advanced technology designed to automatically stop or slow a train before an accident occurs. In particular, PTC is designed to prevent train-to-train collisions, overspeed derailments, incursions into established work zone limits, and the movement of a train through a main line switch in the wrong position.[36] There were many unresolved technical and regulatory issues regarding the full implementation of PTC mandated by Congress. Congress approved an agreement to extend the full implementation of PTC to the end of 2018 at the earliest. Under the new agreement, railroads would have an extra three years to work on the automated train conversion. They will also have the option of requesting an extra two years to work on the installation if they submit plans for doing the work by December 31, 2018. The requests would have to be approved by the United States DOT on a case-by-case basis.[37]

Operation and Infrastructure Needs

As identified in Chapter 6, *Transportation System Condition and Performance*, today's rail network in Wisconsin consists of less mileage (from approximately 7,600 miles in 1920 to 3,300 miles in 2016), while the total amount of tonnage handled annually has slowly increased with a few variable years. Since 1985, total rail movements have increased by roughly 23 million tons in Wisconsin.

Growth in rail movements has resulted in longer freight trains, which places a higher demand on the railroad infrastructure to carry longer carloads. Long-distance freight trains are generally longer than passenger trains, with greater length improving efficiency. The length of a freight train may be measured in the number of railcars (for bulk loads such as coal and iron ore) or in feet for general freight. Train lengths and loads on electrified railways, especially lower voltage 3,000 V DC and 1,500 V DC, are limited by traction power considerations. Drawgear and couplings can be a limiting factor, tied in with curves, gradients, and crossing loop lengths. Conventional freight trains in the United States can average nearly 6,600 feet or 1.25 miles in length. Freight trains with a total length of three or four times that average are possible with the advent of distributed power units, or additional locomotive engines between or behind long chains of freight cars (referred to as a "consist"). These distributed power units enable much longer, heavier loads without the increased risks of derailing that stem from the stress of pulling very

[36] Federal Railroad Administration, Office of Railroad Safety, "Positive Train Control."
[37] The Hill, "Lawmakers Agree to Extend Automated Train Deadline by 3 Years." (October 21, 2015).

long chains of train-cars around curves. Nationally, freight trains are limited by air brake capability (electronically controlled pneumatic braked), which is usually approximately 180 wagons (nearly 10,000 feet or 1.9 miles in length).

The current industry standard for rail line carload carrying capacity is 286,000 pounds. With increased competition, railcar loads are expected to get heavier in order to keep rail lines competitive. To accommodate those increases, several railroad companies are upgrading their infrastructure to accommodate modern rail cars designed to carry heavier loads. As discussed in Chapter 6, *Transportation System Condition and Performance*, Wisconsin's state-owned rail network has a carload weight goal of 286,000 pounds. As of 2016, about 73 percent of track met the FRA standards (capable of operating loaded 286,000 pound rail cars above 10 miles per hour and not exceeding 25 miles per hour). The BNSF corridor that runs along the western edge of Wisconsin has been upgraded with rail capable of handling 310,000 pounds - a weight not considered to be needed just ten years ago. To accommodate increasing rail line carload carrying capacity standards, the state will continue to evaluate the most cost-effective approach to rail line improvements.

Trends in Regional Railroad Freight Movements

Metropolitan Chicago's rail network plays a key role in moving goods and people throughout the region and nation. Approximately one-quarter of all freight trains and one-half of all intermodal trains in the nation pass through Chicago, which serves as the continent's main interchange point between western and eastern railroads.[38]

The Chicago region contains an extensive freight rail network, handling the movement of nearly 1,300 trains each day, including 500 freight and 760 passenger trains for a total of 37,500 railcars.[39] The Chicago region contains an estimated 3,865 track-miles of rail -- greater mileage than nearly 40 other states -- as well as both passenger and freight rail facilities, including more than 50 freight rail yards.[40] Nearly 1,400 of the region's track-miles are shared by both passenger and freight trains. The density of the rail network in Chicago provides unparalleled opportunities to make connections among the railroads, as well as connections to trucking and other modes, providing choices and access to markets for shippers in our region.

However, this concentration of rail activity presents some challenges to the region, such as causing motorist delay at highway-rail grade crossings, transit delays where freight and passenger trains share track, and a reduction in speeds and productivity as trains navigate the region's congested rail network.

Chicago Region Environmental and Transportation Efficiency Program

The Chicago Region Environmental and Transportation Efficiency Program (CREATE) is a partnership between the State of Illinois, City of Chicago, Metra, Amtrak, Association of American Railroads, and the United States DOT. A project of regional and national significance, CREATE includes 70 critically-needed rail and highway infrastructure improvements in Northeast Illinois.[41] The CREATE program aims to enhance the efficiency of freight and passenger rail service throughout the region.

Because of the manner in which train tracks currently intersect with each other and with roads, and because regional freight railroads defer to Amtrak and Metra in track utilization, it can take up to 30 hours for freight trains to pass through the Chicago region.[42] Delays in rail freight threaten the economic vitality of the region, lead to

[38] Chicago Metropolitan Agency for Planning, "Update on Freight Rail Activity." (October 9, 2015).
[39] Ibid.
[40] Ibid.
[41] Chicago Region Environmental and Transportation Efficiency Program, "About CREATE."
[42] Ibid.

increased traffic congestion on roadways, generate higher levels of air pollution, raise safety concerns, adversely affect the reliability and speed of rail passenger service, and make it harder for shippers to make a profit. At-grade rail crossings negatively impact communities and cause chronic traffic delays on roadways. With funding from the State of Illinois, the City of Chicago, the United States Department of Transportation, Metra, Amtrak, and the nation's major freight railroads, CREATE has begun to alleviate these problems.

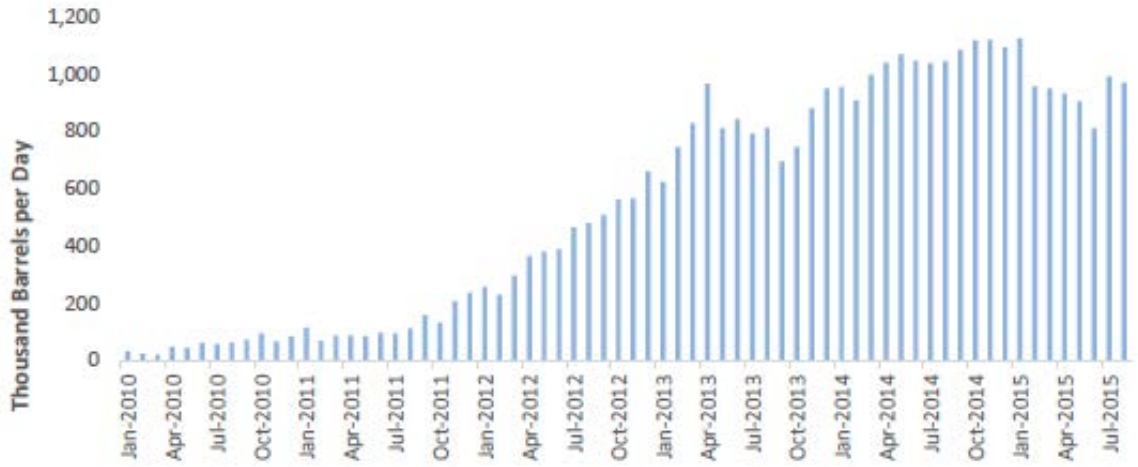
Great Lakes Basin Railroad

In 2016, Great Lake Basin Transportation Inc. (GLBT) filed a request with the STB for authority to construct and operate over 260 miles of new railroad extending from Wisconsin, into Illinois, around Chicago and finally into Indiana.[43] STB asked GLBT to propose multiple alternatives for evaluation, leading to a preferred alternative railroad corridor bypassing the Chicago metropolitan area. Instead, GLBT proposed one preferred alternative which ends near Milton, WI. Subsequent submissions by GLBT to the STB were found to be insufficient for approval. On August 31, 2017 the STB rejected GLBT's application to build and operate its proposed railroad line.[44] WisDOT will continue to monitor any future proposals.

Trends in Crude by Rail

The goal of this section is to identify trends related to rail transportation that have been driven by or have implications on pipelines in Wisconsin. As shown in Figure 7-8, crude oil by rail movements have increased from nearly zero in 2010 to just under one million barrels per day in August 2015. Since a peak of 1.1 million barrels per day in January 2015, there has been a softening of crude oil by rail movements, partially driven by the fall in oil prices from approximately $100 per barrel in August 2014 to $48 per barrel in October 2015.

Figure 7-8: 2010-2015 Crude by Rail Movements in the United States*



*Includes movement to and from Canada
Source: CPCS summary of U.S. Energy Information Administration data

The increased acceptance and use of railroads to transport crude is generally related to limited pipeline capacity and rail's flexibility to serve a greater number of origins and destinations. The resulting increase in crude by rail shipments has contributed to capacity constraints on some rail corridors. A recent study by the University of Minnesota concluded that rail delays cost Minnesota corn, soybean and wheat growers $100 million in the spring

[43] Surface Transportation Board, "Environmental Matters > Great Lakes Basin."
[44] Chicago Tribune, "Federal agency decision derails bid for 261-mile freight line from Indiana to Wisconsin." (August 31, 2017).

of 2014.[45,46] The competition and connections between modes ensure that capacity constraints, inefficiency, or challenges in one mode will impact other modes and in turn the economy.

Since the 2013 accident involving an oil-laden unit train in Lac-Mégantic, Quebec, Canada, there has been increased scrutiny of the transport of crude oil by rail. The train involved in the Lac-Mégantic incident had originated in the Bakken-shale region of North Dakota, which had seen production significantly increase from under 200,000 barrels per day in 2008 to over 1,200,000 barrels per day in 2015.[47]

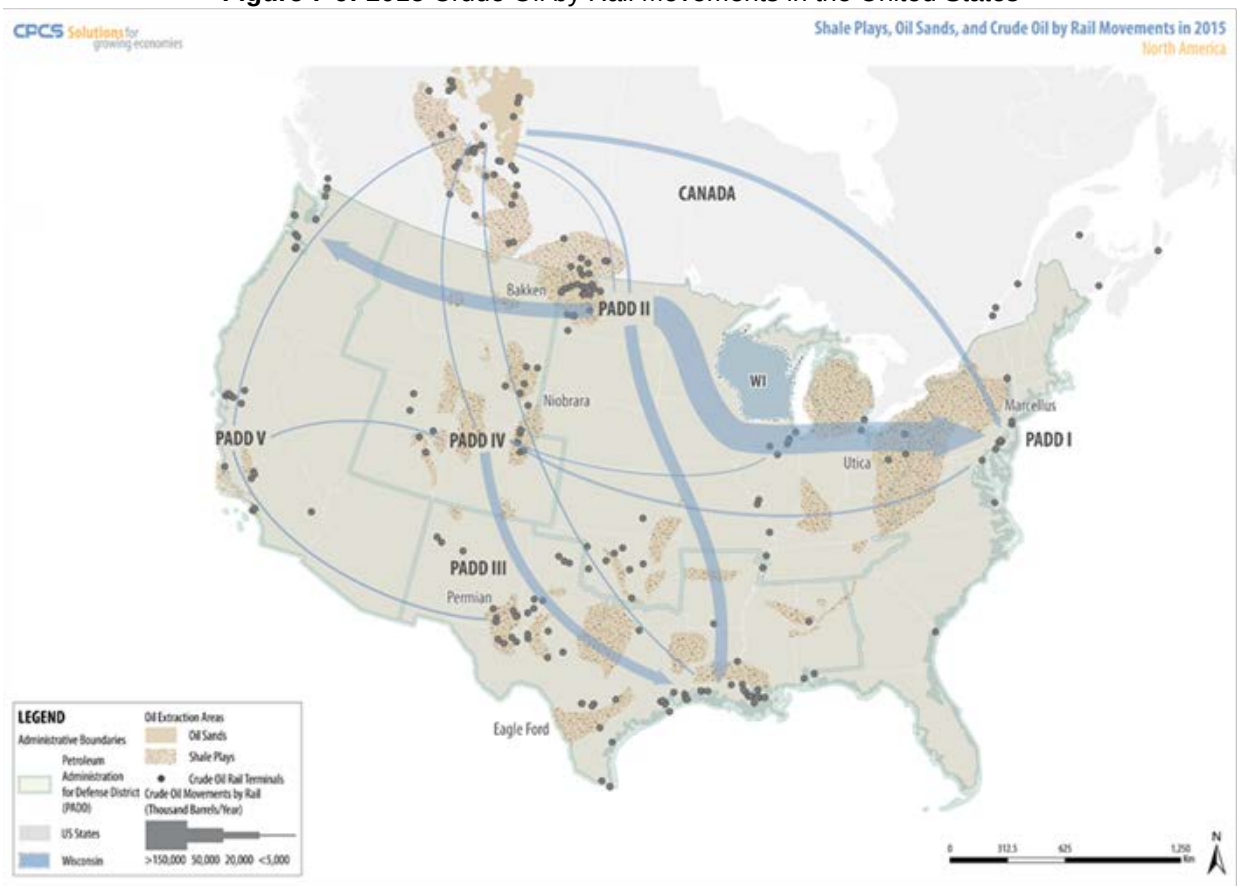
National Crude by Rail Flows

Though there has been a significant increase in crude oil movements, they nonetheless represent a relatively small share – approximately 2.6 percent and 3.7 percent – of overall Class I movements by tonnage and revenues, respectively, in 2014.[48] However, there are several key routes of crude oil by rail movements. Figure 7-9 shows crude oil by rail flows disaggregated by origin-destination within each of the Petroleum Administration for Defense Districts (PADD) in the United States,[49] as well as flows to/from Canada, superimposed on major shale oil plays and the oil sands.

Crude oil by rail volumes include flows from Texas (Eagle Ford and Permian), Colorado (Niobrara), North Dakota (Bakken), and Canada (oil sands and northern extent of the Bakken). The largest flows are from PADD II to PADD I, i.e. flows that originate in the Bakken shale and are destined for east coast refineries. According to EIA data, these flows averaged roughly 400,000 barrels per day in 2015, or approximately six unit trains per day.[50,51] These flows would impact Wisconsin, as they would be routed over the BNSF and Canadian Pacific lines through the state. Flows from Canada to PADD I and II and intra-PADD-II flows could also flow through Wisconsin, though these flows are much smaller than the PADD II to I flows.

[45] Minnesota Department of Agriculture, "Minnesota Basis Analysis - Final Report for the Minnesota Department of Agriculture." (July 10, 2014).
[46] Minnesota Farm Guide, "Minnesota crop farmers lose $100 million due to transportation delays." (July 31, 2014).
[47] U.S. Energy Information Administration, "Bakken Region Drilling Report." (2015).
[48] Association of American Railroads, "2015 Class I Railroad Statistics."
[49] From 2010 onwards, the EIA has collected data on crude oil by rail movements in the US and publishes them at the PADD level.
[50] U.S. Energy Information Administration, "Movements of Crude Oil and Selected Products by Rail between PAD Districts."
[51] This conversion is based on approximately 60,000 barrels per train. Cairns notes that "CP has found that crude from the Bakken shale deposit is moved with 600 to 650 barrels per tank car." Assuming an average train length of 100 cars results in approximately 60,000 to 65,000 barrels per train. The estimate developed using this methodology corresponds well with information gathered by the Wall Street Journal in December 2014, which found that approximately 38 crude oil trains per week pass through Wisconsin on BNSF and CP lines. Cairns, M. 2013. Crude Oil by Rail: Part II: Potential for the Movement of Alberta Oil Sands Crude Oil and Related Products by Canadian Railways. Presentation to the Canadian Transportation Research Forum.

Figure 7-9: 2015 Crude Oil by Rail Movements in the United States



Source: CPCS analysis of U.S. Energy Information Administration data

PADD II to PADD I is a key market for crude by rail as the North American pipeline system historically developed as a north-to-south system, leaving no crude oil pipelines running from PADD II to the east coast. As a result, if refineries on the east coast wish to source crude oil from the midcontinent, they need to use rail (or another non-pipeline mode) to source the crude.

Though the lack of pipelines explains why crude oil by rail flows from PADD II to PADD I, it is the price differential between crude oil produced in PADD II and the international markets that explains why refineries source crude from the Bakken region. Essentially, when the price of Bakken crude falls below the price of Brent crude, an international crude oil benchmark, refineries will try to source crude oil from PADD II, provided the price differential is large enough to offset the price of rail transport. In late 2013, the American Petroleum Institute reported that this spread was over $20 per barrel of oil, double the estimated rail rate of approximately $9 to $10 per barrel.[52] However, oil prices (and hence the spread) are constantly in flux.

Additionally, between 2007 and 2015, North Dakota refining and pipeline export capacity increased three-and-a-half fold to 830,000 barrels per day, with plans to double refining/pipeline capacity again by 2020.[53] Based on estimates presented to the Rail Energy Transportation Advisory Committee Surface Transportation Board in April

[52] Genscape, "Taking the Train: North American Crude-by-Rail Outlook as Seen at the Argus Crude Transportation Summit." (June 5, 2014).
[53] North Dakota Pipeline Authority, "US Williston Basin Crude Oil Export Options." (2015).

2015, this proposed pipeline/refinery capacity could accommodate most if not all of the crude oil coming out of the Bakken, should it proceed.[54]

Economic Considerations

Though most of the trends driving crude by rail are governed by external forces, there are some transportation links within Wisconsin that could be impacted by crude oil by rail. For example, in the winter of 2014 there were several reports regarding crude oil by rail traffic impacting other industries (notably the flow of agricultural commodities).[55] At the time, crude oil traffic was approaching its peak, and a particularly harsh winter caused a reduction in rail capacity (due to the need to run shorter trains).[56] According to these reports, BNSF, which runs through Wisconsin, was particularly impacted.

Rail Service Issues

The capacity of Class I railroads to provide the needed and agreed to rail service is often cited as a concern by freight shippers. Consolidation of rail companies and paring back of rail lines have left little capacity available when "surge" markets such as the increased demand to ship crude-by-rail, and/or frac sand emerge. Concentrations and capacity constraints have led to a lack of car availability in some areas, challenging businesses to identify other shipping options that may be more costly.

Service Thresholds

Rail companies noted that service thresholds, or a minimum amount of carloads, dictate whether or not a siding or spur line can be retained. According to the Wisconsin Freight Advisory Committee (FAC) members who attended the September 16, 2015 FAC meeting (see Chapter 2, *Transportation Stakeholders and Institutions,* for a discussion about the FAC), for a Class I railroad to consider making an additional stop on its rail lines, 100 carloads per mile per year are required in order to reach the minimal demand needed to make service viable and profitable. The capital-intensive nature of railroads was noted as a reason for such high thresholds. Overall customer service, service to smaller businesses, and more consistent/available delivery/pickup schedules were noted as areas where improvements were needed.

Wisconsin businesses face the difficulty of generating enough traffic for Class I service or getting those lines to be operated by short line operators. Generating enough traffic for Class I service usually requires a large business demanding regular deliveries via rail. Wisconsin tends to have a larger concentration of small businesses, making regular service demands unpredictable and less desirable to Class I railroads.

According to FAC members who attended that same September 16, 2015 FAC meeting, private sector businesses need to do a better job expressing their need for rail service through sharing of data that would indicate the level of service needed to satisfy demand. Regular service would be a requirement for short line and Class I railroads, so businesses need to be able to demonstrate need with actionable data. Volatility in markets is a critical concern of the railroads when they determine long-term capital investments. Large capital investments will typically be located in predictable markets that minimize the risk of negative return on investment. Volatile markets do not offer reliable service demand. Overall, the use of rail is seen as an important consideration as the trucking industry faces driver shortages and other challenges.

[54] Tamborski, Jerry, "Oil Industry Segment Update - Presentation to the Rail Energy Transportation Advisory Committee of the Surface Transportation Board, April 14, 2015."
[55] The Wall Street Journal, "Surge in Rail Shipments of Oil Sidetracks Other Industries." (March 13, 2014).
[56] Policy Magazine, "Winter's Impact on Canadian Railway Operations: Fact and Fantasy." (January/February 2015).

Lack of rail service typically results in shippers relying more heavily on trucking, which has its own challenges including current and projected driver shortages and pavement/bridge deterioration. In addition, when heavy loads cannot go by rail, increased wear-and-tear on roadways may be caused by increases in truck volume.

Overall, demand drives service; without sufficient demand, service won't be provided, but that demand is limited by rail car availability, lack of access to rail service, and Class I business models, which are usually designed for multi-car, long-haul shipments. As a result, some Wisconsin businesses seek alternative transportation options to accommodate their full range of business and shipping needs.

Rail Freight Flows

As identified in Chapter 5, *Wisconsin's Transportation Assets*, there is a significant amount of freight tonnage that is shipped overhead by rail (Table 7-9). This can create a challenge for shippers that wish to access rail. In many cases, shippers have to rely on other modes, such as trucking, to ship freight to truck-rail intermodal facilities where rail can be accessed, unless shippers have an opportunity to utilize short line or regional railroads, which can be used to connect to Class I railroads.

Table 7-9: 2013 Wisconsin Rail Shipments by Tonnage (Millions) and Value (Millions $)

Rail Shipments	Outbound	Inbound	Within	Overhead	Total
Tons	24.7	57.9	3.4	120.9	**206.9**
Value	$6,712.4	$13,156.8	$1,256.0	$158,103.7	**$179,228.9**

Source: 2013 IHS Transearch Database

Wisconsin's Publicly-Owned Railroad Condition

As discussed in Chapter 5, *Wisconsin's Transportation Assets*, Wisconsin supports over 700 miles of railroad statewide. The Staggers Act of 1980 marks the beginning of the modern United States rail industry. This legislation deregulated the rail industry, allowing railroads to shed unprofitable and duplicative lines. Many lines in Wisconsin were abandoned. In response, the state partnered with a number of counties to purchase rail lines to maintain freight rail service to local communities. This policy is still in place today.

WisDOT will continue efforts to preserve rail freight service when the service is judged essential, cost effective, and financially viable based on transportation efficiency cost-benefit analyses.

Staggers Act

The passage of the Staggers Rail Act of 1980 and its implementation by the Interstate Commerce Commission (ICC, now the Surface Transportation Board (STB)), meant that many regulatory restraints on the railroad industry were removed. This provided industry increased flexibility to adjust their rates and tailor services to meet shipper needs and their own revenue requirements. It also led to major service and network cutbacks. Since passage of the Act, there has been a significant increase in freight rail productivity, resulting in lower shipping costs for rail users and increased use of the remaining rail network. However, this increase in rail freight has been primarily focused on a few key commodity markets and shipping lanes, such as coal from the Powder River Basin and long-distance import/export container traffic from coastal ports.

The Staggers Act was expected to give railroads the flexibility to make operational and infrastructure changes that would improve their financial standing. By itself, this may have occurred. However, in 1980 Congress also passed the Motor Carrier Act, which reduced regulations on the trucking industry, making it easier for new trucking firms to enter the shipping market. Together, these two acts changed the face of the freight industry. Major railroads were able to raise some shipping rates, while lowering others based on market demand. Railroads also began increasing their intermodal shipments, a trend that continues today. Staggers also simplified the regulatory process associated with railroad mergers, line sales, and abandonments. Remaining economic regulation of the carriers was vested in the STB. The Act also allowed for easier abandonment of light-density rail lines, which led to significant changes among carriers as larger railroads "spun off" their less-productive lines to newly created short line and regional railroads. The primary changes to the regulatory rail system under the Act included:

- Rail carriers could charge any given rate for services unless the STB determined no competition for such services existed.
- Industry-wide rate adjustments were removed.
- Access must be given by one railroad to another's rails in the case where a single railroad had "bottleneck" control of the rail traffic.

Abandonment allows railroads to cease to operate service over a line. Once abandoned, Wisconsin state law gives WisDOT the first right to acquire for present or future transportation any property used in operating a railroad. WisDOT can exercise its right of first acquisition, or, assign this right to any other state agency, any county or city, or any transit commission for acquisition for future transportation or recreational purpose. However, most filings in Wisconsin are actually "exemptions to the abandonment process," which require that a railroad has not carried traffic over the said line segment for two years.

While the state is committed to maintaining essential freight rail service for Wisconsin communities, this must be balanced with preservation of the existing system. WisDOT will continue to work with communities and shippers to assess opportunities to acquire railroad lines if they are deemed essential to maintaining the state's short line rail service. Historically, Wisconsin's focus for short line/regional rail service needs has focused on two components: preservation of key rail corridors through acquisition or rail banking, and infrastructure improvements to meet industry standards. WisDOT's Freight Rail Preservation Program helps to fund rail line acquisitions. The program is also the primary funding source used to preserve and improve the infrastructure of state-owned lines. The department is focused on preserving the existing publicly-owned network to ensure stewardship of the system. Acquisitions remain a secondary focus and are considered on a case-by-case basis. The rail transit commissions contract with the Wisconsin and Southern Railroad to operate the majority of this network for a period of 40 years (operating agreements expire in 2047). A number of smaller railroads operate over other rail lines.

Rail Preservation

WisDOT works with railroads to maintain, improve and increase service in Wisconsin. Efforts are focused on monitoring railroad activity and creating partnerships among businesses and railroads to increase the use of rail. At times rail lines are taken out of service or are abandoned.

Rail Line Abandonments

WisDOT has the ability to preserve rail corridors for uses ranging from a recreational trail to full service rail corridors. Between 1987 and 2010, nearly 97 miles of rail lines were abandoned and railroads in the state submitted over 40 applications to the STB to abandon more than 400 miles of rail lines. Over that period, thirteen abandonment applications were approved by the STB in Wisconsin. Six of those lines were short stub-ended spurs only a few miles in length; others occurred on Native American tribal lands. Over 70 percent of the rail miles proposed for abandonment in that timeframe were preserved or were in negotiations to be preserved for current or future transportation use (as of January 2010). Many of the lines have been used as trails in the interim. Lines preserved under the 1983 National Trails System Act (NTSA) are not abandoned. These lines retain their character as rail corridors and hence may be reactivated at any time in the future. In other words, should there be a need, rail lines in rails-to-trails service are available to bring back into rail service.

Funding for track renewal typically comes from a combination of local, state, and private sources, as well as the Federal Local Rail Freight Assistance Program. Traditionally, rail corridors have been acquired when there is a local interest, sufficient local funding, potential shippers on the line, sufficient state funding, and a willing short line operator.

As of January 2010, there were 11.93 miles of rail that were still in negotiation for sale to the state to be preserved as a rails-to-trails segment (Table 7-10). Rail negotiations can sometimes take years because of the complexities in ownership, land titles, and records that need to be reviewed. Some corridors were acquired decades ago on a parcel-by-parcel basis with each acquisition using a different method of conveyance.

Table 7-10 summarizes rail abandonment activity from 1987 to 2010. During that time span, nearly 97 miles of rail lines were abandoned, 329 miles were classified as preserved lines, 37 miles were service preserved, and nearly 12 miles were pending abandonment.

Table 7-10: 1987-2010 Rail Abandonment Activity

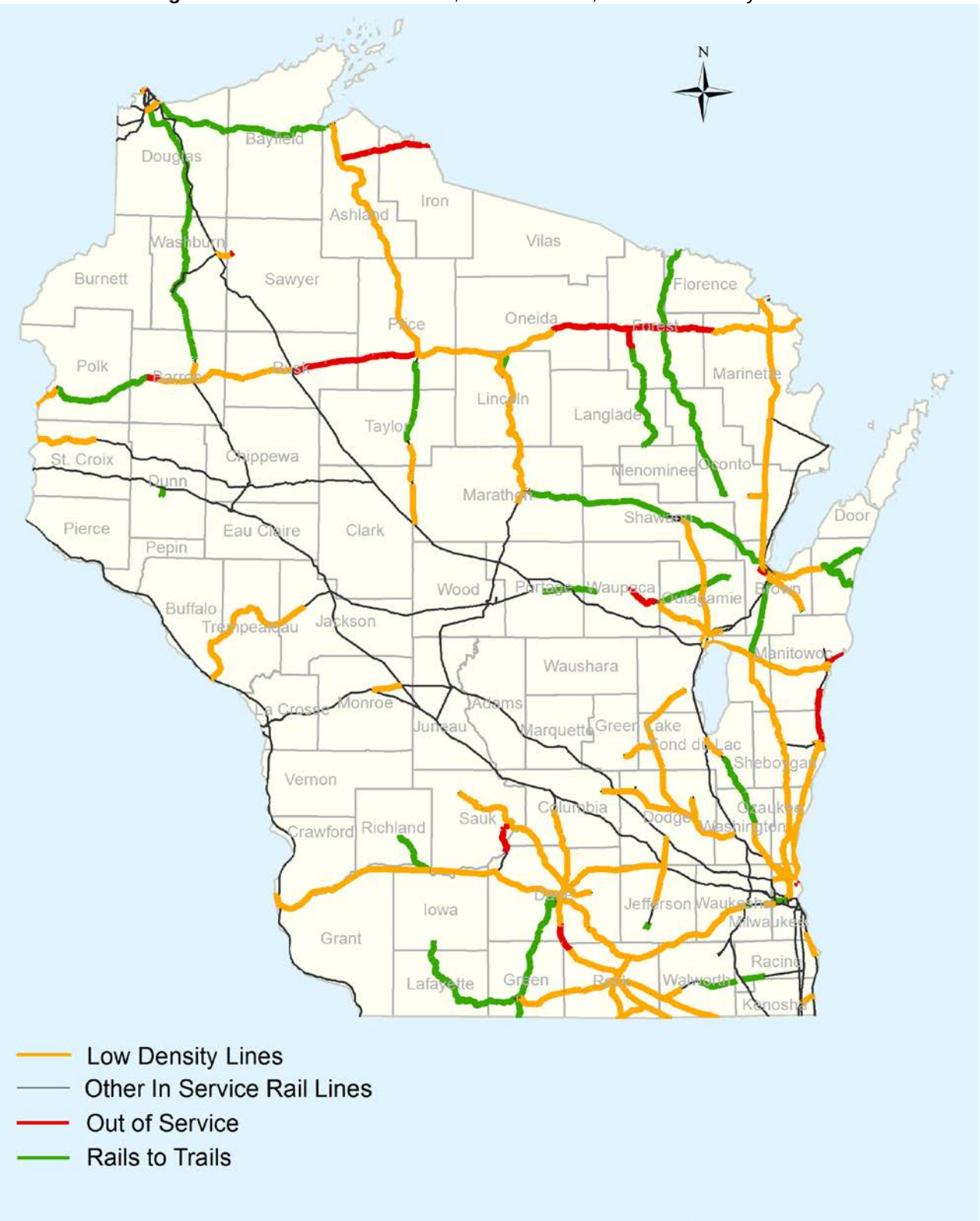
Type of Activity	Miles	Proportion of Total
Abandoned Lines	96.6	20%
Preserved Lines (rail bank and rails-to-trails)	329.1	69%
Service Preserved	37	8%
Pending Abandonment (as of January 2010)	11.9	3%

Source: Wisconsin Department of Transportation, Bureau of Transit, Local Roads, Railroads and Harbors

Out-of-Service Rail Lines

Rail lines that are not abandoned, but taken out of service by the operating railroad, are also of interest to the state (see Figure 7-10) because these line segments represent underutilized economic development assets, but will see no capital investment into the infrastructure, which increases the cost of rehabilitation over time. Some have been out of service for many years. In Wisconsin, there has not been a strong correlation between out-of-service lines and abandonment filings.

Figure 7-10: 2014 Out of Service, Rails-to-Trails, and Low-Density Lines



Source: Wisconsin Department of Transportation, Bureau of Planning and Economic Development

Low-Density Rail Lines

Rail lines that carry less than 5 million gross tons per year (a typical Class I line will carry 10 million gross tons annually) are considered low density and may be at risk for abandonment in the future (Figure 7-10). The economic viability of the state's low-density lines is more susceptible than higher-volume lines to changing market conditions (e.g. losing a customer's business) or increased operating costs. According to the FRA, there are 858 miles of low-density lines in the state. Some of the low-density lines identified in 2007 are now out of service.

Track and Bridge Upgrades for Publicly-Supported Rail Corridors

A critical business need for the Wisconsin short line system (serving local business freight needs), is the ability to accommodate heavier car loadings that are becoming prevalent on Class I railroads. Two types of infrastructure improvements that will meet this need are:

- Track upgrades to industry standards
- Bridge upgrades to handle heavier car weights

The state-owned system was rehabilitated to Federal Railroad Administration Class 2 Track Safety Standards after it was acquired in the 1980s. Market standards have since changed. To improve their carrying capacity, railroads are increasingly hauling heavier loads in each rail car – moving from 263,000-pound cars to 286,000-pound cars.

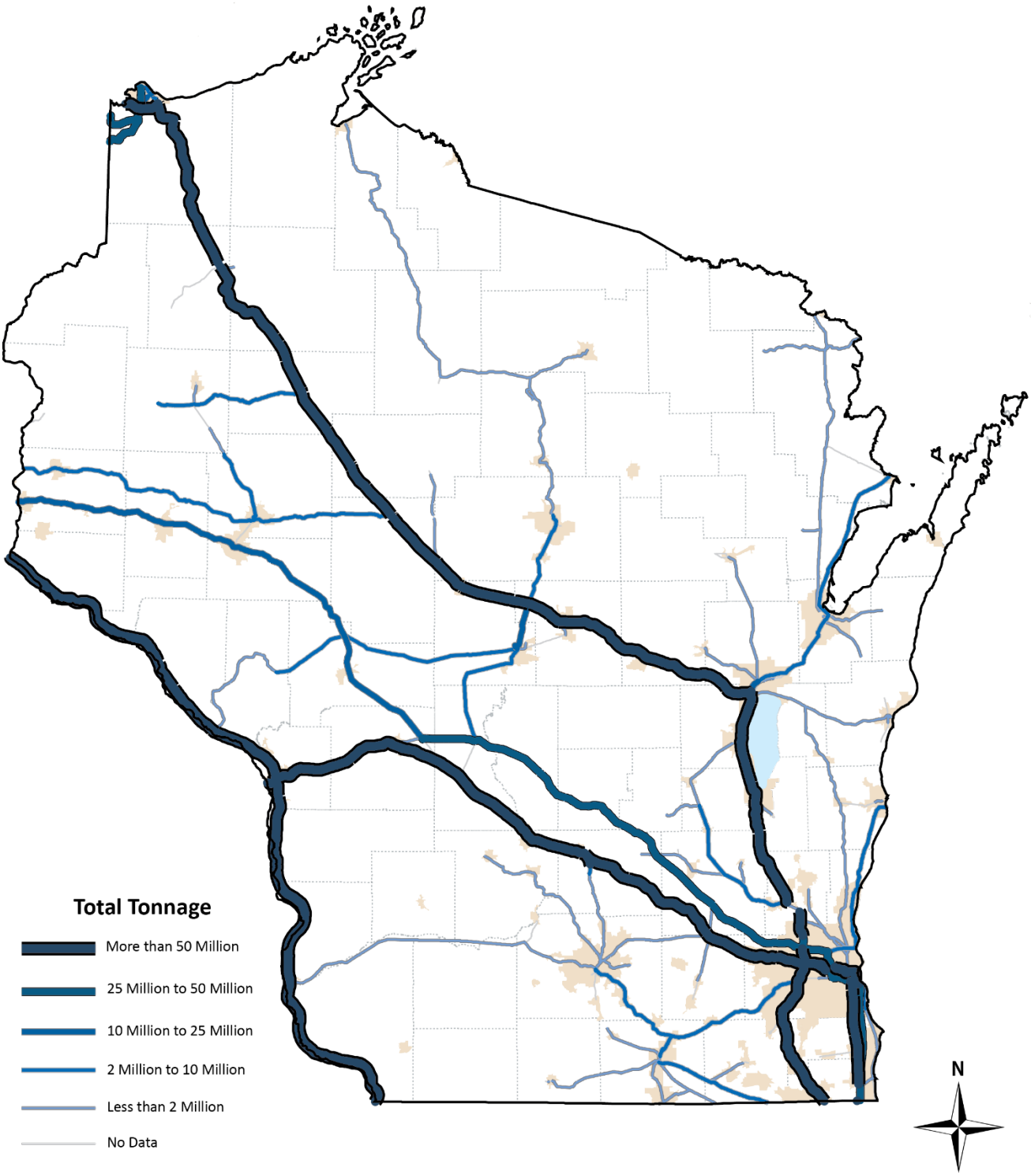
Department efforts have focused on system improvements that not only preserve essential freight rail service but also accommodate heavier car loadings prevalent on Class I railroads. This helps meet industry demands and provides a competitive component of the overall rail network. While approximately 73 percent of the state-owned system can accommodate 286,000 pound cars, there are tracks and bridges that have not been upgraded. System preservation that supports efficient short line freight rail service is a department focus (see Chapter 9, Investment and Implementation). WisDOT will continue to work with rail transit commissions, Wisconsin and Southern Railroad, other operators, and stakeholders to study the economic impacts of the publicly-owned rail system and the opportunity costs to accommodate heavier car loadings.

In addition, Class I railroads are aggressively moving to maximize double-stacked intermodal trains. On routes with this service, railroads have been increasing clearances by raising bridges and lowering trackage to accommodate these containers. It is unclear whether other car heights will also be expanded in the future. Were that to occur, the railroads and WisDOT would need to work together to accommodate this larger equipment on state-owned corridors, as carload weights would increase and geometric clearance issues would become more prevalent.

Rail Freight Forecasts

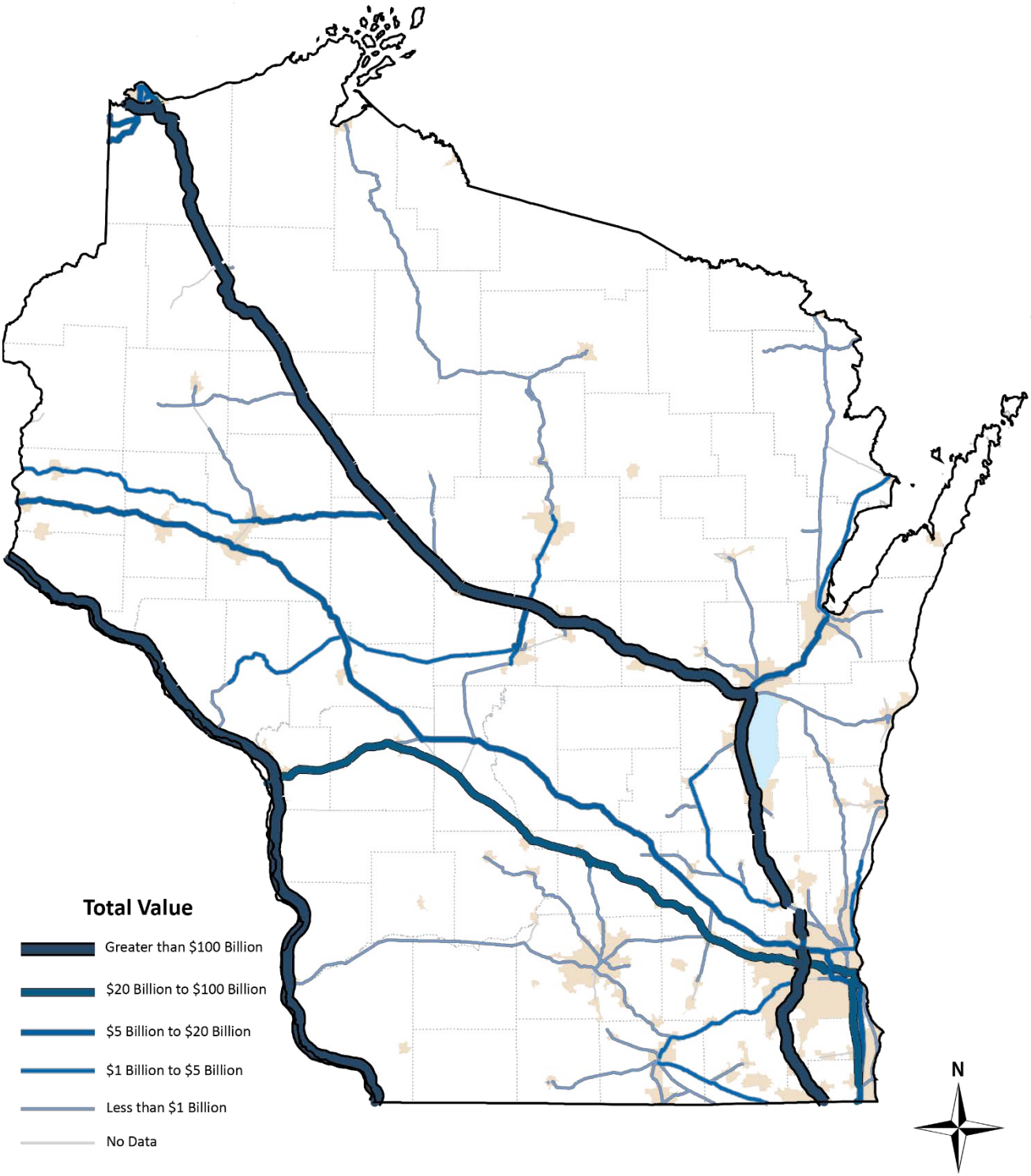
Overall railroad tonnage is predicted to increase by 70 percent statewide between 2013 and 2040. In addition, the value of this tonnage is expected to increase by 122 percent. Figure 7-11 and Figure 7-12 show the rail lines that are expected to carry the 352 million tons of railroad cargo, valued at more than $397 billion, in 2040.

Figure 7-11: Railroad Forecasted 2040 Commodity Tonnage



Source: 2013 IHS Transearch Database

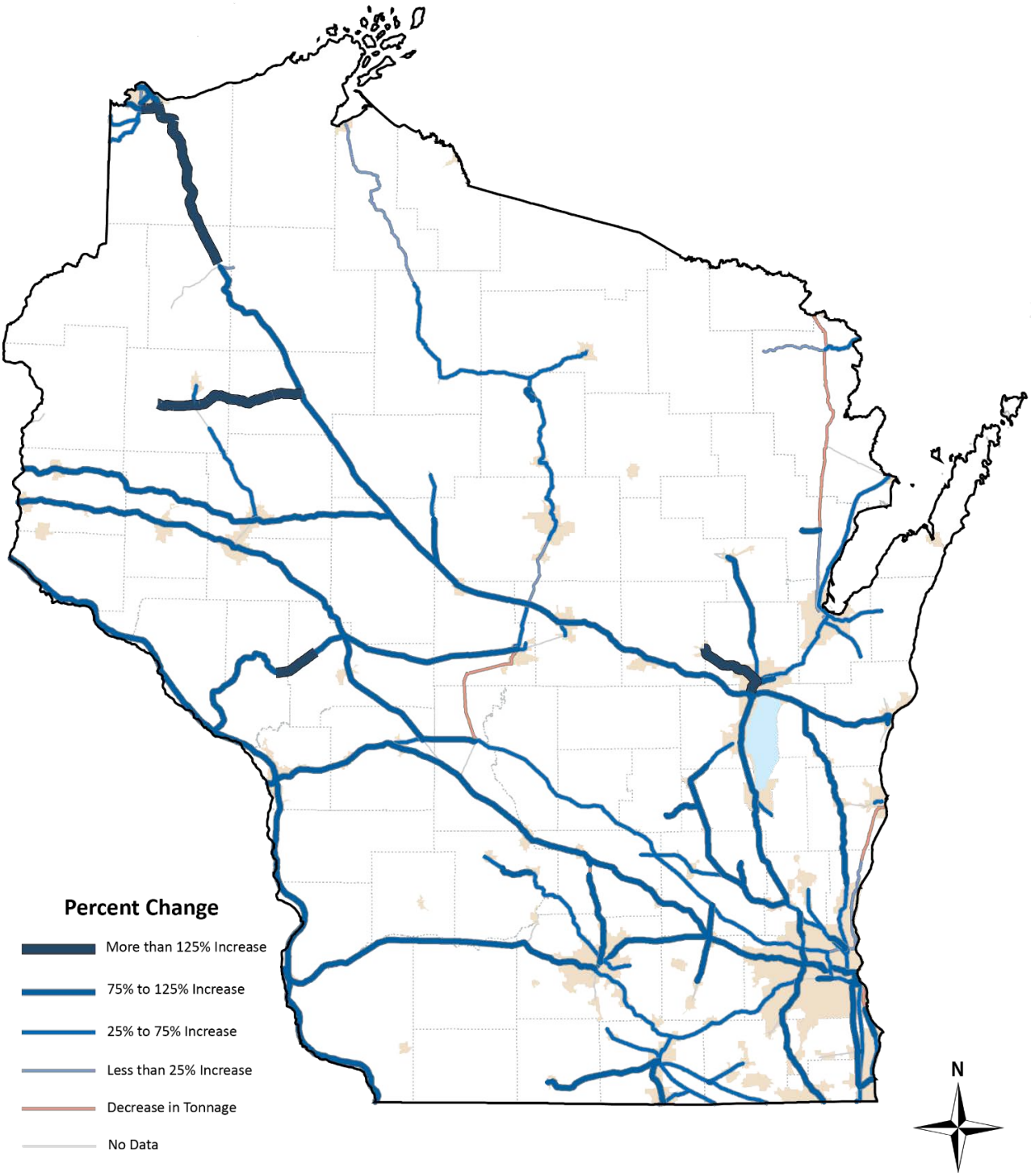
Figure 7-12: Railroad Forecasted 2040 Commodity Value



Source: 2013 IHS Transearch Database

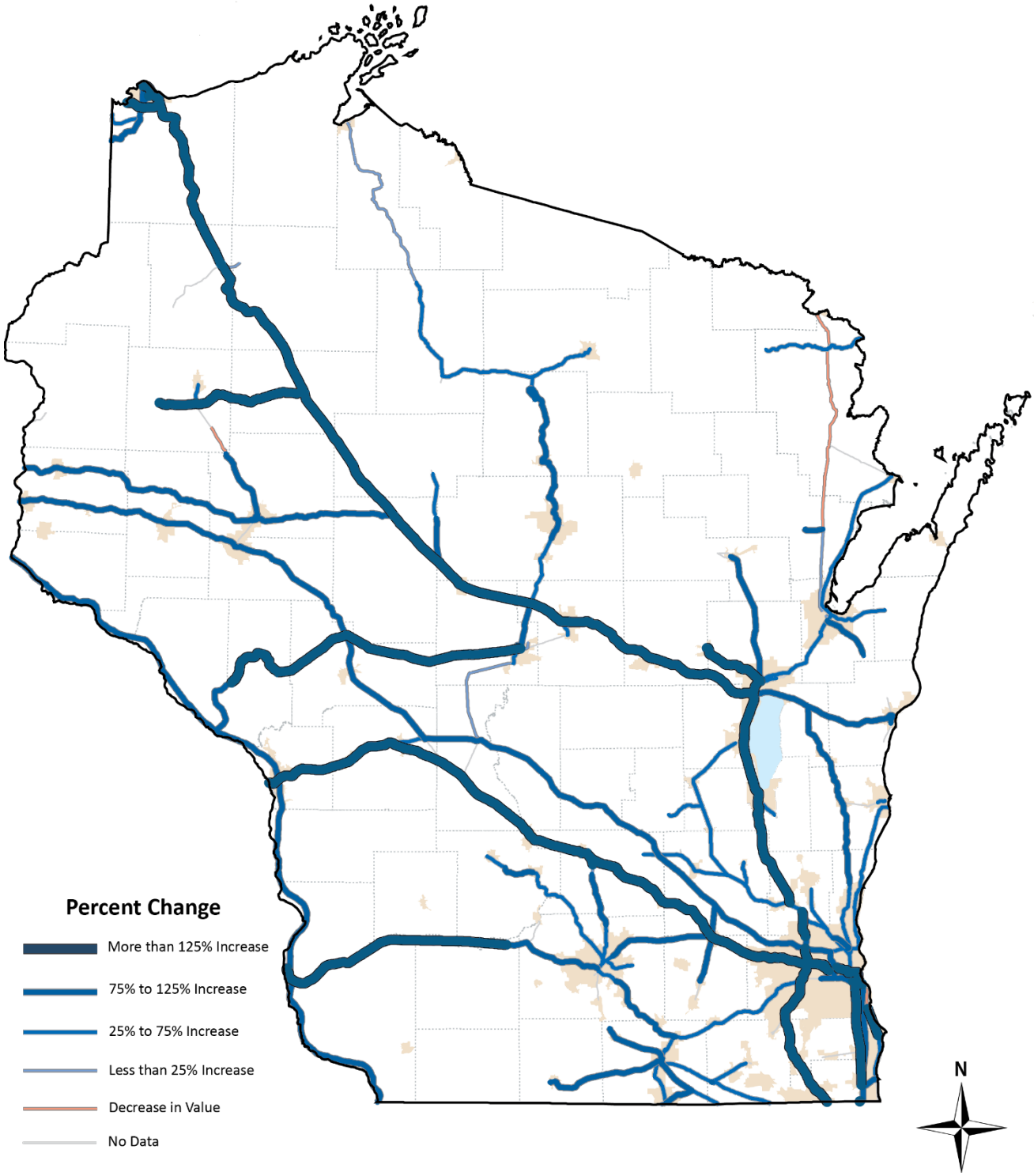
Figure 7-13 and Figure 7-14 show the railroad lines that are projected to see the most growth by 2040. Figure 7-13 shows the percent change in tonnage and Figure 7-14 shows the percent change in the value of the railroad commodities.

Figure 7-13: 2013-2040 Railroad Forecast Percent Change in Tons



Source: 2013 IHS Transearch Database

Figure 7-14: 2013-2040 Railroad Forecast Percent Change in Value



Source: 2013 IHS Transearch Database

Railroad – Origins/Destinations[57]

Commodities that travel by rail may have localized economic benefits for communities or counties (at a larger economic scale). Increases and decreases are most likely due to projected changes in employment by industry sector. The counties expected to see the largest growth (more than 125 percent) in originating tonnage are:

- Barron
- Clark
- Dodge
- Trempealeau

The growth in Barron, Clark, and Trempealeau counties is due to a large forecasted increase in outbound sand and gravel. Much of this increase has already occurred and has then leveled off since 2013. The counties expecting to see the largest growth in terminating tonnage (more than 125 percent) are:

- Monroe
- Pierce
- Walworth
- Washburn

Monroe, Pierce, and Washburn counties are expected to receive many more railroad cars (and are considered by the Transearch model as commodities), accounting for the growth in terminating tonnage. The increase for Walworth County is because of an anticipated increase in terminating food and farm products.

Railroad – Commodities[58]

The five commodity groups forecast to see the greatest rail tonnage in 2040 are:

- Crude Petroleum or Natural Gas (52,387,430 tons, 86.5 percent growth)
- Chemicals or Allied Products (45,055,110 tons, 109.8 percent growth)
- Nonmetallic Minerals (38,641,868 tons, 83.4 percent growth)
- Coal (35,578,950 tons, -14.2 percent growth)
- Farm Products (34,724,587 tons, 91.4 percent growth)

Crude petroleum or natural gas is forecast to see the most rail tons in 2040 (52,387,430), representing a change of 86.5 percent over the forecast period of 2013-2040. Issues that could affect the forecasts developed for Wisconsin's railway mode include increases in national truck size and weight limits and the continued decline of coal as an energy resource.

7.6 Wisconsin Highway/Truck Trends, Issues, and Forecasts

Trucks continue to be the dominant mode for freight movement in the state. Following some recent declines due in part to macro-economic factors, statewide travel is again trending upward. Freight demand fluctuates with economic conditions and is affected by long-term trends in consumer demand. Demographics, globalization and

[57] 2013 IHS Transearch Database.
[58] Ibid.

other macro factors all influence the flow of goods in and through Wisconsin. In addition, conditions in Chicago and the Twin Cities can have a substantial impact on Wisconsin's shipping patterns.

Increases in truck freight movement throughout the state may accelerate the need for enhanced facility maintenance and preservation activities. Accurate forecasts of potential truck freight movement and associated facility impacts will ensure the allocation of existing resources addresses system priorities.

While the trucking industry has grown on pace with the growth of overall freight transportation, its future capabilities will be shaped by opportunities and challenges arising from the public and private sectors. Some of the most critical issues include the following topics.

Truck Parking

A major challenge for commercial truck operators is a shortage of areas near the Interstates to safely park their vehicles and rest. In lieu of available truck parking, some commercial truck drivers have parked illegally on Interstate interchange ramps or on the right shoulders of the Interstate, posing a major safety risk, potentially causing traffic bottlenecks, and causing pavement deterioration.

The shortage of suitable truck parking spaces presented WisDOT with an opportunity to both develop new truck parking facilities at strategic locations in the state and to utilize new technologies to develop a more efficient way to communicate current parking availability to commercial truck drivers.

As discussed in Chapter 5, *Wisconsin's Transportation Assets*, in Wisconsin, truck parking is available at 30 public rest areas which are located near Interstates and state highways in Wisconsin. Truck parking is also available at private facilities, such as gas stations or truck stops, located near Interstates and state highways. Truck parking facilities play an important role in freight operations, safety and security in Wisconsin, and are needed for many reasons, including:

- Respite for over the road truckers
- Adherence to federal motor carrier safety standards
- Use for logistics purposes, such as staging (awaiting dispatch instructions)
- Pickup points for deliveries
- Safe areas during inclement weather conditions

In 2014, WisDOT received a $1 million grant from the Federal Highway Administration (FHWA) to pilot a truck parking availability system in the state. The system was deployed in 2016 at four public rest areas on I-94 eastbound from Dunn County to Columbia County. Hybrid Dynamic Message Signs (HDMS) were installed along the corridor showing truck parking availability information.

In 2015, Wisconsin, along with seven other Midwestern states, was awarded a $25 million grant from the United States DOT through the Transportation Investment Generating Economic Recovery (TIGER) program to build a regional truck parking information management system. Wisconsin's portion of the $25 million grant is $3 million. This system, also using HDMS, will include seven public rest areas along the I-94 corridor, east and westbound from the Illinois to Minnesota state lines. This system will be constructed between 2016 and 2018.

Trends Impacting Driver Hours of Service

Driving hours of service (HOS) are regulated by federal rules and are designed to prevent truck/commercial vehicle-related crashes and fatalities by prescribing on-duty and rest periods for truck drivers. Generally, federal safety regulations require that drivers of heavy duty trucks rest ten hours for every eleven hours that they drive.

In December 2010, the United States DOT's Federal Motor Carrier Safety Administration (FMCSA) issued a proposed rule to revise HOS requirements for commercial truck drivers. This rule would retain the "34-hour restart" provision, allowing drivers to restart the clock on their weekly 60 or 70 hours by taking at least 34 consecutive hours off-duty. However, the restart period would have to include two consecutive off-duty periods from midnight to 6 a.m. Drivers would be allowed to use this restart only once during a seven-day period. The FMCSA reviewed five provisions in the current rules related to driving a commercial motor vehicle (CMV):

- **Limitations on minimum "34-hour restarts" –** there is no current rule on "34-hour restarts." The new ruling states that a restart must include two periods between 1 a.m. and 5 a.m. (home terminal time) and it may be used only once per week.
- **Rest breaks –** there is no current rule on rest breaks. The new ruling states that a driver may drive only if eight hours or less have passed since the end of the last off-duty period of at least 30 minutes.
- **On-duty time –** the current rule considers "on-duty time" to be any time in a CMV except in a sleeper-berth. The new ruling does not consider time spent in a parked CMV, or up to two hours as a passenger before or after eight consecutive hours in a sleeper-berth, as "on-duty time." This provision also applies to passenger-carrying drivers.
- **Penalties –** the current rule states that penalties will be issued for "egregious" hours of service violations, but these are not specifically defined. The new ruling defines driving, or allowing a driver to drive, three or more hours beyond the driving-time limit as an egregious violation subject to maximum civil penalties. This also applies to passenger-carrying drivers.
- **Oilfield exemption –** the current rule requires that drivers waiting at oilfields record "waiting time," off-duty time that does not extend a 14-hour duty period, and make those records available to FMCSA, but there are no standards for recordkeeping. The new ruling requires that drivers record their "waiting time" on a log book or electronic equivalent and indicate this time is "off duty" in annotations in "remarks" or a separate line added to "grid".

Trends in Truck Technology

Communication technology will continue to evolve and be applied to all aspects of truck freight movement, from the cab to the trailer. Technological advances in communication will enable the trucking industry to communicate more effectively. For goods being shipped, point-of-purchase information will have a greater role in driving warehouse orders and just-in-time delivery demands. RFID tagging will increasingly be adopted to track goods movement to improve tracking. Warehouse management systems will allow real-time awareness of inventory location, including items in transit. Electronic Data Interchange (EDI) systems will become more and more sophisticated and integrated across larger supply chains.

Drivers will also witness more technology in their cabs. GPS tracking will be used to monitor speed, service hours, location and anticipated delivery time. Transponders and satellite systems will allow truckers to bypass weigh inspection stations and freight brokers. The remainder of this section outlines technologies affecting the trucking industry.

Freight Broker

Although many shippers have contracts with trucking companies to transport their goods, a significant amount of truck transport in North America is handled by freight brokers. A freight broker is an intermediary between a shipper who has goods to transport and a carrier who has the capacity to move that freight.

Building Efficiencies, Reliability, and Resilience

Effective, coordinated and economical operations are part of an efficient transportation system that helps maximize traffic flow. This can reduce travel delays for freight and people, and improve safety. WisDOT and other transportation providers achieve efficiencies through traditional actions, technologies, and partnerships. Traditional actions such as using larger aircraft or expanding highways can make the system operate more efficiently.

Efficiencies are increasingly gained through the use of technologies like Intelligent Transportation Systems (ITS) or programs like Transportation Systems Management and Operations (TSM&O). ITS makes real-time travel information accessible to all users and can help travelers make decisions before or during their trips if incidents or travel slow-downs occur. Encouraging the use of other transportation modes can help to improve system efficiencies. Driving at lower speeds and reducing vehicle and train idling time can improve fuel efficiency and potentially improve air quality (See Chapter 5, *Wisconsin's Transportation Assets*).

WisDOT also achieves efficiencies by collaborating among business areas, with federal and state agencies, local governments, Native American tribes, regional planning commissions, metropolitan planning organizations, and other stakeholders. These collaborations encourage up-front communication, technical assistance, coordination and planning, and cooperative efforts to reduce administrative barriers.

Achieving efficiencies and ensuring strong collaboration across WisDOT business areas and between WisDOT and other jurisdictions is critical to incident management, emergency response preparedness planning, and traffic management.

Continuing to provide a reliable transportation system enables the department and other transportation providers to meet changing user needs. A reliable transportation system ensures that users can plan their schedules around basic assumptions of travel times. Many Wisconsin businesses require a reliable transportation system. For example, a food processing plant may schedule bulk cheese to be delivered at the time it will be needed for processing and packaging — so the cheese arrives just-in-time. The finished cheese product may then be shipped just-in-time to distribution centers and grocery stores to replenish store shelves. Just-in-time shipping reduces warehousing costs and is especially useful for producing and distributing perishable goods.

Transportation Systems Management & Operations

TSM&O as defined in MAP-21 as integrated strategies to optimize the performance of existing and proposed infrastructure through the implementation of multimodal and intermodal, cross jurisdictional systems, services, and projects designated to preserve capacity and improve security, safety, and reliability of the transportation. TSM&O is expected to enable better evaluation of transportation projects in terms of cost effectiveness, benefit to the public, safety, and ability to integrate into the infrastructure system.

Unexpected delays in delivery of items such as cheese, corn or potatoes can add to production costs and can cause possible spoilage or contamination of the perishable food. Delays can also affect the shelf life of the finished products in grocery stores.

A resilient transportation system is able to quickly respond to unexpected conditions and return to its usual operational state. For example, in the case of a crash or scheduled road construction, alternate route options may be provided.

Providing seamless connections focuses not only on connecting Wisconsin's transportation system to local, regional, national, and international networks, but also in facilitating convenient movement among different transportation modes. This requires investments in a multimodal transportation system that integrates both physical and technological infrastructure.

Specific Technologies Used by WisDOT

In response to increasing demands on Wisconsin's state trunk highway system, WisDOT uses a wide range of technologies to manage the growing volume of traffic, provide real-time traffic information to system users and first responders, and assess existing and future operational and infrastructure needs.

WisDOT's ITS applications consist of numerous tools to help manage highway system traffic flow from detection and response to data collection. Most of the traffic management technologies used by the department to detect and respond to transportation incidents are ITS applications such as variable message signs and portable changeable message signs, ramp meters, closed circuit cameras, and telephone and Internet information systems.

Commercial Vehicle Information Systems and Networks (CVISN, pronounced "see-vision") provide the department with tools to improve motor carrier safety and enforcement, as well as enhance the state's revenue collection. There are numerous CVISN applications designed to improve the efficiency of traffic flow and enforcement of motor carrier regulations. Primary regulatory components addressed using CVISN technology include monitoring truck weight and size, and ensuring that each truck has proper insurance and necessary safety equipment.

The majority of the department's CVISN tools and technologies are housed at the state's thirteen Safety and Weight Enforcement Facilities (SWEF), commonly called weigh stations. WisDOT's Motor Carrier Enforcement unit in the Division of State Patrol uses CVISN technology to monitor and enforce commercial truck operations in Wisconsin. Specifically, they monitor the legal weight, length, and height of loads. They also identify the registration, insurance, authority/permits, and fuel tax collection for the operators. Currently, weigh stations are located along the state's Interstates, United States Highways and at entry points to the state.

Drivewyze allows commercial motor vehicles to bypass SWEFs by using electronic weight detection and Automatic Vehicle Identification technologies. This technology allows safety and enforcement inspections to focus on commercial motor vehicles most likely to be in violation of statutory requirements.

The Wisconsin State Patrol deploys virtual scales that can detect approximate vehicle weights. Commercial motor vehicle images are captured, which can identify overweight commercial motor vehicles attempting to bypass SWEFs or avoid detection by driving in the opposite lane or on the shoulder. This technology is accessible via laptop computers in State Patrol squad cars. In addition, this technology is currently located along two routes bypassing the Kegonsa SWEF and near Lake Butte des Morts in Winnebago County. Another location is proposed near the Beloit SWEF.

Weigh-in-Motion technology is also utilized by the Wisconsin State Patrol. Weigh-in-Motion technology can detect the approximate weight of commercial motor vehicles via inductance loops, axle sensors, and load cell scales beneath the pavement. Information is transmitted to SWEFs and instructs (via changeable message signs) vehicles measured as oversize-overweight to exit the roadway for additional measures. This allows vehicles that are not oversize-overweight to continue without stopping and allows State Patrol staff to focus on vehicles most likely to be in violation of statutory limits.

Autonomous and Connected Vehicles

New developments in autonomous vehicle technology, including driverless trucks, have been in prototype testing since 2014. Recent investment in both commercial and consumer applications suggests these technologies are viewed as emerging by the private sector. Implementation of this technology could take a variety of forms, one of which is "cooperative trucks" that use Dedicated Short Range Communications (DSRC) to communicate vehicle-to-vehicle (V2V) and/or vehicle-to-infrastructure (V2I). Fuel savings, increases in lane capacity and enhanced traffic flow stability are just a few of the benefits that will attract trucking companies, drivers, equipment manufacturers and DOTs to systems that provide V2V and V2I communication and cooperation.

Through WisDOT's Advanced Traffic Management System (ATMS), the department would be able to integrate data from roadside ITS and vehicle communications from V2I and V2V. By integrating this data along with systems already in place, WisDOT will have better information about the real-time conditions experienced on its highways. As next generation systems and communications are proven effective, WisDOT's ATMS would likely need upgrades to be able to use the data produced.

The largest motivating factor for truck operators to adopt cooperative trucks is the drag reduction found when trucks can safely and closely cluster together. Researchers have measured significant fuel savings - as much as 20 percent - which has economic implications for long-haul truck operations.[59,60] Cooperative trucks may help mitigate the truck driver shortage in the longer term, but there are many legal and regulatory issues to resolve.

Another innovation, intelligent cruise control, may greatly reduce congestion and incidents, thereby reducing non-recurring congestion and improving system reliability and safety. This can be effective for trucks since they take longer to accelerate on a highway after slowing down in traffic.

Trends Impacting Fuel Efficiency

Trucking is particularly vulnerable to fuel costs, since it is generally less fuel efficient than rail or water. For many trucking companies, fuel costs are nearly the same as labor costs on a per mile basis.[61] The trucking industry is highly competitive, with companies typically operating on thin margins. For every dollar in revenue, there are 95.2 cents in costs. When fuel costs rise, this has the potential to alter many aspects of freight movement, especially if high costs are sustained over an extended period of time. Even though major carriers can pass along some costs though fuel surcharges to customers, rising fuel costs are very problematic for the trucking industry.

Federal Regulation

Government regulations will also accelerate innovative technologies. In 2014, the President directed the Environmental Protection Agency (EPA) and the United States DOT to produce a rule by March 2015 to tighten fuel

[59] MIT News, "Driverless platoons." (December 20, 2016).
[60] Truckinginfo.com, "Truck Platooning, Past, Present, and Future." (April 2016).
[61] American Transportation Research Institute, "An Analysis of the Operational Costs of Trucking: 2015 Update." (September 2015).

efficiency standards for post-2018 model-year trucks. The rule went into effect in March 2016. To achieve greater fuel efficiency, the White House hoped the plan would "spur manufacturing innovation and lead to the adoption of new fuel-efficient technologies on trucks and semi-trailers." The EPA and United States DOT hope to emphasize improvements in engine and powertrain efficiency, aerodynamics, weight reduction, tire rolling assistance, hybridization, and automatic engine shutdown, among others. The following technologies have been identified as already being under implementation or consideration by the trucking industry.

Conversion to Natural Gas and Hybrid Delivery Trucks

This change would be reinforced by federal fuel efficiency standards for heavy-duty trucks as well as concerns. Other potential changes include redesigned internal combustion engines, with micro turbines and other efficiency-increasing engineering.

Electrification of Truck Stops and Rest Areas

While resting at truck stops, most drivers allow their engines to idle so that they can continue to use their heaters, air conditioners, and other accessories. Idling diesel trucks burn about 1 gallon of fuel an hour, releasing significant amounts of air pollutants.

Equipment Changes

Changes to improve the operational efficiency of trucks include soft-sided trailers to reduce weight, more aerodynamic design to reduce fuel consumption, low-rolling-resistance tires, and computer-controlled automatic transmissions that optimize shift points for fuel efficiency.

Both private fleets owned by shippers and for-hire trucking companies are using the latest technology to deliver goods in a more environmentally sustainable way, and this trend will continue. Freight carriers will adopt more sophisticated routing optimization software to maximize truck capacity, increase efficiency, and minimize the number of trucks on the road.

Increased Weight and Options for Vehicle Configuration

Many shippers and carriers have advocated for higher vehicle weights, and/or longer tandem trailers, which would allow more freight to be shipped per driver/cab unit. While states have authority to make changes in the State Highway System, the Interstate Highways remain under federal authority and weight changes on that system would need to be federally designated.

Issues in Oversize-Overweight Movements

The size and dimensions of oversize-overweight (OSOW) loads, such as wind components or mining/drilling equipment, continue to grow. Not only is it difficult to find efficient routes to accommodate the loads, but these movements also lead to accelerated damage of roadways and bridge structures. Planning for OSOW transportation needs and providing safe and efficient routing is an ever-increasing challenge that requires considerable time and resources. With an increase in permitting to accommodate the movement of oversized loads, many state DOTs are studying the impacts on their highway systems, specifically infrastructure, safety, and operational efficiencies (See Chapter 5, *Wisconsin's Transportation Assets*).

In addition to the challenge of finding efficient routes, drivers of these loads are often challenged by inconsistent rules and regulations across states. Most states have different size and weight restrictions for OSOW loads, making the process of moving through multiple states with an OSOW load very complex.

As lowering transportation costs continue to be a top priority for freight movement, the exploration and testing of different axle and wheel configurations has taken place. The intent is to decrease the number of trips taken by trucks to make transportation more efficient for businesses; this may lead to further increases in the number of OSOW loads in Wisconsin.

Issues in Truck Driver Shortage

Due to worker retirements in an aging workforce, stricter safety regulations, and higher costs, a shortage of experienced drivers has developed into a chronic problem in the trucking industry nationwide. Changes in HOS rules impact delivery schedules and distribution areas for most shippers, and will likely require shippers to hire additional drivers to cover the same geographic area. It is also resulting in more firms shipping cross-country to choose freight rail combined with last-mile urban delivery by truck.

The persistent shortage of qualified long-haul truck drivers will cause more firms shipping cross-country to choose freight rail combined with last-mile urban delivery by truck. Long-haul truck routes are getting shorter; this is partly caused by regionalization of distribution centers, as retailers find it easier to provide the right products at the right time to their stores from regional, not national, warehouses. The exceptions to this rule are shippers sending smaller amounts via Less-than-Truckload (LTL) carriers and high-value goods requiring truck team drivers for security. The shortage of qualified truck drivers in all sectors will likely lead to higher prices for trucking services, which could be passed along as increased prices for consumer goods.

Preservation Challenges

Wisconsin's existing transportation system was developed over many decades using both private and public investment. It includes extensive infrastructure and services ranging from highways, local roads, and airports, to railways, harbors, sidewalks, and transit systems. The existing transportation system is the foundation on which future investments will be made. However, this foundation faces several challenges:

- Aging highway system infrastructure
- Increasing costs
- Increasing user demand
- Maintenance and Technology
- Local road challenges, including heavier loads

Highway System Infrastructure

Much of Wisconsin's Interstate highway system was constructed in the 1950s and 1960s, and bridges on the state trunk highway system (which includes the Interstate highway system) can date back to the 1930s and 1940s. Since then, user demands have increased, and in some cases, designs that were applied to address anticipated travel demands are now outdated. In response, WisDOT's efforts continue to focus on maintaining and preserving the system, along with addressing safety deficiencies, traffic flow concerns, and critical design features. If pavement replacement continues over the typical lifespan of the infrastructure, roads can last up to 60 years (prior to complete reconstruction), and bridges can last up to 75 years. However, keeping pace with both emerging and existing needs remains a challenge.

Funding and Costs

Financing Wisconsin's freight infrastructure utilizes prioritization methodologies to ensure the most cost-effective improvements are implemented. As the system ages, maintenance and preservation activities typically change and costs tend to increase – particularly those related to real estate, energy, and construction materials. Anticipating

these trends and maintaining a fiscally responsible budget will allow WisDOT to address these challenges appropriately.

User Demand

Increased user demand can present challenges. Freight traffic will place increased pressure on the state's transportation system as commercial annual Vehicle Miles Traveled continues to increase. In 2013, truck traffic accounted for 5.7 billion vehicle-miles; by 2040 truck traffic is forecast to account for 6.9 billion vehicle-miles, an increase of 21 percent.[62] In some cases, state and local roadways are not designed to handle the number of trucks, or the heavy loads associated with truck shipping.

Maintenance and Technology

Maintaining and improving the efficiency of Wisconsin's transportation system is crucial to supporting economic growth; however, transportation providers, including WisDOT, are facing several challenges:

- Balancing cost-effective strategies with efficiency and safety
- Increasing costs
- Changing technology
- Balancing highway access needs with economic growth initiatives

Balancing cost-effective strategies with efficiency and safety is a significant challenge. For example, many transit systems are receiving requests for expanded service areas at the same time costs are increasing. As a result, many transit systems have either reduced existing service to keep pace with current costs or increased fares to try to expand service into new areas.

In addition, projected demographic changes suggest transportation demands are likely to go up as Wisconsin continues to experience increases in the overall population and as the aging population stops driving and turns to public transit and other transportation options for their mobility. This will further necessitate the need for cost-effective strategies that maximize efficiency and safety.

Technology presents challenges and opportunities. Keeping pace with ongoing updates and improvements in technology can be expensive. A technological system that may have been state-of-the-art five to ten years ago may no longer be used or supported today. In addition, using technology for data collection to monitor traffic flow, and identify system needs and potential improvements has raised questions about individual privacy concerns and data storage requirements. Ensuring that the technologies are available during an emergency or incident requires system redundancy or backups. For example, many signalized intersections also have stop signs that can be uncovered if the traffic signals malfunction.

Finally, balancing transportation and land use continues to be a challenge. By protecting the safety, capacity and traffic flow on state trunk highways, public investment can also be preserved. Through sound access management techniques, the public and local governments can work with WisDOT to preserve the state's roadway investments and promote investment in the local economy through safe access points. In addition, providing increased access to transit provides more options for individuals, particularly those who do not or cannot drive.

Local Roads

At the local level, governments face challenges related to increasing costs – particularly those related to real estate, energy, and construction materials. As identified in Chapter 6, *Transportation System Condition and Performance*, the road network is typically not designed to adequately serve oversize or overweight trucks

[62] Wisconsin Statewide Travel Demand Model, August 2017.

traveling to and from freight generators like ports. This can result in trucks traveling farther distances to avoid bridges with weight limits, areas with reduced clearances, or roadways with insufficient turning radii.

Highway Freight Forecasts

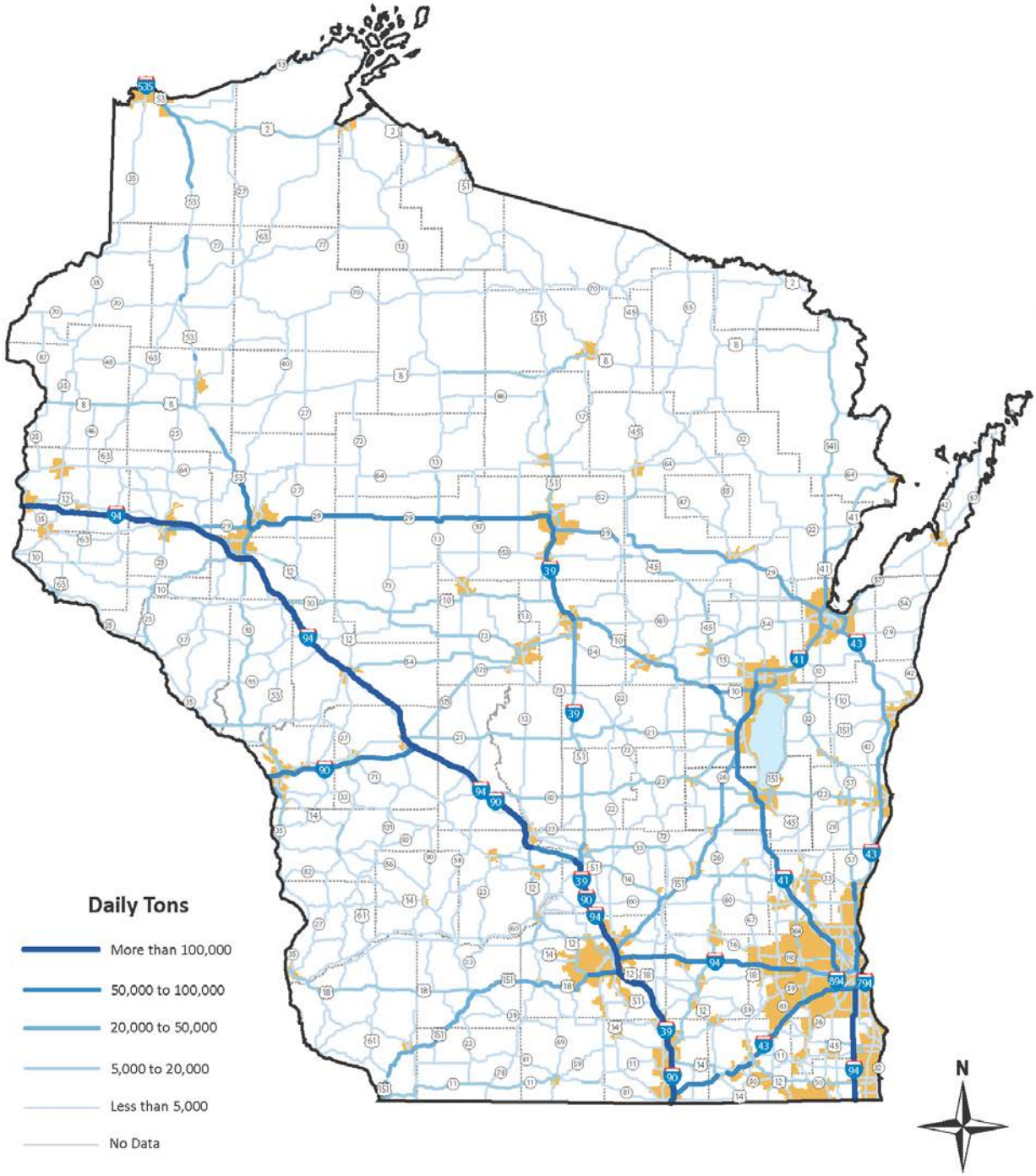
WisDOT prepares roadway traffic forecasts to project what might happen 20 to 30 years in the future. Forecasts identify total traffic volumes for roadways. Different vehicle classifications (such as light vs. heavy vehicles or trucks) are also forecast. The vehicle classifications are further broken down into percentages for different types of trucks, such as single trailer trucks and multi-trailer trucks. Because trucks are the heaviest vehicles on the roadway, roadway engineers use truck traffic information to help determine the design parameters of the pavement to be constructed and the roadway's adequacy over the life of the pavement.

Figure 7-15 displays the highway network based on the anticipated percent change by 2040 in tons, while Figure 7-16 displays the percentage change in value. Figure 7-17 displays the 2040 forecast for daily trucks. Figure 7-18 displays the percentage change in tons or value, and Figure 7-19 shows the percentage change in daily trucks. The highways expected to see the most growth include:

- WIS 15 (East Wisconsin)
- WIS 26 (SW Wisconsin)
- WIS 35 (NW Wisconsin)
- WIS 60 (South Wisconsin)
- WIS 64 (NW Wisconsin)
- US 12 (West Wisconsin)

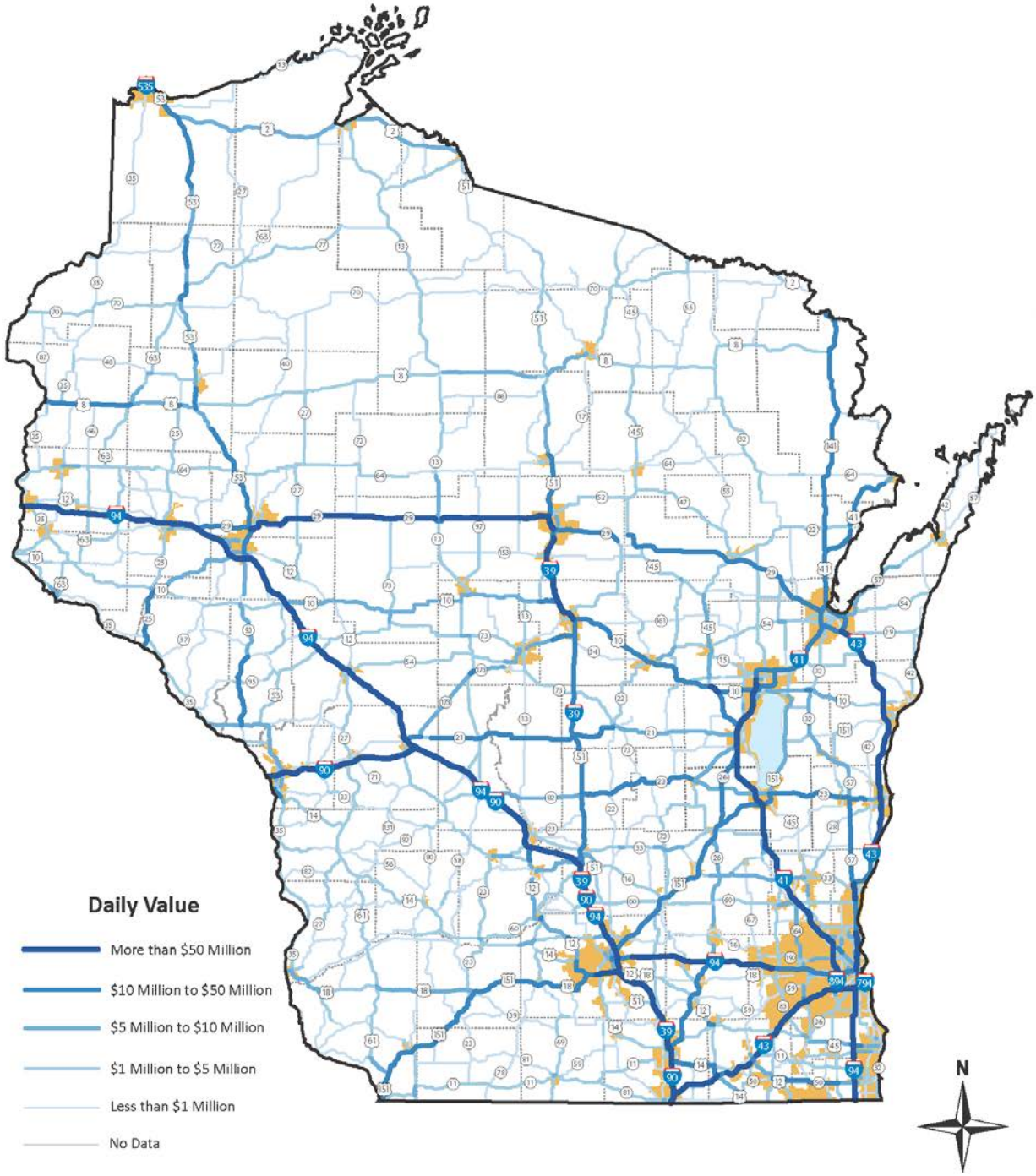
Wisconsin highways that carry bulk commodities are the facilities expected to see the increase in tonnage. With overhead (pass-through) traffic expected to increase, the trucks that carry valuable shipments to/from distribution centers will increase traffic on our Interstate system.

Figure 7-15: Highway Forecasted 2040 Commodity Tonnage



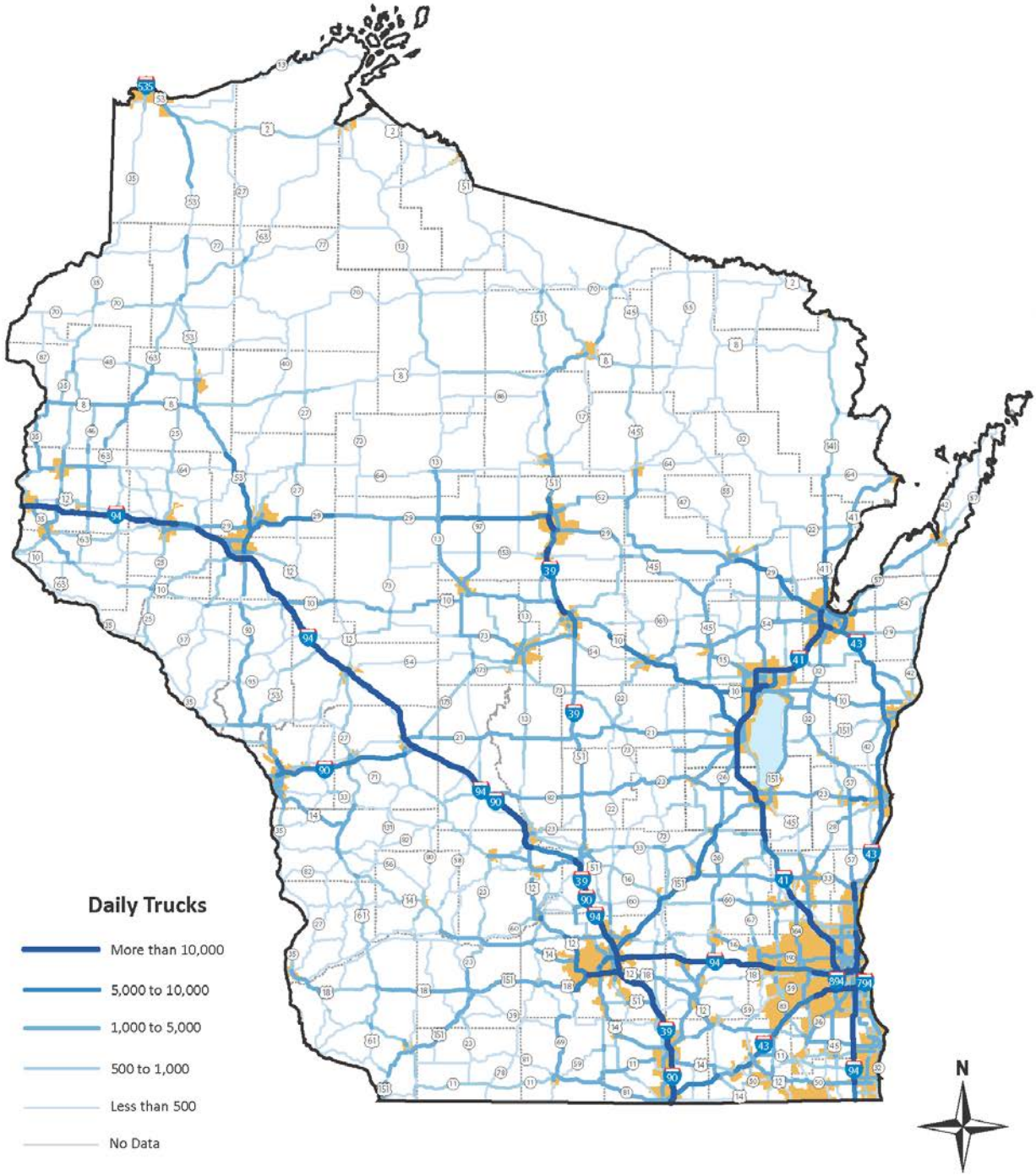
Source: Wisconsin Department of Transportation, Statewide Travel Demand Model

Figure 7-16: Highway Forecasted 2040 Commodity Value



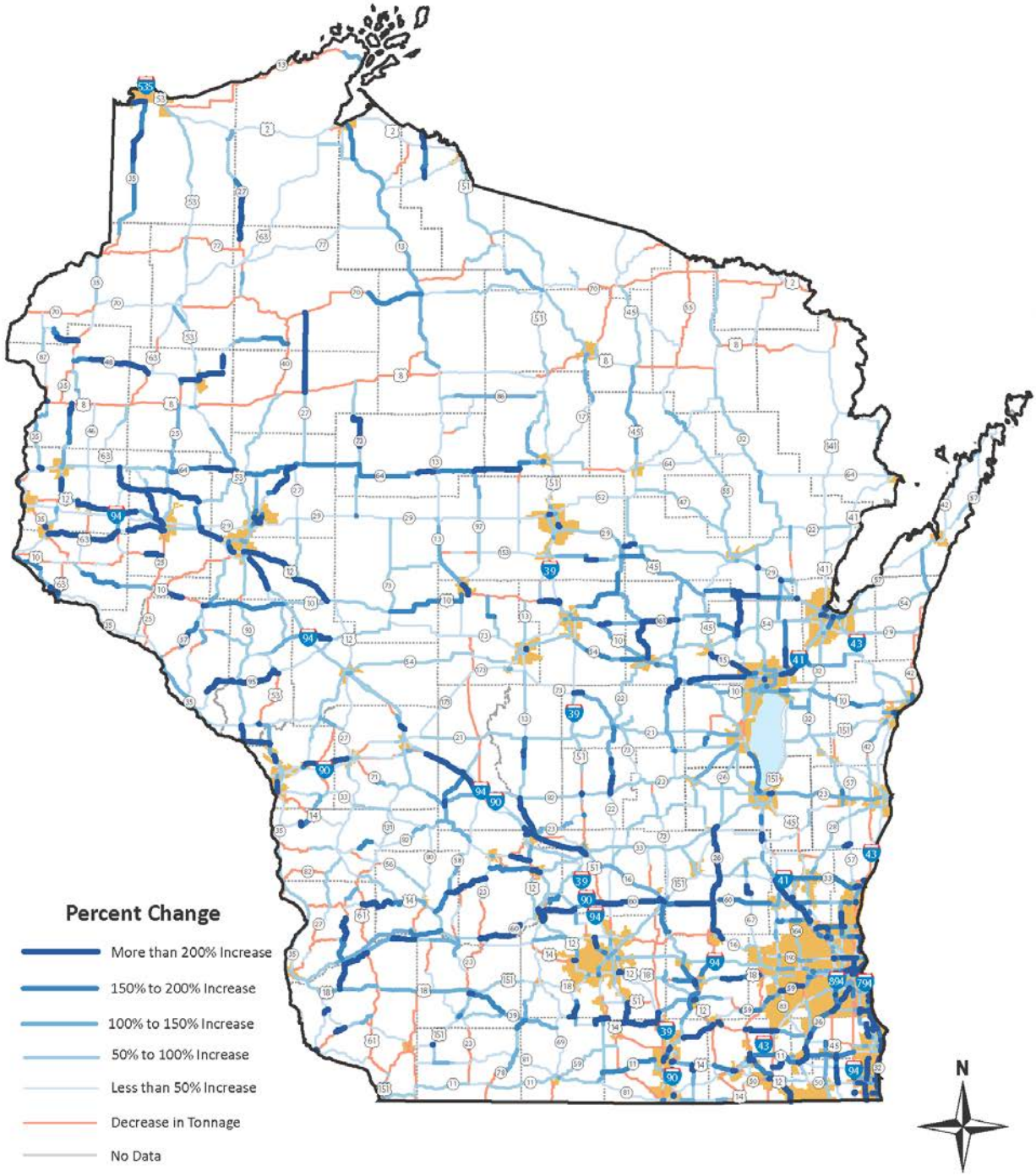
Source: Wisconsin Department of Transportation, Statewide Travel Demand Model

Figure 7-17: Highway Forecasted 2040 Daily Trucks



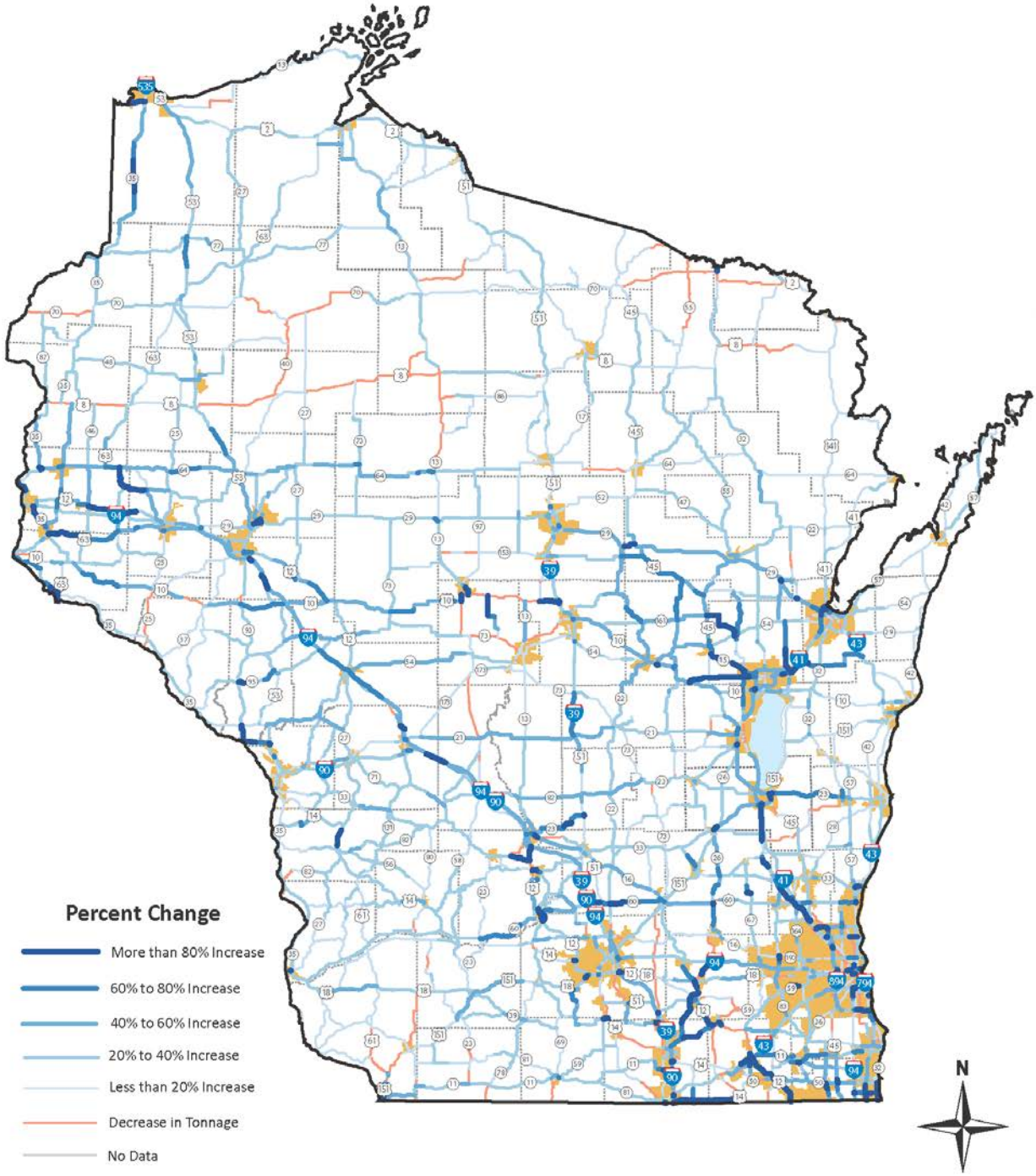
Source: Wisconsin Department of Transportation, Statewide Travel Demand Model

Figure 7-18: 2013-2040 Highway Forecast Percent Change in Tons/Value



Source: Wisconsin Department of Transportation, Statewide Travel Demand Model

Figure 7-19: 2013-2040 Highway Forecast Percent Change in Trucks



Source: Wisconsin Department of Transportation, Statewide Travel Demand Model

Highway - Origins/Destinations[63]

Commodities that travel by truck may have localized economic benefits for communities or counties (at a larger economic scale). Economic forecasts are the basis for growth or decline in originating or terminating tonnage amounts over time. Increases and decreases are most likely due to projected changes in employment by industry sector. The counties expected to see the largest growth in originating tonnage (more than 100 percent) in 2040 are:

- Calumet
- Douglas
- Eau Claire
- Waupaca

The counties expecting to see the largest growth in terminating tonnage are:

- Richland
- Rock
- Sawyer
- Washington

Highway - Commodities[64]

Over time, commodities change relative to the economy. In Wisconsin, many of the top commodities today are anticipated to remain the top commodities for highway transport in the future. The five commodity groups forecasted to have the greatest quantity of tonnage transported via truck in 2040 are:

- Nonmetallic Minerals (125,445,249 tons, 72.8 percent growth)
- Farm Products (118,571,860 tons, 52.7 percent growth)
- Secondary Traffic (66,235,217 tons, 192.7 percent growth)
- Food or Kindred Products (58,113,096 tons, 74.7 percent growth)
- Clay, Concrete, Glass, or Stone (43,337,557 tons, 138.7 percent growth)

Two of the top five commodities, secondary traffic and clay, concrete, glass, or stone, are growing substantially faster than the average growth rate of the top 50 Wisconsin commodities. Farm products are growing substantially slower than the average growth rate of the top 50 commodities.

Nonmetallic minerals are forecasted to see the most truck tons in 2040 (125,445,249), representing a change of 72.8 percent over the forecast period of 2013-2040. Issues that could affect the forecasts developed for Wisconsin's highway mode include the fluctuation of fuel prices and increases in national truck size and weight limits.

7.7 Wisconsin Waterway (Port/Harbor) Trends, Issues, and Forecasts

Wisconsin relies on access to the Great Lakes and Mississippi River system for shipping transportation, drinking water, recreation, and fishing. Key state industries such as agriculture, forestry, and mining rely on the efficient movement of freight via the waterway to drive competitiveness. Freight shipments by water face several

[63] 2013 IHS Transearch Database.
[64] Ibid.

challenges including seasonal water limitations, winter lock closures, aging lock systems, lack of dredging, and fluctuating water levels.[65]

Any increases of freight activity at Wisconsin ports is expected to provide economic benefits in the forms of jobs and business development, while also helping to mitigate the burgeoning demand on the region's highways and rail systems. In conjunction with the results of the Wisconsin Commercial Ports Development Initiative (WCPDI), a number of current trends and issues present opportunities or challenges to increasing the amount of freight shipped through Wisconsin ports.

Jones Act

Coastwise Shipments
Coastwise is the term used to describe a voyage that begins and ends within the United States and delivers a type of commercial cargo

The Jones Act refers to federal statute 46 USC section 883, which regulates maritime commerce between "points in the United States to which the coastwise laws apply."[66] Points may include docks, vessels, drilling rigs, windmills, or other facilities. The Act requires that goods and passengers transported by water between United States ports be done in ships made in the United States, owned by United States citizens, and crewed by United States citizens. The Jones Act also provides sailors with additional rights, including the ability to seek damages from the crew, captain, or ship owner in the case of injury. This is also the act that controls coastwise trade within the United States and determines which ships may lawfully engage in that trade and the rules under which they must operate.[67]

Generally, the Jones Act prohibits any foreign-built or foreign-flagged vessel from engaging in coastwise trade within the United States. A number of other statutes affect coastwise trade, including the Passenger Services Act, 46 USC section 289, which restricts coastwise transportation of passengers, and 46 USC section 12108 restricts the use of foreign vessels to commercially catch or transport fish in United States waters.

Various cases have extended the definition of merchandise to include anything of a commercial value, including dredged materials used for landfill. The federal district courts have ruled that the transportation of sewage sludge is not "merchandise" because it is a valueless commodity.

Trends Changing Energy Transport via Waterway

The following section outlines the trends in the movement of energy products via the waterway, organized by product.

Petroleum Products

About 3.2 million tons of petroleum products were carried on the Great Lakes to/from United States destinations/origins in 2013.[68] Nearly two-thirds of these flows were composed of asphalt, tar, and pitch, as well as petroleum coke. As such, these products are not ideal candidates for pipeline transportation.

Petroleum product flows are composed of distillate fuel oil, gasoline, and residual fuel oil. The ports of Chicago, Indiana Harbour, Toledo, and Detroit are major shipping and receiving facilities for these products, which are

[65] National Center For Freight & Infrastructure Research & Education, "Wisconsin Commercial Ports Development Initiative - Final Project Report." (December 2014).
[66] 46 USC 883.
[67] Maritime Law Center, "The Jones Act."
[68] U.S. Army Corps of Engineers, Waterborne Commerce Statistics Center.

shipped to/from other Great Lake ports and into the United States river system. In Wisconsin, petroleum products were shipped from Green Bay prior to the 2016 closure of the West Shore Pipeline, although in limited amounts (25,000 tons in 2013). Now, the Port of Green Bay receives petroleum products (see below).

As recently as 2015, the department provided Harbor Assistance Program (HAP) funding for projects that enable liquid bulk loading at ports in Green Bay, Milwaukee, and Marinette. These locations add redundancy to the petroleum products supply chain should an incident such as the West Shore Pipeline closure occur (see Chapter 6, *Transportation System Condition and Performance*).[69]

Consultations with industry suggest that the frequency of shutdowns on some of the state's petroleum product pipelines are increasing. The West Shore Pipeline was specifically mentioned as experiencing recurring issues, with the most recent incident occurring in March 2016. The incident removed the pipeline from service north of Milwaukee; in April 2017 the owners decided to permanently close the pipeline.[70] The closure has resulted in both truck and waterway transportation of petroleum products to Green Bay, with the Port of Green Bay importing up to two barges per week of gasoline and diesel through the Great Lakes in summer 2016.[71]

Liquid Bulk Vessels
Supplying Wisconsin petroleum products from United States ports would require United States-flagged vessels. Currently, U.S. Oil operates a 70,000-barrel barge and U.S. Shipping operates another products barge. U.S. Shipping also operates a fleet of United States-flagged products ships which deliver products to the east, west and Gulf coast states, and could potentially redeploy some capacity into the Great Lakes. Also, Interlake Steamship, a major ore carrier, has a subsidiary, Moran Towing, which operates several integrated tug-barge units on the east coast, some of which could possibly be redeployed to the Great Lakes. Supplying Wisconsin from Canadian ports would be most cost effective – this would not require United States-flagged vessels. Currently Algoma Central operates seven refined products tankers on the Great Lakes to deliver from Sarnia and Nanticoke refineries to the geographically dispersed Canadian markets. Currently operating on the Great Lakes, these ships could make deliveries to Wisconsin on relatively short notice. Also, McKeil Marine is a Canadian barge operator which has looked at such projects in the past.

Crude Oil

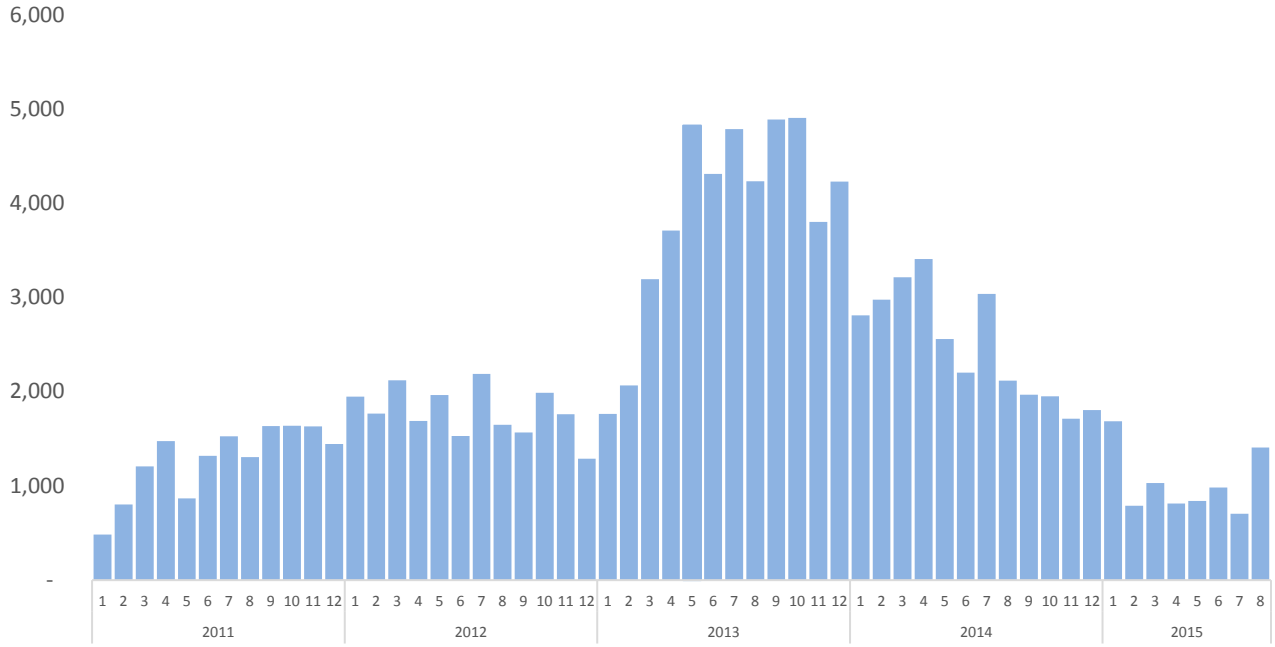
In the case of crude oil, United States Army Corps of Engineers (USACE) data indicates that tonnages carried on the Great Lakes in 2013 reached 14,000 tons.[72] These volumes consisted of intraport traffic that occurred in the port of Chicago. However, up to 220,000 tons of crude oil were loaded in Chicago and shipped on the Illinois River to the south. The total amount of crude carried on the Illinois Waterway in 2013 reached nearly 400,000 tons, of which over 90 percent was heading south. Such flows are relatively recent and were limited to 10,000-20,000 tons before 2012. According to Platts, the recent surge in crude-by-barge carriage on United States inland water systems mirrors crude-by-rail trends. [73]

However, recent improvements in pipeline capacity towards the south and the decreasing price spread between Western Crude Select (WCS) and West Texas Intermediate (WTI) in recent months clearly impacted Gulf Coast

[69] The West Shore Pipeline still serves a major distribution terminal in Milwaukee.
[70] Milwaukee Journal Sentinel, "Company won't replace only fuel pipeline to Green Bay." (April 21, 2017).
[71] S&P Global, Platts, "Port of Green Bay becomes importer of refined products as pipeline shuts." (July 8, 2016).
[72] U.S. Army Corps of Engineers, Waterborne Commerce Statistics Center.
[73] S&P Global, Platts, "US crude-by-barge industry faces rough waters in oil markets: Petrodollars." (August 24, 2015).

(PADD 3) refinery interest in North Dakota and Canadian crude deliveries by barge. Figure 7-20 illustrates this situation by presenting deliveries of crude by barge from PADD 2 to PADD 3.

Figure 7-20: Gulf Coast (PADD 3) Receipts by Tanker and Barge from Midwest (PADD 2) of Crude Oil (Thousand Barrels)



Source: CPCS summary of U.S. Energy Information Administration data

Figure 7-20, however, underestimates total volumes transiting between PADD 2 and PADD 3 because it does not include all Utica condensate volumes that flow down the Ohio River to Gulf Coast refineries.[74]

For Wisconsin, this situation tends to confirm that the extreme volatility in North American crude markets makes it difficult for any port in the state, notably Superior, which is the only one in proximity to a crude pipeline, to position itself as a crude by barge hub. Refiners will continue to prioritize pipeline deliveries when possible and existing barge shipping capacity from the Illinois Waterway appears to be meeting demand, although supply was considered tight in the summer of 2015.[75] Data for 2013 from the USACE also indicates that some petroleum products are shipped from the Upper Mississippi River in the Minneapolis area. These flows essentially consisted of petroleum coke.

In Canada, there have been initial discussions of the possibility to ship crude from a Great Lake port to a port on the St. Lawrence for eventual export to offshore markets. This would mirror some grain export logistics. The economics of such logistical solutions are however different for crude because freight rates for the carriage of grains from the Great Lakes to the St. Lawrence reflect the possibility for lakers to carry iron ore as back-haul. There are no known back-haul cargoes for tankers which would sail down the Great Lakes St. Lawrence Seaway System with crude and this would certainly translate into higher freight rates. With the reversal of Enbridge's Line 9B to Montreal, there is also possibility to ship crude directly to the St. Lawrence by pipeline for export to offshore. There have notably been such exports from Montreal to Italy in 2014, even before the reversal of Enbridge's Line 9B.

[74] RBN Energy, LLC, "Down To The River - Growing Crude-By-Barge Traffic On The Ohio River." (July 14, 2015).
[75] Ibid.

Port Movement of Oversize-Overweight Freight

OSOW loads, such as wind turbine towers and blades, are big business opportunities for Wisconsin's commercial freight ports. The integration of the marine transportation system with the road transportation system when moving OSOW shipments can provide many benefits, including improved safety and fuel efficiency and decreased congestion and pollution. This requires close coordination among shippers, carriers, port authorities, terminal operators, and transportation agencies at the local and state levels, as well as a streamlined permitting process and a properly connected and designed OSOW route to move the load from the port to the ultimate inland destination. Although WisDOT issues permits for OSOW loads, impediments such as low-clearance bridges and tight turning radiuses on the transportation system can hinder OSOW movements from the port inland. Thus, many port authorities encourage OSOW loads to follow the path of least resistance through Wisconsin. As OSOW loads get larger, it is important to ensure that intermodal connections and the state's "last mile, first mile" connections can accommodate these OSOW loads.

In 2016, Broadwind Towers began moving wind tower segments by lake barges from Manitowoc, Wisconsin to Ohio. Approximately six barges were used, each holding over a million pounds of freight on a barge almost as long as a football field. Shipping by water from the deep-water port was lower in cost compared to a truck haul.[76]

Milwaukee to Muskegon Ferry
A new year-round, daily freight ferry service between Milwaukee, WI and Muskegon, MI is in the planning stages and is anticipated starting operations in the near term. The Port of Milwaukee is partnering with ECO ships, Supply Chain Solutions and the Port of Muskegon to establish and improve short sea shipping, trailer, container, and intermodal services for shippers in the Upper Midwest. The initial focus is on loaded containers and trucks with a goal of adding oversize freight, bulk freight and rail intermodal. Backup trucking service may be provided in the event that the ferry can't operate. Initial cross-lake service could expand to inter-lake and international service. The planners are assessing various types of vessels for lease and purchase, establishing market demand and determining infrastructure needs.

Issues with Safe Harbor Distance

Barges are currently being used to ship grain and Wisconsin-manufactured flexible oil pipeline, which is used in deep sea oil drilling, from Milwaukee to the Illinois River. However, the use of river barges on the Great Lakes is restricted by the United States Coast Guard to ensure safe harbor access. Shippers may apply to the United States Coast Guard for a load-line exemption to use river barges on the Great Lakes. There are three current load-line exemptions: 1) Burns Harbor route between Burns Harbor, IN and Calumet, IL; 2) Milwaukee, WI to Calumet, IL; and 3) Muskegon route up to 119 miles past Burns Harbor, IN. If operating past Burns Harbor, river barges must obtain a special load-limit for the route, issued by the American Bureau of Shipping (ABS). In 2015, the United States Coast Guard denied a request from the Michigan Agri-Business Association for a load-line exemption to allow river barges along eastern Lake Michigan as far north as Muskegon to move products on river barges to and from the Mississippi-Illinois River system. The shippers had sought a complete exemption from ABS load-level certification.[77] This exemption would allow the carrier to use river barges without needing to first apply for a load-limit from ABS. Without a load-line exemption, the carrier would need to apply and receive permission from ABS or use a different vessel type.

[76] Manitowoc Herald Times Reporter, "Wind Towers Setting Sail in Manitowoc." (June 18, 2016).
[77] Great Lakes/Seaway Review, "Load-line exemption denied." (April-June, 2015).

Soo Lock System

Located along the St. Mary's River in Sault Ste. Marie, Michigan, the Soo Lock System provides the only water connection between Lake Superior and the rest of the Great Lakes system. About 86 million tons of freight pass through the lock system each year, of which iron ore, coal, and grain are the primary commodities. These commodities account for approximately 90 percent of the total freight transported into and out of the Port of Duluth-Superior.

The Soo Lock system is operated by USACE and consists of two functioning locks. Currently, the Poe lock is the only Soo lock capable of handling the largest vessels in the Great Lakes fleet. Failure of this lock would prevent these large vessels from traveling between Lake Superior's ports and other Great Lakes ports. For this reason, USACE recommends constructing a new Poe-sized lock. The new lock would provide needed capacity and redundancy to ensure reliable service to Lake Superior's ports in the future. However, full funding for the construction of this lock has not been included in any recent USACE budgets.

A 2015 study by the United States Department of Homeland Security found that should the Poe lock unexpectedly cease operations for an extended period of time due to maintenance or terrorism, unemployment would spike to numbers far worse than during the Great Recession of 2008-2009.[78] The closure of the MacArthur lock in 2015 for three weeks to undergo emergency maintenance forced ships to be rerouted through the larger-sized Poe lock. During this emergency maintenance, 103 ships were delayed a combined 166 hours while repairs were underway by USACE. Nearly 1.9 million tons of cargo was overdue, causing untold losses in economic activity throughout the Midwestern United States.[79] The closure of the MacArthur lock for just three weeks underscores the importance of the Poe lock. The Poe lock is a potential single point of failure in this supply chain. An unexpected six-month closure of the Poe lock would have consequences for the national economy. Specifically, a Poe lock closure is estimated to result in a nearly 100 percent closure of North American appliance, automobile, construction equipment, farm equipment, mining equipment, and railcar production industries. Wisconsin could see a nine percent drop in economic activity and a loss of 301,000 jobs due to prolonged closure, as well as an increase in freight traffic through its ports and on its rail lines.[80]

Port and Harbor Preservation

Wisconsin is surrounded on three sides by commercially navigable waterways. The commercial ports and harbors that line its shores are the state's most direct link to world markets. Cargo that funnels through Wisconsin's ports includes high value metallic ores bound for the steel industry, coal for power plants, heavy machinery, salt and asphalt for roads, concrete for the construction industry, and agricultural products for the world.

Historically, Wisconsin projects have not competed well for federal funding, which tends to go to high-volume harbors in other regions of the United States. From 2012 through 2016, for example, Great Lakes harbors reported only one percent of port and private capital expenditures compared with high-volume harbors. While the state does not own any harbors, the department administers the Harbor Assistance Program (HAP) for commercial ports (see below for more information on HAP). Maintenance and rehabilitation projects such as repairing a dock wall collapse are generally prioritized.

[78] U.S. Department of Homeland Security, "The Perils of Efficiency: An Analysis of an Unexpected Closure of the Poe Lock and Its Impact." (October 2015).
[79] Cleveland.com, "New Great Lakes lock must be built to keeping manufacturing humming in Cleveland." (March 7, 2016).
[80] U.S. Department of Homeland Security, "The Perils of Efficiency: An Analysis of an Unexpected Closure of the Poe Lock and Its Impact." (October 2015).

Harbor investments support Wisconsin's commercial ports and maintains the state's ability to attract and retain industries that rely on efficient bulk freight movement. Continued and coordinated investment strategies will identify commercial ports serving as sources of economic development and evaluate financing capabilities that ensure infrastructure conditions remain acceptable.

Harbor Assistance Program (HAP)

Created in 1979, the HAP assists port communities along the Great Lakes and Mississippi River in maintaining and improving waterborne commerce. Port projects typically include dock reconstruction, mooring structure replacement, dredging, and the construction of facilities to hold dredged material.

From 1980 to 2015, WisDOT has contributed over $121.6 million in matching funds for 99 port projects. Since 2014, WisDOT has invested $39.77 million in HAP funds into the state's waterways and ports.[81]

While the HAP recognizes and serves economic diversity at Wisconsin ports, the focus of the program has been on projects that support freight at larger commercial ports that predominantly move freight. In looking at the entire program life, 67 percent of projects have supported freight at these ports. Projects supporting shipbuilding (12 percent of all projects), ferries (13 percent of all projects), and projects supporting commercial fishing (8 percent) round out the program. Further, 73.2 percent of the funds associated with these projects were invested in freight-supporting projects.[82]

Based on the 2013 corrected dollars of $140 million, approximately 60 percent of the HAP funding has been directed to gateway ports, 18 percent has been invested in diversified cargo ports, 15 percent to limited cargo ports, and approximately 6 percent of the funding has gone to other ports in Wisconsin. The HAP supports and enables their port as an economic development resource, as well as a local and state transportation resource.[83]

Port and Harbor Freight Forecasts

Water Origins and Destinations[84]

Total water tonnage is predicted to increase by 21 percent statewide between 2013 and 2040. The value of this tonnage is expected to increase by 55 percent. Ports are expected to ship or receive 34 million tons of water freight, valued at more than $3.4 billion, in 2040.

The counties expected to see the most growth in originating water freight by 2040 are Crawford, Door and Milwaukee. La Crosse County is predicted to ship less freight than it does now. This is because gravel and sand currently shipped from the port is instead forecasted to move by rail in 2040.

The counties forecasted to see the most growth in terminating water tonnage are Ashland, Bayfield, Manitowoc, and Marinette. This is mostly due to more salt and fertilizer being shipped to these locations. Brown, Grant, and Vernon counties are predicted to receive less freight by water in 2040 than they do now because of the forecasted lower demand for coal. Some ports in Wisconsin are eligible for the HAP and some are not. HAP eligible activities include waterborne freight movement of at least 1,000 tons, commercial fishing, shipbuilding, cruise vessel, and

[81] Wisconsin Department of Transportation, Bureau of Transit, Local Roads, Railroads and Harbors.
[82] Ibid.
[83] Ibid.
[84] 2013 IHS Transearch Database.

ferry operations. Some counties, like Vernon County, do not have a municipal harbor, but may have more or less tonnage or value because they have other types of private waterborne freight facilities, like coal docks.

Water Commodities[85]

Several commodity types move by water and will see growth in the future. The five commodity groups forecast to see the greatest water tonnage in 2040, are:

- Metallic Ores (15,274,564 tons, 161.6 percent growth)
- Coal (8,624,454 tons, -40.7 percent growth)
- Nonmetallic Minerals (5,767,407 tons, 17.5 percent growth)
- Clay, Concrete, Glass or Stone (2,180,374 tons, 49.2 percent growth)
- Farm Products (1,212,585 tons, 86 percent growth)

Metallic ores are forecast to see the most water tons in 2040 (15,274,564), representing a change of 161.6 percent over the forecast period of 2013-2040. Issues that could affect the forecasts developed for Wisconsin's waterborne mode include the continued decline of coal as an energy resource, increased truck size and weight limits, and the status of subsidies for wind turbines.

7.8 Wisconsin Pipelines Trends, Issues, and Forecasts

Wisconsin is not a producer of crude or natural gas and contains very little refining capacity to produce petroleum products, but Wisconsin relies on pipeline commodities as a key economic input to the economy. Commodities such as natural gas, propane, gasoline, diesel, fuel oil, and other petroleum products support transportation, commercial and residential heating, energy production, manufacturing, and agricultural sectors. Therefore, WisDOT should consider the trends and issues impacting pipelines.

WisDOT should focus on trends and issues based on the state's consumption of the commodity transported and the impact pipeline transportation has on other modes. The critical variables that influence the relevance of pipeline trends and issues for WisDOT are as follows:

- **In-State Consumption** – the commodity is used by individuals and businesses in Wisconsin. The importance of a commodity increases as state consumption increases.
- **Impact on Other Modes of Transportation** – crude oil, natural gas, and petroleum products may travel via non-pipeline modes, which has the potential to increase congestion. The greater the congestion imposed on another mode, the greater the importance of efficient pipeline transportation.

The remainder of this section provides an overview of the trends and issues impacting Wisconsin, organized by pipeline type.

Trends in Crude Oil Pipeline Capacity

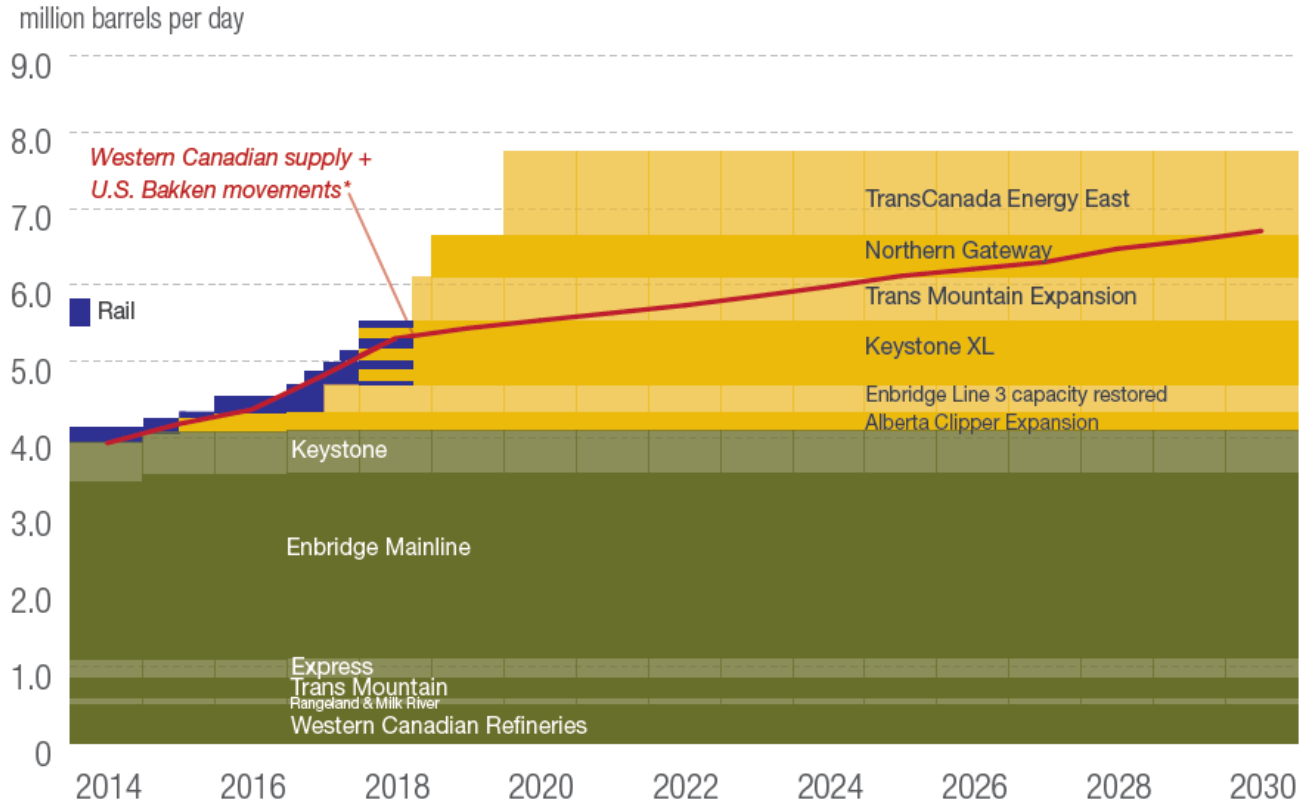
Pipelines are the preferred method to transport large volumes of liquids and gasses because they are less costly and more efficient relative to rail or truck for large volumes. Where volumes do not justify a pipeline, when a pipeline is not economically feasible, or when, "surge capacity" is needed to accommodate additional volumes, other modes of transport such as barge, rail, and truck may be used. In addition to increased domestic and Canadian production, a number of trends are impacting the capacity of crude oil pipelines in the United States.

[85] 2013 IHS Transearch Database.

Crude Oil Production and Pipeline Development

The development of crude oil pipelines within and outside of Wisconsin is critical to the understanding of future implications of growing domestic crude oil production on Wisconsin's transportation system. The amount of crude oil shipped via rail is a function of the availability and capacity of pipelines to serve these flows. Figure 7-21 displays estimates from the Canadian Association of Petroleum Producers (CAPP) for the capacity of crude oil pipeline projects, Canadian and United States Bakken production projections, and the likely timing for completing announced crude oil pipeline projects. A key takeaway for WisDOT from Figure 7-21 is the role of rail in making up the difference between pipeline capacity and crude oil production. The recent decline in crude oil prices calls into question the rate at which oil will be extracted from the more expensive shale and oil sands, which affects the near-term viability of proposed of crude oil pipelines. That said, complex market factors and operational differences in extraction methods may cause oil sands producers to continue production and development due to the sunk cost and a long-term view of rebounding prices.[86,87]

Figure 7-21: Projected Western Canadian and United States Bakken Oil Production and Transportation Capacity



**Refers to the portion of U.S. Bakken production that is also transported on the Canadian pipeline network. Capacity shown can be reduced by temporary operating and physical constraints.*

Source: Canadian Association of Petroleum Producers

Similarly, Figure 7-22 displays the pipelines that deliver crude oil from Western Canada to markets throughout North America as well as recently completed, underway and proposed pipeline projects. Taken together, Figure 7-21 and Figure 7-22 display how the timing and capacity of United States and Canadian crude oil pipeline projects

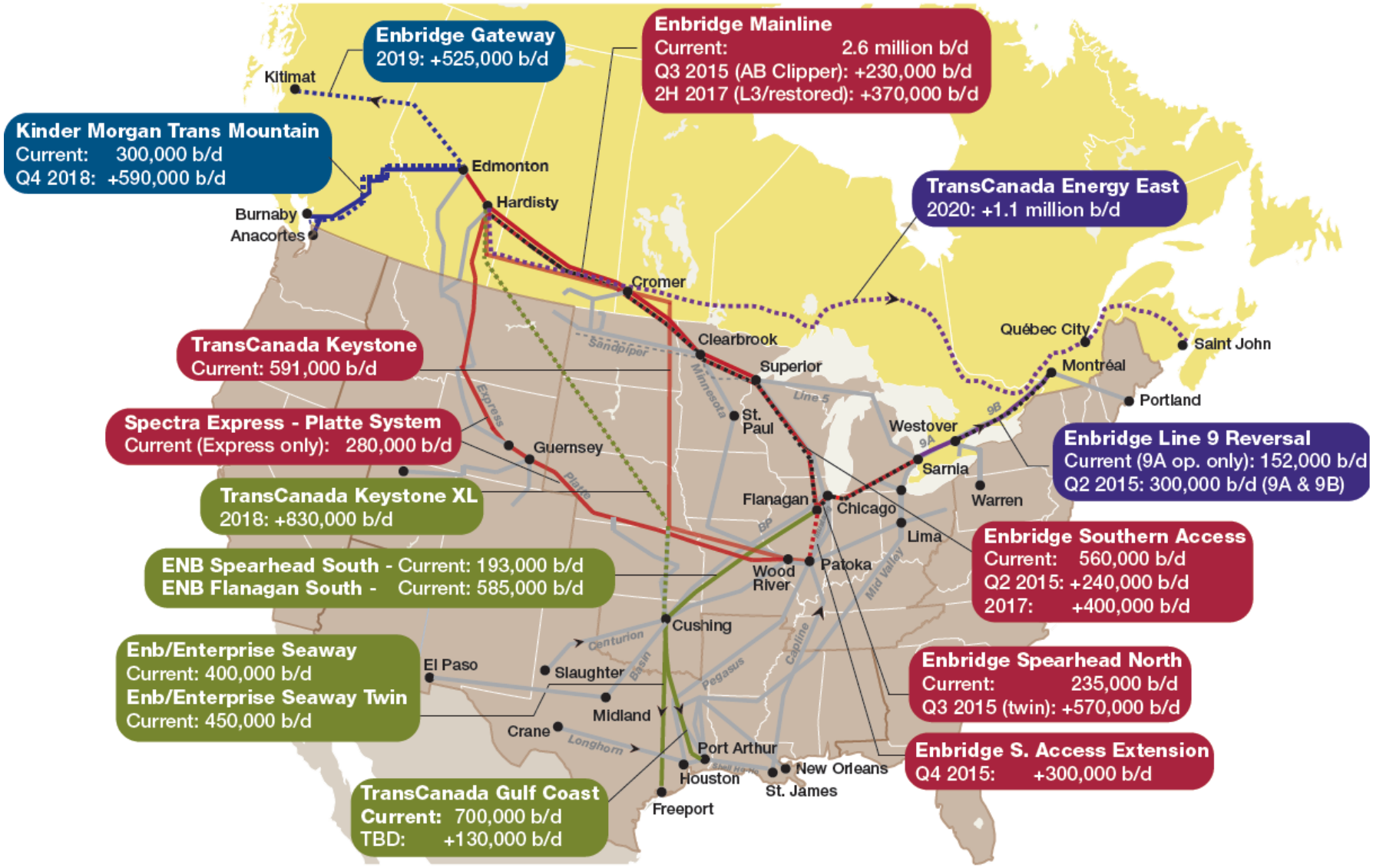
[86] Reuters, "Canadian energy companies sell 'jewels' to keep oil sands afloat." (February 9, 2016).
[87] Bloomberg, "Crude at $10 Already a Reality for Canadian Oil-Sands Miners." (January 13, 2016).

and production affects crude by rail flows in terms of quantity and destination. Additionally, some producers have found themselves bound by take-or-pay contracts or with significant capital costs in rail terminals and tank cars, resulting in a slower reduction in crude by rail than might otherwise be expected.[88]

Many variables will impact the flow and quantity of crude oil traveling through Wisconsin, including the final form of the projects shown in Table 7-11. As such, Table 7-11 focuses on projects likely to have a direct impact on Wisconsin. The impacts listed suggest increased pipeline throughput leading to a decrease in crude traveling through Wisconsin via rail.

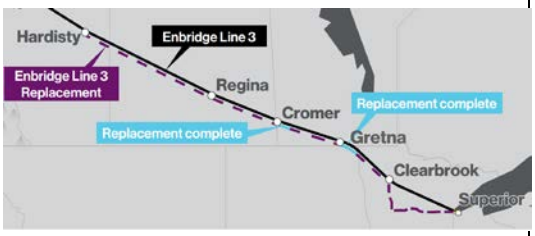
[88] RBN Energy, LLC, "Slow Train Coming - Crude By Rail Decline Picks Up Pace." (February 2, 2016).

Figure 7-22: Canadian and United States Crude Oil Pipelines under Construction and Proposed



Source: Canadian Association of Petroleum Producers

Table 7-11: Crude Oil Projects Impacting Wisconsin

Project	Origin / Destination	Capacity and (Estimated Completion)	Wisconsin's Interest
Enbridge Sandpiper (Yellow Line) 	Tioga, ND to Superior, WI	New: 375,000 barrels per day (2017) Awaiting Wisconsin and Minnesota Permit Decision	Delivers Bakken crude to Superior, WI, replacing rail shipments in the region.
Enbridge Line 3 (Purple Dotted Line) 	Hardisty, AB to Superior, WI	Total: 760,000 barrels per day New: 370,000 barrels per day (2017) Awaiting Wisconsin and Minnesota Permit Decision	Additional capacity to move crude via pipeline to Superior, WI.
Enbridge Line 61: Phase 2 	Superior, WI to Pontiac, IL	Total: 1.2 million barrels per day New: 640,0000 barrels per day (2016)	Additional capacity to move crude through the state.

Source: Enbridge Energy

Table 7-11: Crude Oil Projects Impacting Wisconsin (continued)

Project	Origin / Destination	Capacity and (Estimated Completion)	Wisconsin's Interest
Enbridge Line 9 (Yellow and Red Line) 	Sarnia, ON to Montreal, QC	Total: 300,000 barrels per day New: 60,000 barrels per day Reverse flow: Moves crude East (Complete)	Provides access to North American crude, which is connected to Enbridge pipelines traveling through Wisconsin.

Source: Enbridge Energy

Pipeline Freight Forecasts

Pipeline infrastructure and data are owned and maintained by private entities. Further, today's heightened security environment has resulted in pipeline-related data being highly inaccessible to the public. The Freight Analysis Framework does attempt to estimate flows by pipeline, using a synthetic process. These estimates are very crude, and while perhaps acceptable for estimating petroleum pipeline movements between large regions, they are not suitable for determining county-to-county flows of the type that are reported in Transearch.

7.9 Wisconsin Air Cargo/Freight Trends, Issues, and Forecasts

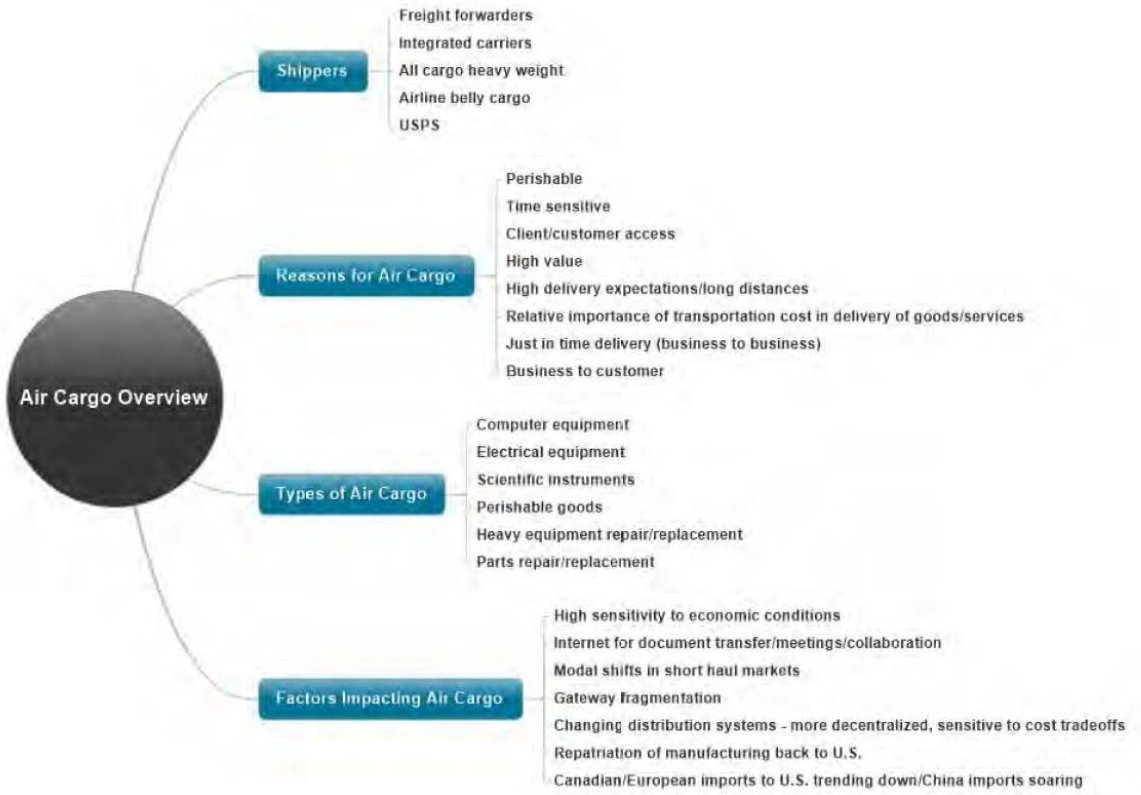
In the last decade, the aviation industry has experienced positive and negative changes related to security, the economy, the cost of aircraft operation, and changes in aircraft and navigational options. Declines in enplanements and cargo transport reflect these changes. In addition, the primary air cargo users in the state, FedEx and UPS Inc., have reduced their use of the mode and moved cargo to truck.

Air cargo is shipped into and out of commercial service airports and some general aviation airports in Wisconsin. Typical airport users engaged in air cargo lift include:

- The airlines that carry mail or freight in the cargo hold of commercial aircraft
- Integrated carriers such as FedEx and UPS
- Dedicated all-cargo heavyweight carriers that operate unscheduled charters
- Freight forwarders and logistics companies
- United States Postal Service (USPS)

Figure 7-23 provides an overview of types of shippers, reasons for use of air cargo lift, types of air cargo, and factors that influence air cargo lift demand and how it is provided.

Figure 7-23: Air Cargo Overview



Source: Kramer Aerotech Inc.

Trends Impacting Air Cargo Nationally

Shipment by air is typically the most expensive mode of freight transport. Usually, goods are sent by air if they are perishable, of high value, delivery is time sensitive, or the product is shipped from or going to another country. Air cargo is highly sensitive to economic conditions. During the recession of 2008-2009, air cargo shipments decreased as demand disappeared and/or other less expensive modes were substituted.

A number of trends have shifted demand in the United States away from air transport to either ground transport for packages or to electronic transfer of information and money. The technology that powered express air service has been replicated by ground transport services. Many packages that were once shipped by air are transported by truck and tracked at a much lower cost. Often, a shipper is concerned that a package arrives on schedule and is indifferent about how the package is transported.

Both the USPS and the integrated carriers have responded to shifts in demand and modes of transport. In 2011, UPS and FedEx increased their ground capacity. FedEx reported an 11 percent expansion of ground operations; while express services were flat. Short haul markets are frequently served by ground transportation. Some cargo in Wisconsin that was previously shipped by air is now trucked to Minneapolis-Saint Paul or Chicago for consolidation and further transport.

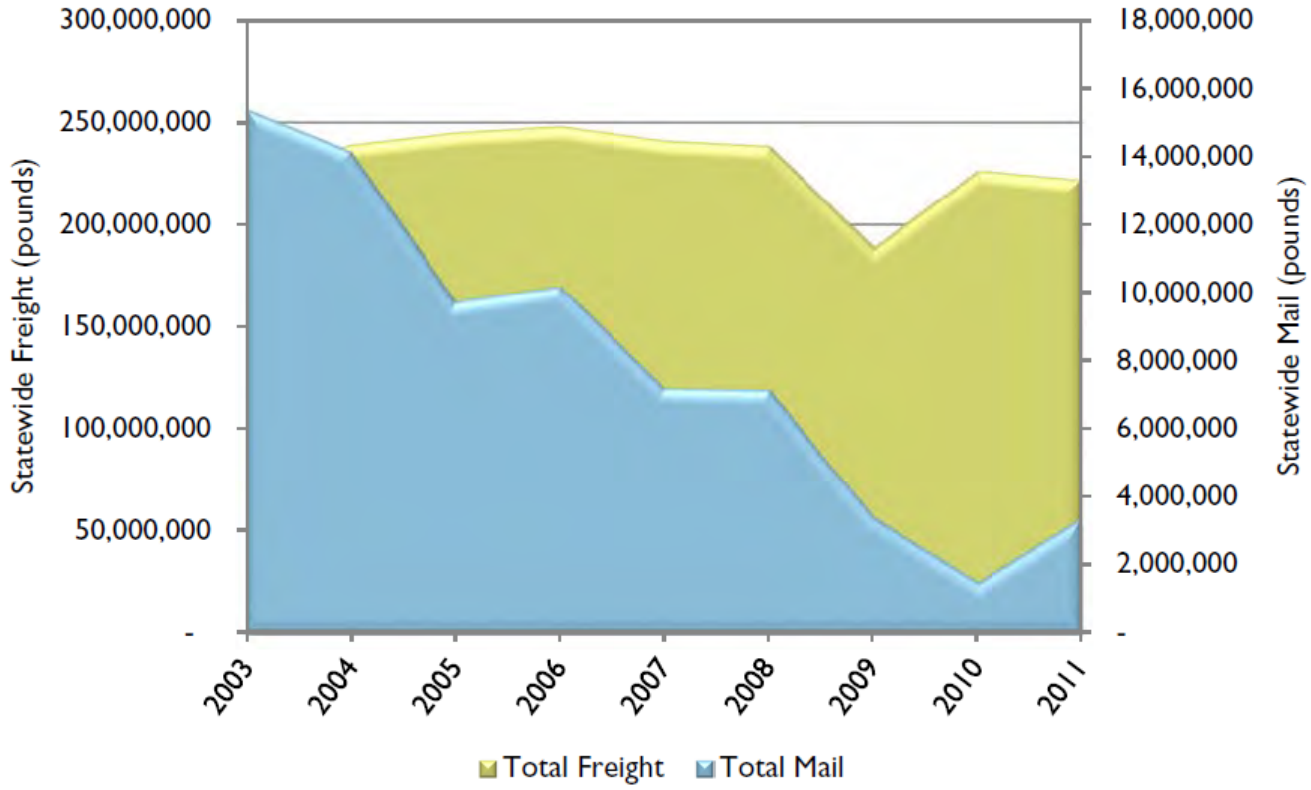
Trends in Air Cargo Use in Wisconsin

Since 2003, commercial air carriers and all cargo carriers report information such as pounds of air freight and mail, airport origin and destination, and the aircraft used for transport directly to the United States DOT. However, the data set is incomplete. Some smaller carriers that transport cargo for a larger carrier do not always report this information. Also, FedEx has held a USPS contract for more than a decade to carry USPS first class, priority, and express mail. FedEx does not report mail separately. To construct a reasonable estimate of air cargo shipped to and from Wisconsin, three data sources were used:

- United States DOT T-100 market and segment data (air carrier reports)
- Wisconsin airport reports on enplaned and deplaned pounds of cargo
- Interviews with air cargo airlines operating in Wisconsin.

Figure 7-24 and Table 7-12 present Wisconsin air freight and mail from 2003 to 2011. Air freight has remained above 225 million pounds per year statewide, except during the 2008-2009 recession and subsequent recovery years. What has changed dramatically is the percentage of air freight versus mail. In 2011, there were 227.2 million pounds of enplaned and deplaned freight and mail handled at Wisconsin airports. Ninety-eight percent was reported as freight, versus two percent as air mail. Looking back to 2003, air mail represented six percent of total air freight.

Figure 7-24: 2003-2011 Enplaned/Deplaned Air Freight and Air Mail at Commercial Service Airports



Source: Wisconsin Department of Transportation, "Wisconsin State Airport System Plan 2030"

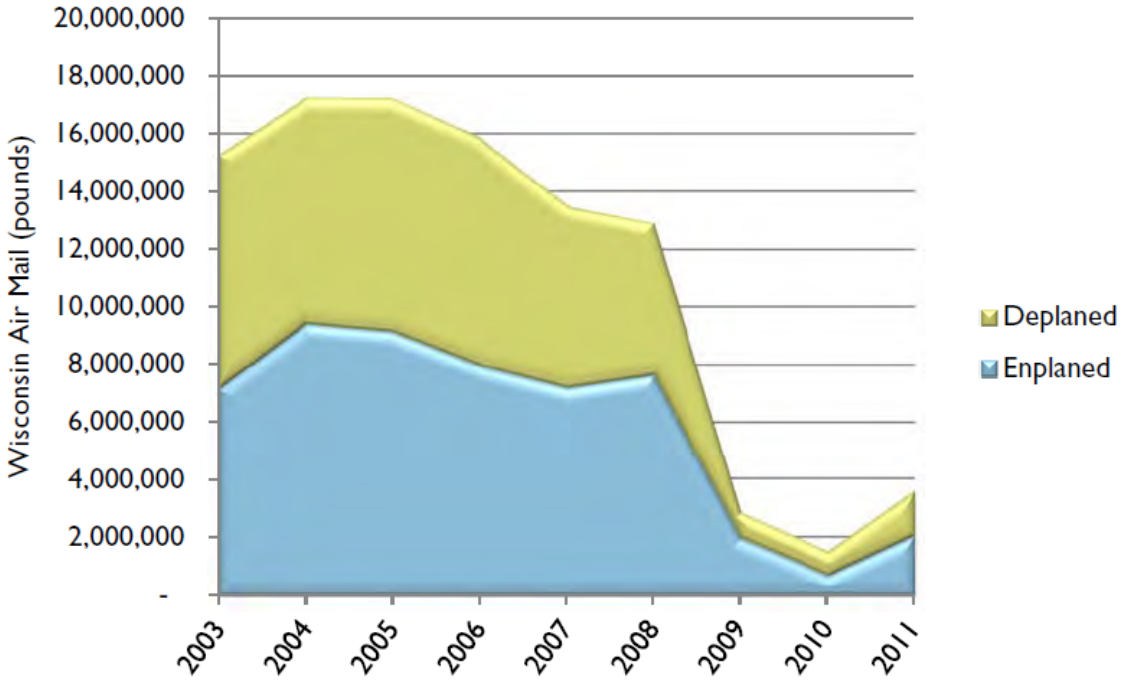
Table 7-12: 2003-2011 Enplaned/Deplaned Air Freight and Mail at Commercial Service Airports

Year	Pounds		
	Mail	Freight	Total
2003	15,389,220	225,343,590	240,732,810
2004	14,152,230	239,160,170	253,312,400
2005	9,746,280	245,097,810	254,844,090
2006	10,195,610	248,174,570	258,370,180
2007	7,216,320	241,092,700	248,309,020
2008	7,161,190	238,528,300	245,689,490
2009	3,382,860	189,015,160	192,398,020
2010	1,470,620	226,735,590	228,206,210
2011	3,361,210	221,945,990	225,307,200

Sources: U.S. DOT T-100 and Individual Airport Reports

The trend for mail in Wisconsin mirrors national trends. In October 2011, the United States Government Accountability Office (GAO) examined USPS data and reported a substantial decline in mail volumes due to the rise in e-commerce, electronic billing and payment transactions, and online communications.[89] First class mail, a major component of air mail, is projected to decrease by 50 percent. In 2010, fewer than 50 percent of all bills were paid by mail. These trends also appear in Wisconsin and there is reason to anticipate a more diminished role for mail as a component of air cargo in the future. The surviving components of air mail include express, priority and international mail. Figure 7-25 shows historical trends for enplaned and deplaned mail at Wisconsin airports.

Figure 7-25: 2003-2011 Enplaned/Deplaned Mail at Wisconsin Commercial Service Airports



Source: Wisconsin Department of Transportation, "Wisconsin State Airport System Plan 2030"

[89] U.S. Government Accountability Office, "U.S. Postal Service: Mail Trends Highlight Need to Fundamentally Change Business Model." (October 20, 2011).

Despite steady volumes of air freight since 2003, the airlift of cargo has shifted from a competitive multi-provider environment to a highly concentrated provider market. Integrated carriers have dominated, but in 2003 nearly one-quarter of air cargo was carried in the cargo hold of passenger aircraft. Air freight and mail was a stable product of every airline, including the regional carriers. By 2011, cargo lift by airlines represented three percent of all cargo lift, with the integrated carriers hauling 97 percent. The integrated carriers serve all of the commercial service airports except Eau Claire and La Crosse. Air cargo out of La Crosse and Eau Claire is carried by the airlines or otherwise trucked to Rochester, Minneapolis-Saint Paul or Chicago.

The lack of growth in air cargo can be attributed to a number of factors. Some existing barriers to growth include:

- Wisconsin's excellent surface transportation infrastructure (i.e., highways, railroads, and waterways), as well as a terrain that makes it the overwhelming choice for cargo movement.
- The state is bordered by large cargo airports in Minneapolis, Minnesota; Rockford, Illinois; and Chicago, Illinois. The current business model involves trucking cargo to these larger air cargo hubs.
- The price of aircraft fuel, in recent years, has made surface transportation a more affordable choice.
- A looming pilot shortage makes it challenging for airlines to stay fully staffed.
- Current airline business models include using regional jets with less room for cargo.

Unmanned Aircraft Systems (UAS)

A new industry is emerging in unmanned aircraft systems (UAS) and a continued increase in commercial UAS applications is expected to be significant in the coming years. At the same time, pilot flight training and recreational flying have decreased. Increases in business aviation and growth in the UAS sector could influence the facilities and services needed at airports in the future.

The number of people and where they live is related to economic activity. People, or a population, and the location of the population are demographic factors that influence economic activity, such as the demand for food, fuel, consumer goods, and other needs. A sound transportation system connects this economic activity to populated areas throughout the state. Demographic factors often overlap with economic factors when a percentage of people within populated areas become members of the labor force, which provides the means of production, cultivation, and extraction of other freight that must be transported.

FAA Modernization and Reform Act of 2012

The FAA Modernization and Reform Act of 2012, a four-year federal authorization act, capped the federal match for the AIP at 90 percent, down from 95 percent of the previous ten years. Many airport owners are challenged to meet the larger cost-share requirement.

FAA is implementing the Next Generation Air Transportation System (NextGen), a ten-year federal initiative to move the nation's air traffic control system from ground-based radar to a modern satellite-based system.

NextGen's long-term objective is to achieve a more efficient and precise air traffic control system yielding increases in fuel economy, utility and safety. The FAA is systematically establishing global positioning system-based runway approaches around the country. Funding to clear runway approaches of obstructions, such as trees, will need to come from federal, state, or local aid.

Airport owners are responsible for making their airports compatible with NextGen. Wisconsin's Air Carrier airports have most of the needed infrastructure in place, but many General Aviation airports do not. Some airports need to acquire land in their runway approaches. Other requirements will surface as the system is further developed. All aircraft participating in the National Airspace System (NAS) under NextGen will need updated electronics on board by January 1, 2020.

Air Freight Forecasts

While air cargo movement represents a relatively small percentage by volume of overall trade, relatively low-weight, time-sensitive, and high-value freight is important to Wisconsin's economy. The forecasted increase in air freight movement reflects a continuing business trend toward adopting just-in-time logistics practices where time-definite transactions, as well as production flexibility and speed of relatively low-weight and high-value items, are paramount in meeting the requirements of modern manufacturing supply chains. Smaller quantities, for example, are being shipped more frequently. Shipping via air can mean more quick and reliable business over long distances.

Air Origins/Destinations[90]

Total air tonnage is forecast to increase by 253 percent statewide between 2013 and 2040. The value of this tonnage is expected to increase by 155 percent. Airports are forecast to ship or receive 370,000 tons of air freight, valued at more than $26.6 billion, in 2040. Despite the largest forecasted increase in tonnage of all the modes, freight moving by air will still be less than 1 percent of all Wisconsin freight shipments in 2040.[91]

The counties that are expected to see the most growth in originating airport freight shipments are Milwaukee, Marinette, Manitowoc, and Racine. The counties that are forecasted to see the most growth in terminating airport freight shipments are Brown, Dane, Milwaukee, and Marathon. Small amounts of freight move to and from general aviation airports to the areas in the state that do not have general aviation.

Air Commodities[92]

The five commodity groups forecast to see the greatest air tonnage in 2040 are as follows:

- Small Freight Shipments (233,757 tons, 364.7 percent growth)
- Miscellaneous Mixed Shipments (33,877 tons, 203.5 percent growth)
- Transportation Equipment (23,623 tons, 156.9 percent growth)
- Electrical Equipment (19,886 tons, 230 percent growth)
- Instruments and Optical Equipment (13,153 tons, 179.1 percent growth)

Small freight shipments are forecast to see the most air tons in 2040 (233,757), representing a change of 364.7 percent over the forecast period of 2013-2040. Issues that could affect the forecasts developed for Wisconsin's airborne mode include the continued growth in just-in-time logistics and e-commerce, as well as the continued dominance of Chicago's O'Hare International Airport for air cargo shipments within the region.

[90] 2013 IHS Transearch Database.
[91] Air forecasts do not include possible new types of delivery, including the use of drones or automated delivery.
[92] 2013 IHS Transearch Database.

7.10 Wisconsin Populations Trends

Population growth has a direct impact on freight demand and freight movement. As populations grow, more trips and services are required. Wisconsin's population in 2040 is projected to be nearly 6.5 million, an increase of more than 800,000 people, or 14 percent, from 2010.[93]

Age Distribution of Wisconsin's Population

Although the state's total population is expected to grow by 14 percent - more than 800,000 residents - over the 30-year projection period, the change will be much greater in certain age groups. Shifts in the age distribution will be heavily concentrated in the 65-84 and 84-and-over age groups (Table 7-13).

Table 7-13: Wisconsin Population, 2010 Census and 2040 Projection, by Age Groups

Age Group	Census 2010	Projected 2040	Numeric Change	Percentage Change
0-4	358,443	373,940	15,497	4.3%
5-17	981,049	1,007,370	26,321	2.7%
18-24	549,256	563,995	14,739	2.7%
25-44	1,447,360	1,493,595	46,235	3.2%
45-64	1,573,564	1,517,370	-56,194	-3.6%
65-84	658,809	1,251,765	592,956	90.0%
84 and Over	118,505	283,600	165,095	139.3%
Total	**5,686,986**	**6,491,635**	**804,649**	**14.1%**

Source: UW-Madison Applied Population Laboratory, "Wisconsin's Future Population."

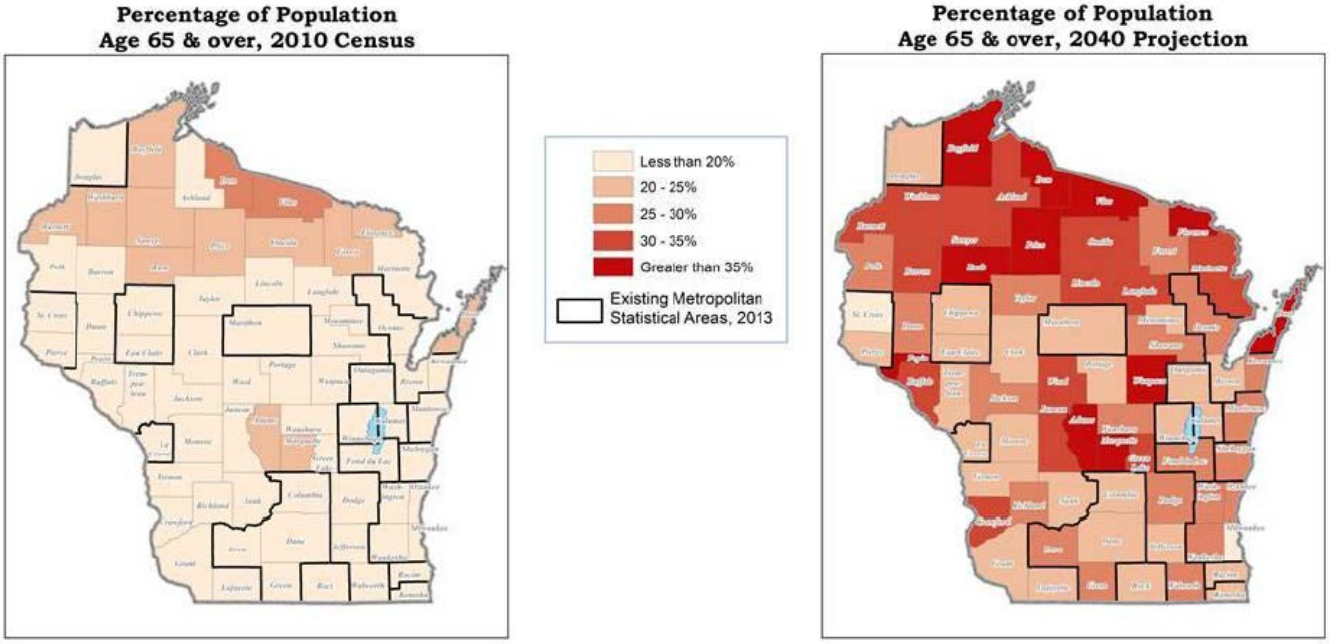
Table 7-13 depicts the Census 2010 and projected 2040 residents by discreet age categories, and the projected numeric and percentage change of each group. The 0-4, 5-17, 18-24, 25-44, and 45-64 age groups will be relatively flat between 2010 and 2040, whereas the 65-84 age group will almost double and the 84-and-over age group will more than double in size. All counties in the state of Wisconsin will experience growth in the 64-84 and 84-and-over age groups. The decline in the 45-65 age group from 2010 to 2040 may be attributed to people relocating and seeking jobs out-of-state.

Nearly half of Wisconsin's counties had fewer than 15 percent of their populations age 65-and-over in 2010, and none had greater than 30 percent (the highest being 26 percent); by 2040 no county will have fewer than 15 percent of its population being age 65-and-over, and one-third will have age 65-and-over populations greater than 30 percent.

Figure 7-26 compares the change in the 65-and-over population of each county between 2010 and 2040. Counties in the far northern part of the state, in general, are projected to have more than three out of every 10 residents being age 65-and-over.

[93] Wisconsin Department of Administration, Demographic Services Center, "Wisconsin's Future Population: Projections for the State, Its Counties and Municipalities, 2010-2040." (December 2013).

Figure 7-26: Comparison of Percentage of Population Age 65 and Over, 2010 Census and 2040 Projection



Source: UW-Madison Applied Population Laboratory, "Wisconsin's Future Population."

The traditional full-time (40-hour work week) working-age population - ages 18 through 64 - will rise modestly from 3,570,000 in 2010 to 3,603,000 in 2020, then begin a slow decline during the 2020s and 2030s to 3,575,000 in 2040, resulting in a 0.1 percent increase across time. Employers in northern Wisconsin and those in counties with higher 65-and-over populations may face a worker shortage due to the slow decline in the traditional full-time working-age population from 2020 to 2040.

However, Wisconsinites are living longer and healthier lives and they are retiring later in life. Over the next 30 years, older Wisconsinites may work later in their lives and travel for work and leisure more often. The 65-and-over age population may also choose to remain in the workforce but in part-time (less than 40-hour work week) capacities.

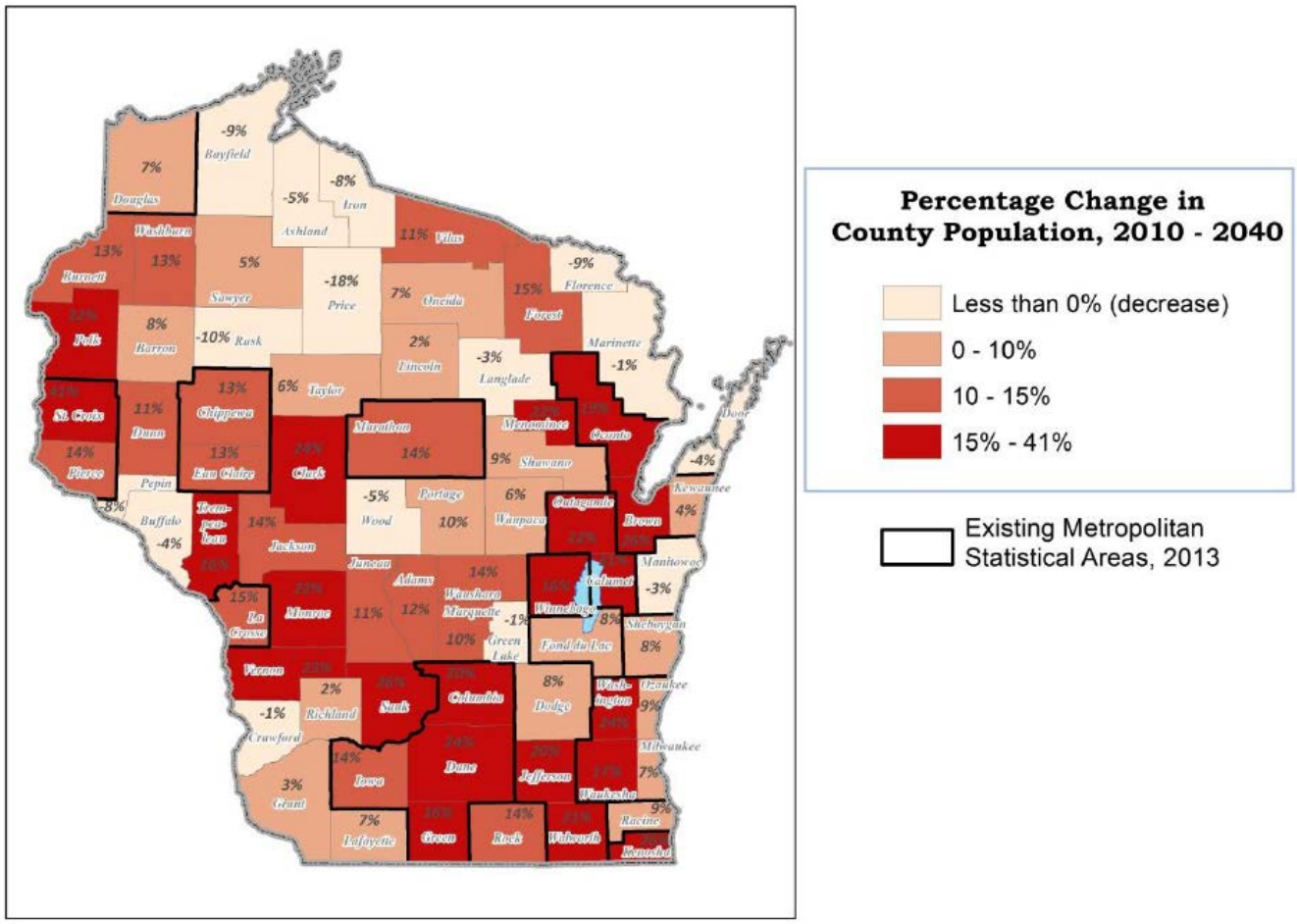
Despite gradual increases in retirement age, as the population ages, the proportion of Wisconsinites in the workforce is expected to shrink, which may have an impact on freight movement. In the future, an aging population, continued decline in the proportion of families with children, and changing settlement preferences could increase the demand for more walkable, transit-friendly development in urbanized areas. Also, a declining workforce participation may slow growth in rush-hour traffic, which may lessen some freight bottlenecks.

Trends in the Geographic Distribution of Wisconsin's Population

Freight demand is expected to increase in rural areas of the state, particularly in northern Wisconsin. Freight demand will still be concentrated in the large urban and metropolitan areas where Wisconsin's population is changing the most. With an aging population, online shopping will drive up demand for small-package home delivery, which could soon substitute for many household shopping trips. Autonomous vehicles may also contribute to the safe and efficient movement of people and freight.

Across the full 30-year period of these projections, it is predicted that 57 of Wisconsin's 72 counties will have a population at 2040 that is higher than it was at 2010 (Figure 7-27).

Figure 7-27: 2010-2040 Percentage Change in County Population



Source: UW-Madison Applied Population Laboratory, "Wisconsin's Future Population."

Counties with Population Growth

Most of the fastest growing counties are ones that adjoin in-state metropolitan areas (e.g., Jefferson, Walworth), out-of-state metropolitan areas (e.g., Kenosha, Polk, Rock, St. Croix) or are projected to have a strong natural increase (e.g., Clark, Menominee, Trempealeau, Vernon).

Metropolitan Statistical Area

A metropolitan statistical area (MSA) is a geographical region with a relatively high population density at its core and close economic ties throughout the area. Such regions are neither legally incorporated as a city or town would be, nor are they legal administrative divisions like counties or separate entities such as states. As such, the precise definition of any given metropolitan area can vary with the source.

In general, Wisconsin cities and suburban areas are growing and the population in rural areas, particularly in northern Wisconsin, is declining. Wisconsin's population has grown increasingly suburban over the past couple of decades. Most of Wisconsin's population and job growth have been and are occurring in cities and more suburban areas of the state.

Despite signs of change in settlement patterns, Wisconsin's population is likely to continue growing in suburban areas. While cities have become more desirable to many Wisconsinites, and the rate of population growth in cities

has increased, the majority of Wisconsinites continue to move to areas with lower density, cheaper housing and more jobs.

Saint Croix County is projected to be the fastest-growing county (Table 7-14), in terms of percentage change, through 2040, increasing by 41 percent. As part of the Minneapolis-Saint Paul metropolitan area, it also ranked as Wisconsin's top-growing county from 1980 to 2010. Many of Saint Croix County's residents commute to jobs in the Minneapolis-Saint Paul metropolitan area.

Calumet County – containing much of the suburban growth southeast of Appleton – is predicted to be the second-fastest growing county, increasing by 31 percent by 2040. Job growth in the city of Appleton is projected to grow by 35 percent over the next ten years.[94]

Dane County, projected to be the sixth-largest gainer in percentage terms, is expected to experience the highest numeric growth in the state through 2040. Madison's unemployment rate has been the lowest in the state since the great recession of 2008-2009 and future job growth over the next ten years is predicted to be close to 40 percent.[95]

Among the state's largest counties, Milwaukee will continue its position as the most populous in the state and is projected to gain about 70,000 additional residents, increasing to more than one million residents. The four largest counties - Milwaukee, Dane, Waukesha, and Brown - are predicted to maintain their ranked position, but Outagamie County is expected to pass Racine to become the fifth largest. In addition, Kenosha County is likely to exchange places with Winnebago, and Washington County will increase over time to surpass Marathon and become the 10th largest county.

Table 7-14: 2010-2040 Fastest Growing Counties (%)

County Name	Census 2010	Projected 2040	Numeric Change	Percent Change
Saint Croix	84,345	119,010	34,665	41.1%
Calumet	48,971	64,210	15,239	31.1%
Kenosha	166,426	209,670	43,244	26.0%
Brown	248,007	312,320	64,313	25.9%
Sauk	61,976	77,815	15,839	25.6%
Dane	488,073	606,620	118,547	24.3%
Washington	131,887	163,890	32,003	24.3%
Clark	34,690	42,980	8,290	23.9%
Vernon	29,773	36,520	6,747	22.7%
Menominee	4,232	5,170	938	22.2%

Source: UW-Madison Applied Population Laboratory, "Wisconsin's Future Population."

With both population and employment moving to suburban areas of the state, commuting is not simply about moving people from suburban homes to jobs in urbanized areas. Population and job growth in Wisconsin's suburban areas has serious implications for the state's transportation policy. Congestion may worsen as more Wisconsinites might have to drive further to get to jobs. Also, as noted earlier, this commuting pattern also presents challenges for age 65-and-over populations and lower-income Wisconsinites to jobs and social services, such as healthcare facilities.

[94] Sperling's Best Places, "Appleton, Wisconsin."
[95] Sperling's Best Places, "Madison, Wisconsin."

Counties with Declining Population

At least 10 counties are projected to lose population between 2010 and 2040 in Wisconsin. The 10 with the predicted greatest percentage decline are shown below in Table 7-15. Population losses, which are predominately located in northern Wisconsin, will be due to both rising natural decrease (i.e., the number of deaths exceeding births) and reduced net in-migration, or actual out-migration. The decline in population in these areas may reduce economic productivity within these areas (see Chapter 4, *Economic Context of Freight on Wisconsin's Transportation System*).

Table 7-15: 2010-2040 Counties with Greatest Percent Decline

County Name	Census 2010	Projected 2040	Numeric Change	Percent Change
Door	27,785	26,620	-1,165	-4.2%
Buffalo	13,587	13,000	-587	-4.3%
Wood	74,749	71,150	-3,599	-4.8%
Ashland	16,157	15,315	-842	-5.2%
Pepin	7,469	6,885	-584	-7.8%
Iron	5,916	5,420	-496	-8.4%
Bayfield	15,014	13,725	-1,289	-8.6%
Florence	4,423	4,030	-393	-8.9%
Rusk	14,755	13,310	-1,445	-9.8%
Price	14,159	11,645	-2,514	-17.8%

Source: UW-Madison Applied Population Laboratory, "Wisconsin's Future Population."

As suburbs have expanded, rural populations have declined, birth rates in rural areas have declined, and retirees and job-seekers have moved to suburban areas in Wisconsin. Areas with shrinking populations face challenges maintaining existing infrastructure and preserving access to economic opportunities and social services.