

Minnesota Statewide Freight System Plan

Task 2.2 - Economic Context of Freight System Planning

draft

report

prepared for

Minnesota Department of Transportation

prepared by

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with

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date

September 2014

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1.0 Introduction

This technical memo serves as the deliverable for Task 2.2, *Economic Context of Freight System Planning* of the *Minnesota Statewide Freight System Plan*. The objective of this task is to give MnDOT an opportunity to better understand how mode-specific issues and challenges combine to affect the entire freight system's performance. It will enable MnDOT to recognize which economic sectors are most impacted by freight mobility issues, what benefits these sectors bring to the economy (in terms of jobs and income), how different aspects of freight mobility influence costs for these businesses, and how these costs affect the ability of the State to attract and retain key industries. The focus of this memo is to tell the "freight story" through the following sections:

- **Existing Economic and Demographic Characteristics.** At its very base, the people of Minnesota are the "drivers" of the State economy. This section discusses economic and demographic characteristics of Minnesota, including employment, output, population and household data, and the cost of living and doing business in the State.
- **Minnesota's Freight-Related Industries.** Freight-related industries are key to driving Minnesota's economy and its future growth. This section describes geographic and employment trends related to these industries.
- **Industry Utilization of the Transportation System.** This section presents a picture of how major and emerging industries use Minnesota's transportation system. The future competitiveness of many of the State's major and emerging industries in the global marketplace will require an integrated freight transportation system with strengths in all modes—airports for moving high-tech goods, waterways and railroads for handling bulk shipments or intermodal containers, and highways for serving distribution centers and warehouses.
- **Freight Trends: Minnesota and Beyond.** This section presents major national and global supply chain and logistics trends that may impact goods movement in Minnesota. Although freight movements affecting Minnesota are increasingly national and global in scope, the effects of these movements are simultaneously often felt locally in the form of increased congestion at intermodal access points and gateways and increased volumes on highway and rail corridors. This section discusses key trends that affect Minnesota's freight-related industries now and in the future.

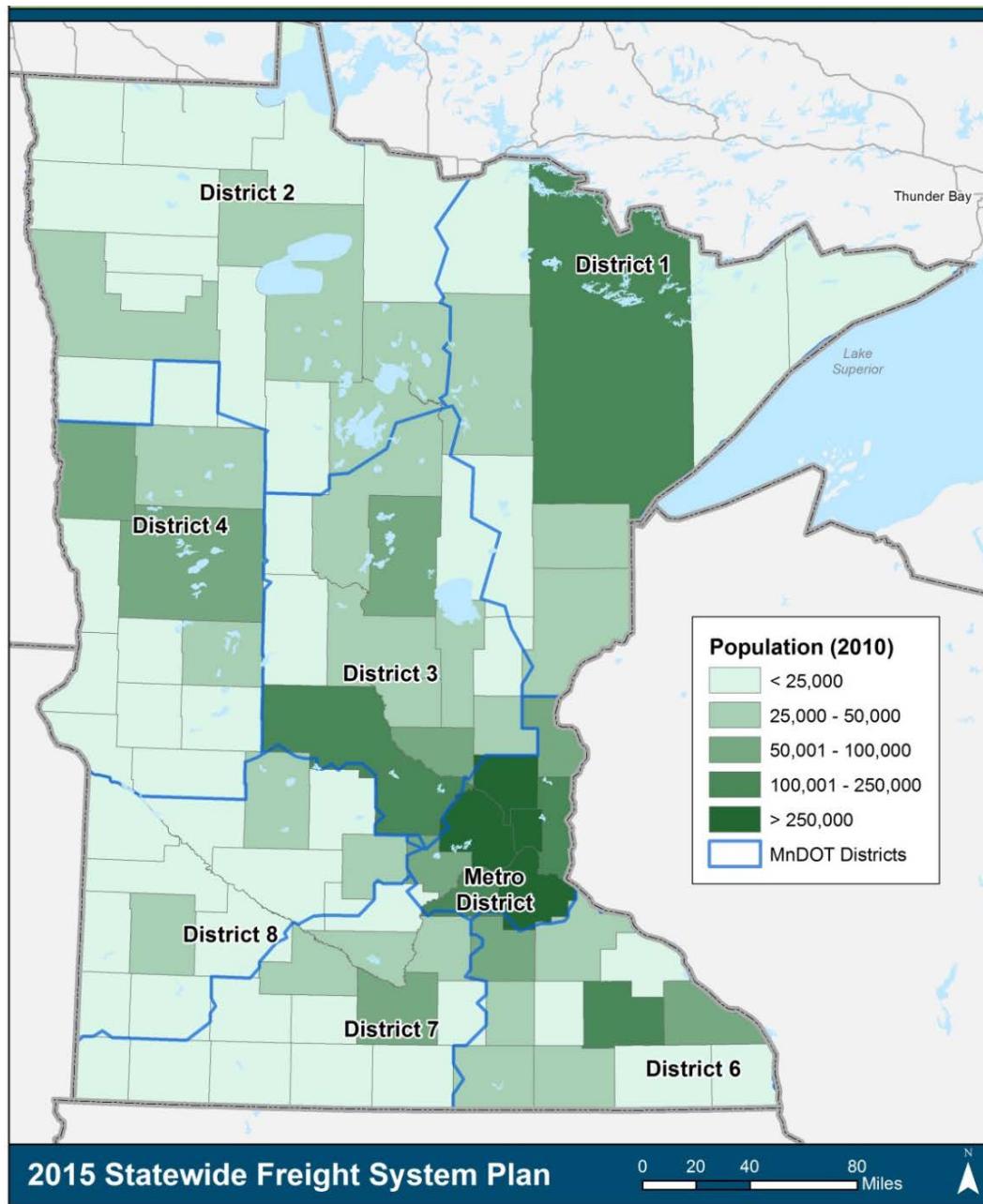
2.0 Existing Economic and Demographic Characteristics

This section presents a recent snapshot and ten-year trends of Minnesota's population and per capita income. Additionally the section includes information on cost of living and cost of doing business in Minnesota as compared to its neighbors and the nation as a whole.

2.1 POPULATION

Approximately 60 percent of Minnesota's population is centered in the Metro District area near Minneapolis-St. Paul. Hennepin, Ramsey, Dakota, and Anoka counties in the Metro district area are the most populous counties in the state. No other county in Minnesota has a population that exceeds 250,000. This concentrated nature of Minnesota's population, coupled with the large geographic size of the state, means that although both rail and highway networks serve wide rural areas, much of the freight and passenger activity is concentrated in key pockets within the state. The least populated county in Minnesota is Traverse County in the western part of the State on the South Dakota border, as shown in Figure 2.1.

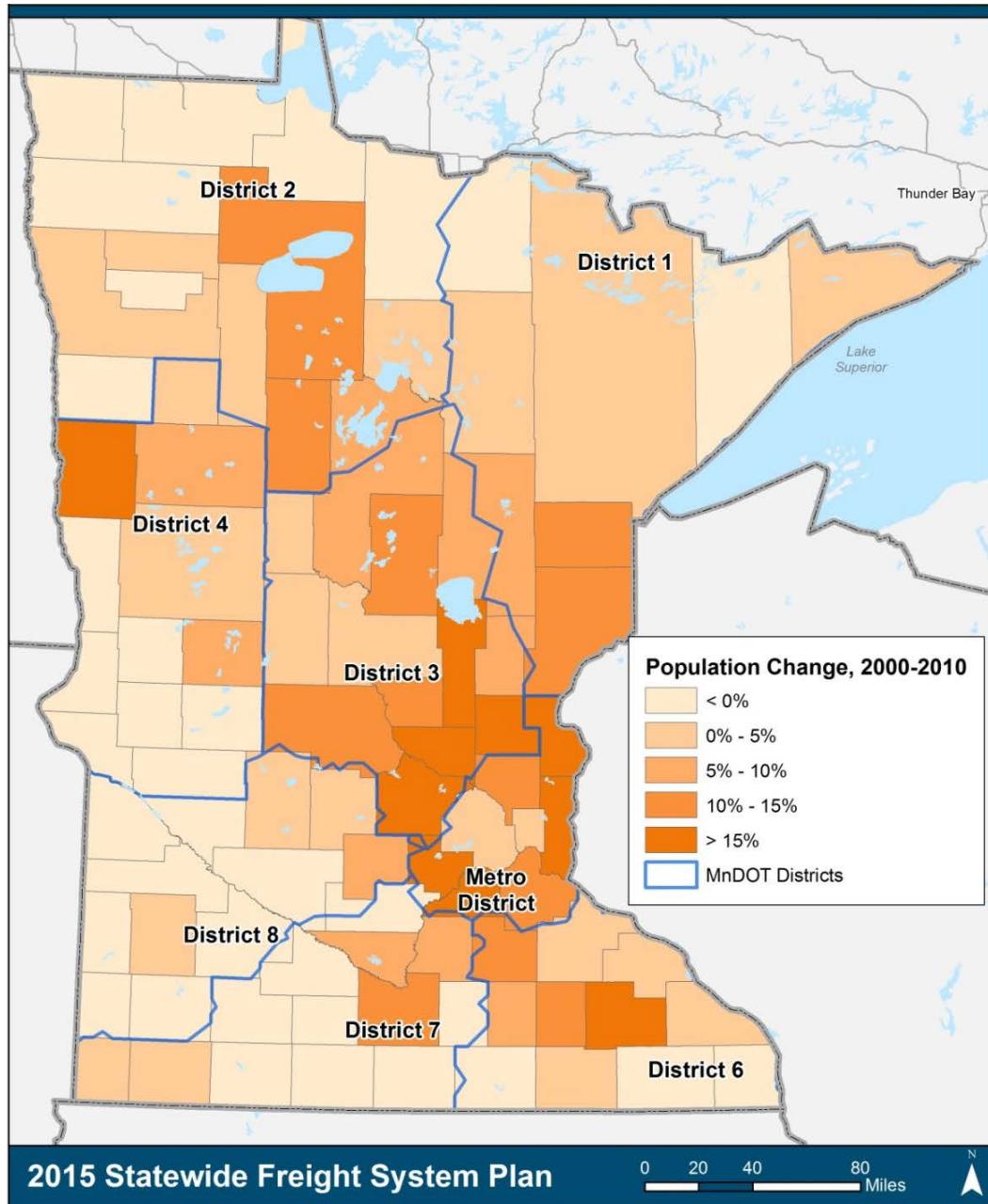
Figure 2.1 Minnesota Population by County, 2010



Source: U.S. Census Bureau

Population growth has been greatest in the central portions of the state, including around the greater Twin Cities area. Some lower population density counties have also experienced rapid population growth reflecting retirement relocations near lake areas. District 3 has experienced the most consistent population growth, likely requiring some renewed attention to freight and other highway projects in the area (Figure 2.2).

Figure 2.2 Minnesota Population Change by County, 2000-2010



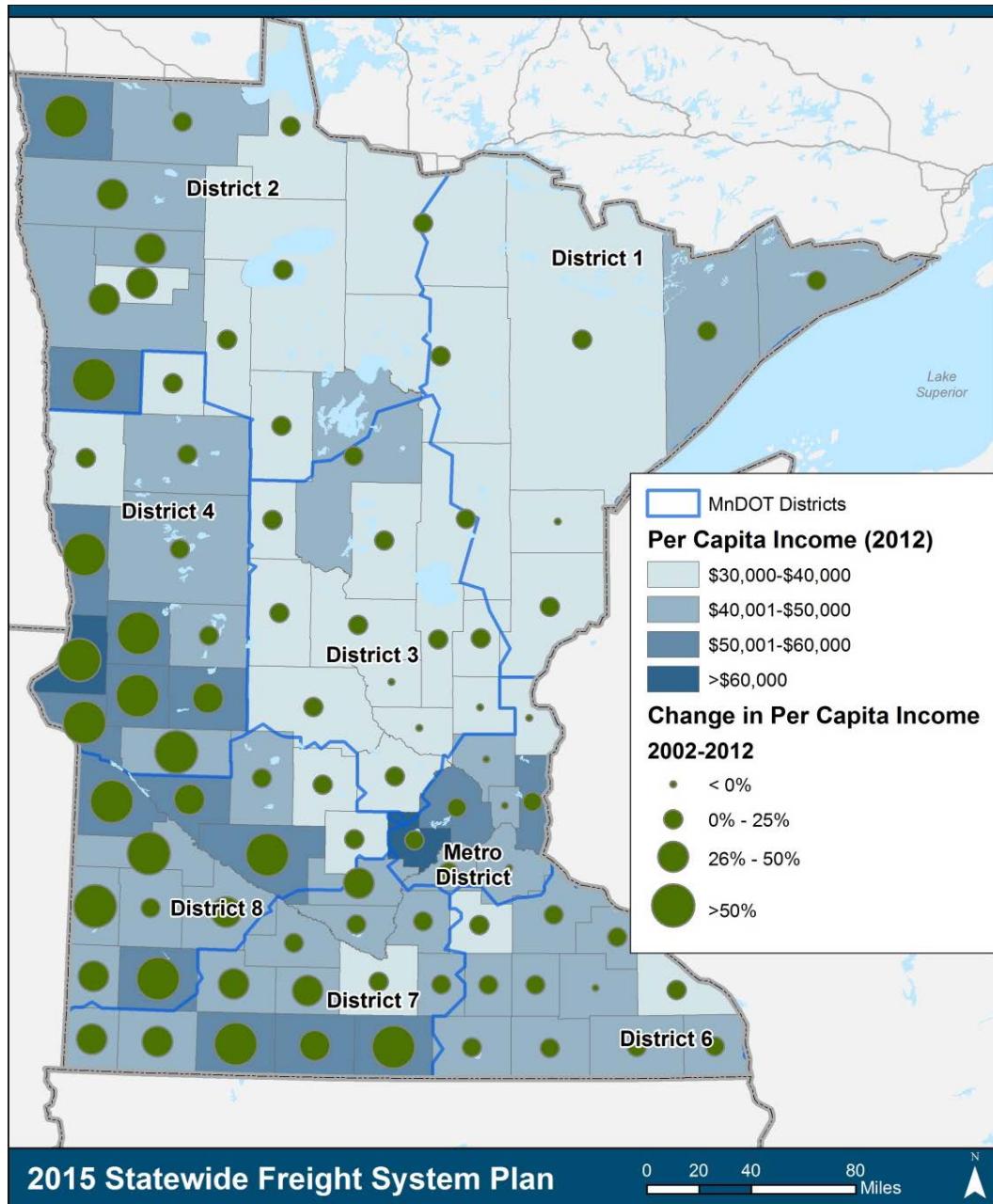
Source: U.S. Census Bureau

2.2 MEAN PER CAPITA INCOME

Minnesota's per mean capita income statewide stands at \$46,925 as of 2012, a total which grew by 4.6 percent between 2002 and 2012 (after adjustment for inflation). At the county level, mean per capita income ranges from \$30,568 in Pine County to \$65,115 in Traverse County. In general, mean per capita incomes are highest in the southern and western portions of the state, including District 6, 7, 8, 4, and Metro, as well as the western half of District 2.

While some counties saw their mean per capita incomes decline during the 2002-2012 period, most experienced a modest increase. Percent changes in income range from a decrease of 4 percent in Anoka County to an increase of 92 percent in Traverse County (adjusted for inflation). Like per capita income, the areas with the greatest percent change are generally the southern and western portions of the state.

Figure 2.3 Current Per Capita Income and Percent Change 2002-2012
2014 \$USD

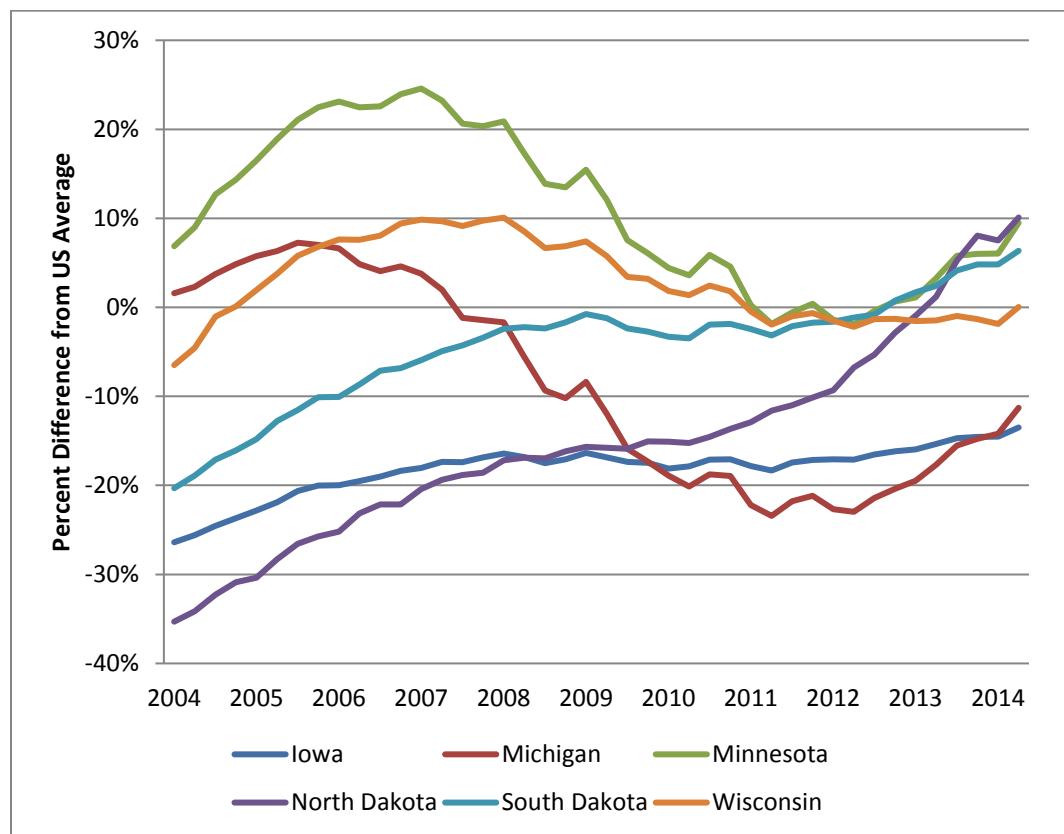


Source: U.S. Bureau of Economic Analysis. Note: Percent change in per capita income adjusted for inflation.

2.3 COST OF LIVING AND DOING BUSINESS

Minnesota's housing market continues to be in alignment with peer states in the Midwest region. After being significantly above the national average from the 2004-2010 time period, Minnesota housing prices returned to near average in 2011-2012. A recent uptick in the economy has shown a return to higher than average home prices, as shown in Figure 2.4.

**Figure 2.4 Percent Difference in Housing Prices Compared to US Average
By State, 2004-2014**



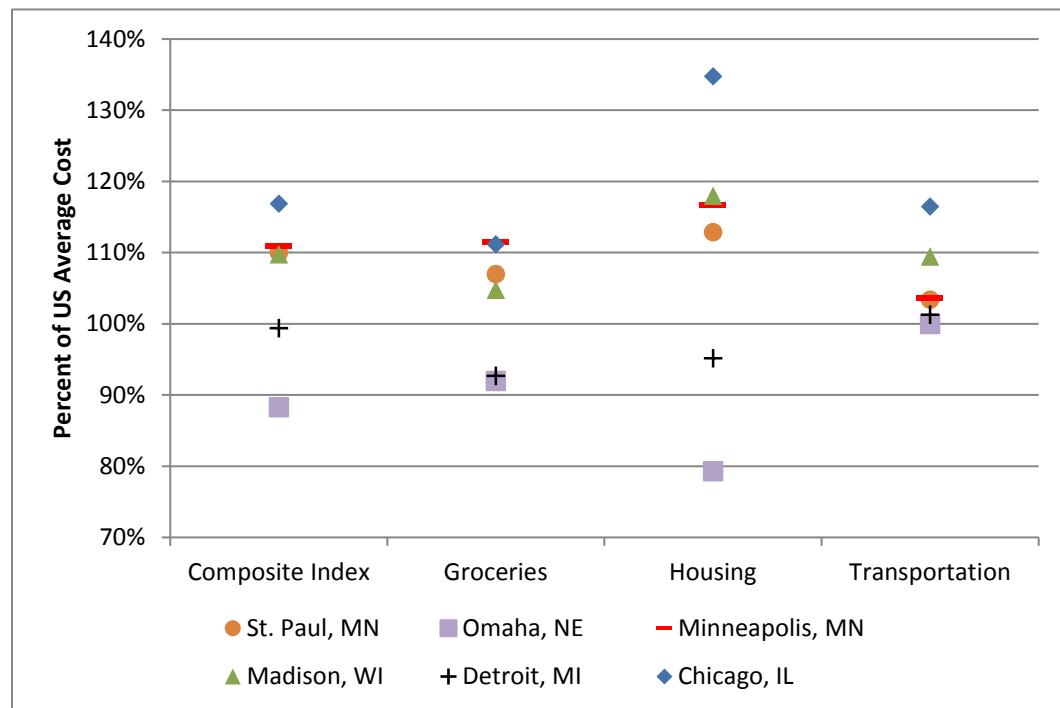
Source: Federal Housing Finance Agency, Housing Price Index, 2nd Quarter 2014.

Housing values in South and North Dakota are also above national averages according to the Housing Price Index. Recent growth of North Dakota's oil and gas extraction markets have substantially increased the price of housing in North Dakota since 2010. Michigan and Iowa continue to have prices below national averages.

Metropolitan cost of living comparisons place Minneapolis and St. Paul both above national averages with respect to the cost of groceries, housing, and transportation (Figure 2.5). Compared to peer cities, Minneapolis has lower costs than Chicago, but remains above the national average for groceries, housing, and transportation. Omaha, Nebraska has the lowest average costs for this peer

group. Utility costs and health care are also slightly above national averages in Minnesota.

Figure 2.5 Cost of Living Index for Urban Areas – Percent Difference from U.S. Average Cost, 2010



Source: ACCRA Cost of Living Index Annual Average 2010.

3.0 Minnesota's Freight-Related Industries

To fully understand the freight transportation system in Minnesota, it is crucial to understand the ongoing trends in Minnesota's major and emerging industries, as well as industry relationships with the freight transportation system. Although almost every business relies on the transportation system in some capacity, "freight-related" industries in particular are heavily dependent on the transportation system to conduct their business. In general, freight related industries include agriculture and forestry, mining, utilities, construction, manufacturing, wholesale and retail trade, and transportation and warehousing. These industries can be defined by their NAICS (North American Industry Classification System) codes, as described in Table 3.2. Minnesota serves as headquarters for 18 Fortune 500 companies, many of which are freight-related, specializing in a range of areas from medical devices and financial services, to retail and food production. The list includes major manufacturers like 3M, General Mills, Medtronic, Land O' Lakes, Ecolab and Mosaic. Agricultural commodities giant Cargill Inc., the largest privately held company in the country, is headquartered in Wayzata. Best Buy and Target have corporate headquarters and distribution centers.

This section describes freight-related industries that are drivers of Minnesota's economy and its future growth. Freight-dependent industries that exhibit declining growth or are maintaining a status-quo are also identified. InfoUSA data on freight-related business with more than 20 employees was used to show the location of businesses within the state. Bureau of Labor Statistics (BLS) data is also used to show the employment, by county/district in freight-related industries within the state.

3.1 OVERVIEW OF MINNESOTA'S FREIGHT-RELATED INDUSTRIES AND ECONOMY

Minnesota is a leader in several freight-related industries. Agriculture, mining, and manufacturing form the core of these freight related industries, and are described in more detail in the following sections. Trade-related industries are also key drivers of the freight-related economy in the state. For example, Minnesota is home to the headquarters of 22 Fortune 1000 companies, many of which are located in the Metro District (Table 3.1).

Table 3.1 Minnesota's Freight-Related Fortune 1000 Companies

Company	Headquarters Location (District)	Company	Headquarters Location (District)
Target	Metro District	The Mosaic Company	Metro District
Best Buy	Metro District	Hormel Foods	District 6
CHS	Metro District	St. Jude Medical	Metro District
Supervalu	Metro District	Valspar	Metro District
3M	Metro District	Polaris	Metro District
General Mills	Metro District	Patterson	Metro District
Medtronic	Metro District	Fastenal	District 6
Land O' Lakes	Metro District	Donaldson	Metro District
Ecolab	Metro District	HB Fuller	Metro District
CH Robinson	Metro District	Toro	Metro District
Xcel Energy	Metro District	Michael Foods Group	Metro District

Source: Fortune Magazine 2014, <http://fortune.com/fortune500/>, InfoUSA 2014.

Table 3.2 describes the number of Minnesota firms, by size, for each freight-related industry, organized by NAICS codes. Minnesota boasts a number of large firms over 100 employees in both the retail trade and manufacturing sectors. Additionally, the state has a large number of firms between 20 and 100 employees in the construction, manufacturing, wholesale trade, retail trade, and transportation and warehousing sectors.

In terms of gross state product (GSP), manufacturing leads the freight-related sectors in this metric. Figure 3.1 shows the contribution of freight-related and other industries to the Gross State Product (GSP) of Minnesota and neighboring states. Forty percent of Minnesota's GSP is dependent on freight-related industries, a higher percentage than many of its neighboring states. Figure 3.2 details the percentage contribution, by industry sector, to Minnesota's GSP, with freight-related industries in bold.

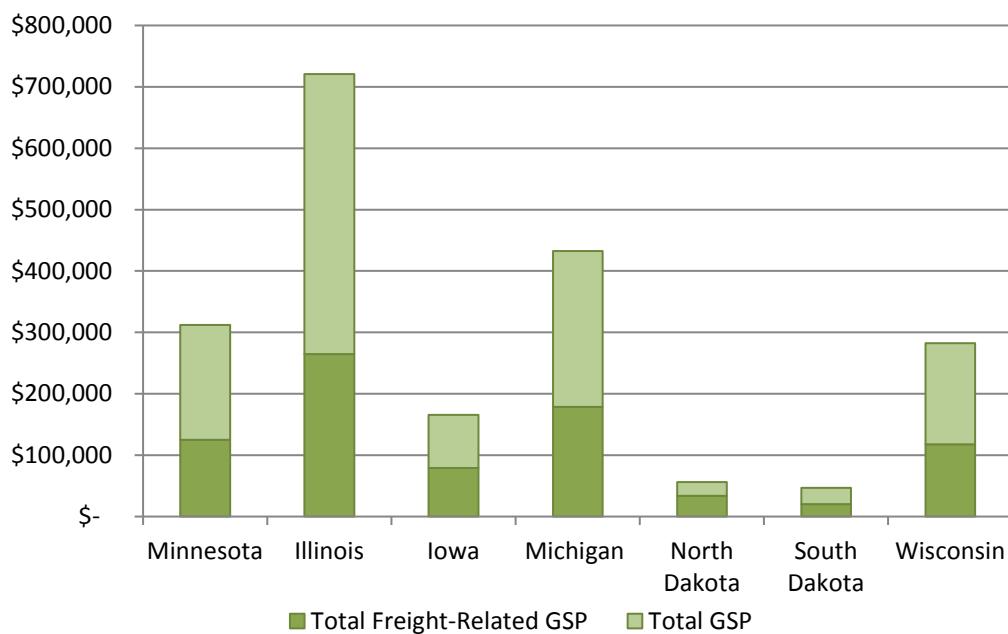
Table 3.2 Freight-Related Industries and Number of Minnesota Firms

(NAICS) Industry	# Firms	# Firms	# Firms
	20-49 Employees	50-99 Employees	>100 Employees
(11) Agriculture, Forestry, Fishing and Hunting	62	12	6
(21) Mining	7	4	6
(22) Utilities	12	4	13
(23) Construction	602	159	72
(31-33) Manufacturing	773	332	435
(42) Wholesale Trade	569	178	128
(44-45) Retail Trade	1,649	487	692
(48-49) Transportation and Warehousing	293	106	85

Source: InfoUSA, 2014

Figure 3.1 Gross State Product, Minnesota and Neighboring States

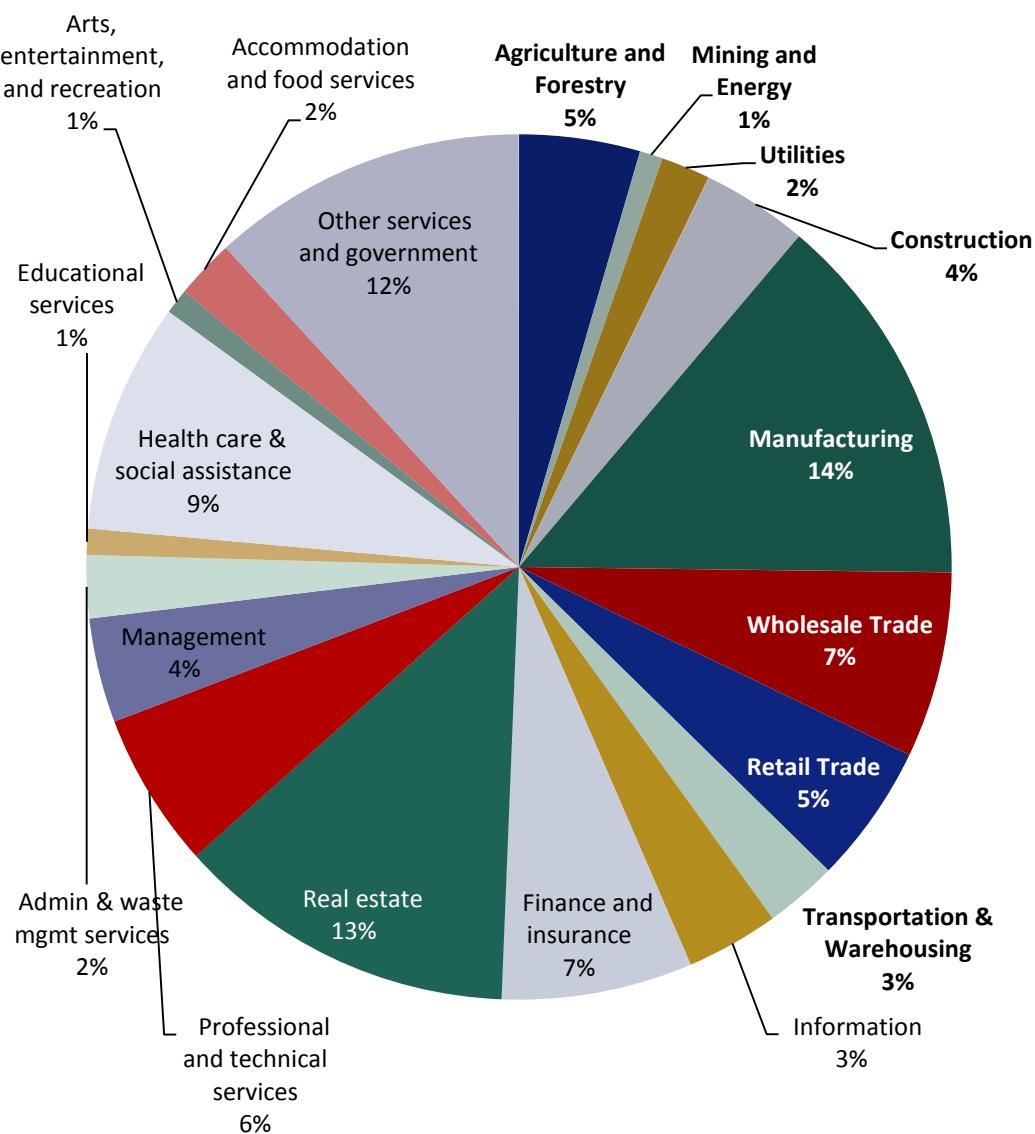
Millions of 2013 \$USD



Source: U.S. Bureau of Economic Analysis

Figure 3.2 Industry Sectors as Percent of Minnesota Gross State Product (GSP)

*Freight-related industries in **bold** text.*



Source: U.S. Bureau of Economic Analysis

A few of Minnesota's key freight-related industries are profiled in more detail below.

Mining

Mining and its associated industries, including granite, sand, gravel, and iron ore remain valuable employers for the State. Over 7,500 jobs are associated with the extraction of natural resources in Minnesota, ranging from small mineral extraction to large taconite mining operations.

Granite

Granite manufacturing remains one of the critical industries for the state. After nearly disappearing in the 1950s and 1960s, a surge in the popularity of granite as a building material (mostly countertops) revitalized the industry. Coupled with increases in transportation costs and higher production costs in India and China, some granite manufacturing returned to the State. Growth areas include laser etching, kitchen and building, tiling, and smaller scale artisan productions. According to InfoUSA data, secondary granite finishing and its associated marketing and wholesale operations support over 250 jobs in Minnesota and nearly \$200 million in revenue without including retail operations.

Iron Ore

Steel production in the U.S. has been increasing substantially since its near collapse in the late 20th century. The large taconite deposits in Northern Minnesota are the source of much of the iron. A substantial portion is shipped via the Great Lakes. The continuing improvement and demand for domestic production of steel will continue to drive growth in steel associated businesses.

Foundries

While Minnesota has less foundry production than the neighboring state of Wisconsin, foundry activity remains active and employs nearly 2,500 people in the state. The reliance on freight movements for the industry is essential as sand and finished products typically have lower value but higher weights. Sand mining for foundries, and for use in the extraction of petroleum, is a growing industry in Minnesota with several moratoriums passed to address community concerns and environmental regulations.

Agriculture

Changes in agricultural production generally in the U.S. also have altered the delivery of farm products from field to market or processing. Consolidation of small farms into fewer but larger farms and cooperative ventures means that farmers and farming corporations can achieve transportation economies of scale by shipping their own products using their own or hired semitrailer equipment.

Consequently, in Minnesota and elsewhere, farmers are shipping more outputs over longer distances compared to the previous pattern where farmers would focus on short moves to local consolidation points and rail terminals. At the same

time, Class I railroads are trending more towards unit trains. This is leading agriculture towards larger, 100-plus car, grain shuttle and consolidation facilities, which involve longer shipments via truck to deliver products to these facilities. As an example, the Crystal Valley Cooperative Grain Shuttle Terminal in Hope, Minnesota is currently under development. With a projected completion date of September 2014, this facility will allow for 110-car train loading to handle the 6.6 million bushels which can be stored here. However, along with increased transportation costs, the shift towards increased truck traffic may provide some increased mobility to grain producers by providing the ability to bypass local grain elevators and railroads and haul directly, albeit over a longer distance, to the processor, to another railroad, or to the Mississippi River for export to foreign markets.

Another mode highly utilized by the agriculture industry, barge transportation is the least costly operation for export. Most grains are exported from Minnesota via the Mississippi through the Panama Canal for East Asian markets. However, recent weather conditions, both drought and excessive rainfall, have caused navigational problems. In total, between April and July 7, 2014, the three Minneapolis Locks were closed to commercial navigation four times for a total of 47 days. Emergency maintenance dredging has also been required to maintain the nine foot channel depth.¹

Machinery

With nearly \$18 billion in wages, manufacturing accounted for 16 percent of all wages paid in Minnesota in 2012, according to the Minnesota Department of Employment and Economic Development. About 10 percent of this total manufacturing is in machinery. Machinery production, generally accounts for over 7,000 employees across a range of industrial and recreational machinery in the state. These include pump manufacturers, recreational machinery, and industrial machinery.

¹<http://www.mvp.usace.army.mil/Media/NewsReleases/tabid/9473/Article/488790/corps-is-performing-emergency-dredging-to-reopen-the-mississippi-river-navigation.aspx>

3.2 GEOGRAPHIC AND EMPLOYMENT TRENDS FOR MINNESOTA'S KEY FREIGHT-RELATED INDUSTRIES

This section presents geographic and employment trends for Minnesota's key freight-related industries based on InfoUSA data for firms with more than 20 employees and BLS data by District. Location quotients² are used to identify the top freight related industries. In each case, the location quotient represents the average for the district against national averages. A key representative firm for each top sector, as well as the employment for that firm, is also listed for each District.

Minnesota

At the statewide level, Minnesota is strong in a number of freight-related industries. Of the top 10 industries in the state by location quotient, seven relate to freight, as shown in Table 3.3.

Table 3.3 Minnesota's Top Industries, by Location Quotient

Freight-related sectors in bold

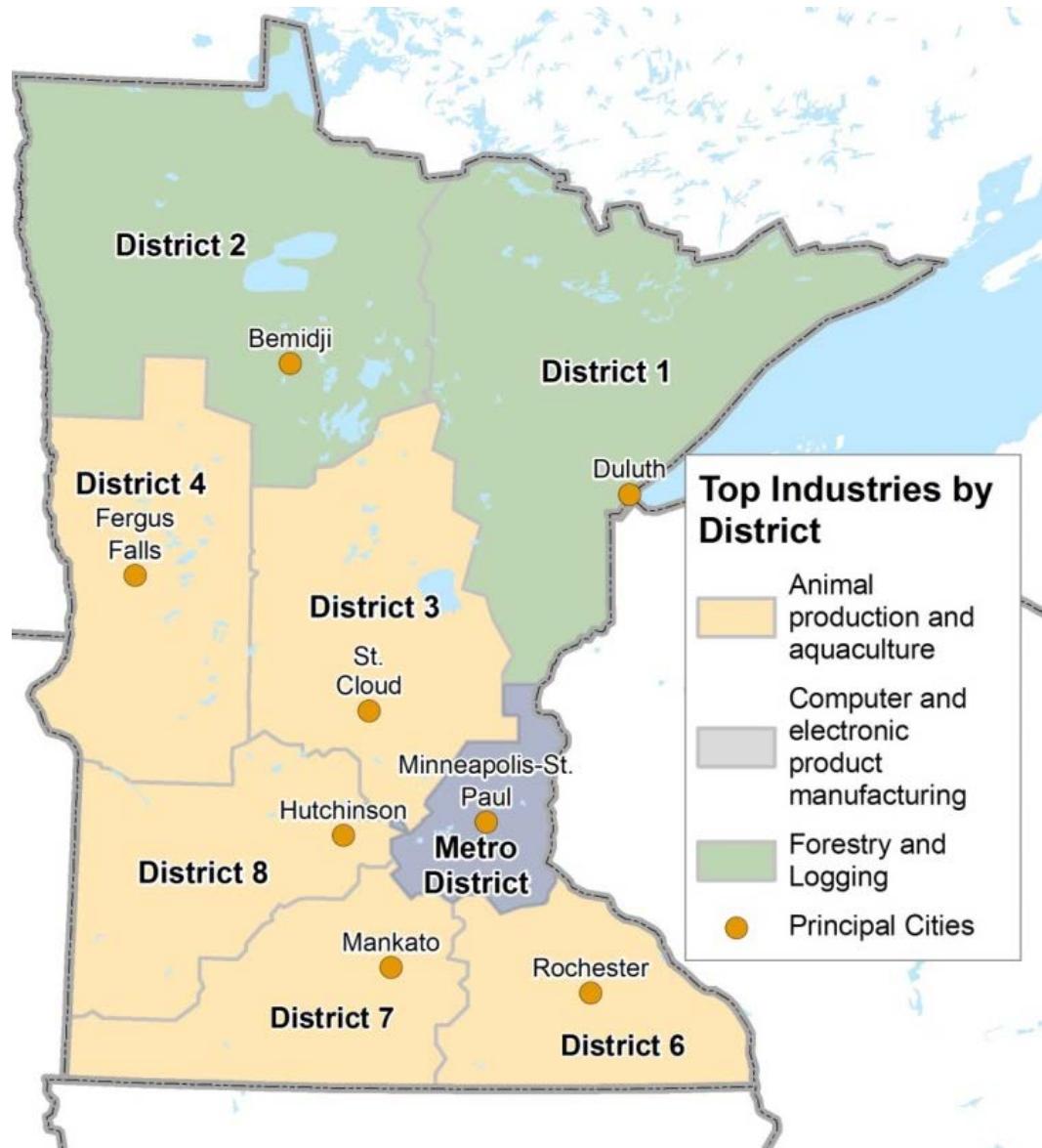
Industry Sector	NAICS Code	Location Quotient
Printing and related support activities	323	2.53
Rail transportation	482	2.3
Animal production and aquaculture	112	2.12
Computer and electronic product manufacturing	334	2.05
Miscellaneous manufacturing	339	1.89
Leather and allied product manufacturing	316	1.87
Lessors of nonfinancial intangible assets	533	1.86
Management of companies and enterprises	551	1.79
Nursing and residential care facilities	623	1.59
Transit and ground passenger transportation	485	1.51

Source: Bureau of Labor Statistics Location Quotient Data, 2013

² Location quotients indicate how concentrated a given sector is relative to the national average. For example, a location quotient of 1 means that a sector is as concentrated at that geography as it is nationally; a location quotient of 2 indicates that the sector is twice as concentrated as the national average.

Top freight-related location quotients by District are shown in Figure 3.2. Three sectors represent the top freight-related industries at this geographic level—animal production, computer and electronic product manufacturing, and forestry and logging.

Figure 3.3 Top Location Quotients, by District



Source: Bureau of Labor Statistics Location Quotient Data, 2013.

Top Freight-Related Industries, by District

District 1

Table 3.4 shows the top freight-related industries, measured by location quotient, in District 1. For each industry sector, a major employer, location, and employment numbers (as reported by InfoUSA) is also listed in the table. Note that only firms with more than 20 employees are analyzed.

District 1 is 15 times more likely to have a cluster of forestry and logging related companies than elsewhere in the country. District 1 is also home to several taconite facilities. Among the companies located in District 1 in these categories are: United Taconite, Essar Steel Minnesota LLC, Hibbing Taconite Co, Northshore Mining Company, US Steel, and Cliffs Natural Resources all operate facilities in St. Cloud County. This is the self-proclaimed “Taconite capital of the world.” Only St. Cloud and Itasca counties have mining activities, making the District the mining center for the state as well. Scheff Logging and Koski Logging are the dominant players for logging in District 1.

Table 3.4 Top Freight-Related District 1 Industries by Average Location Quotient³

Industry	NAICS Code	Mean Location Quotient	Major District Employer	Employer Location	Employment
Forestry and logging	113	15.16	Scheff Logging & Trucking	Marcell	<50
Mining, quarrying, and oil and gas extraction	21	6.28	Northshore Mining Company	Silver Bay	4,189
Wood product manufacturing	321	3.80	Lake States Lumber, Inc.	Aitkin	80

Source: Bureau of Labor Statistics Location Quotient Data, 2013, and InfoUSA.

³ District-level location quotients are determined by averaging county-level location quotients, by industry.

District 2

Table 3.5 shows the top freight-related industries, measured by location quotient, in District 2. In District 2, logging is a defining characteristic. Logging and forestry is 10 times more likely in District 2 than nationally. Crop production and wood products also result in higher location quotients than other areas of the country; however, no employers (in freight-related industries) employ more than 150 persons in District 2.

Table 3.5 Top Freight-Related District 2 Industries by Average Location Quotient

Industry	NAICS Code	Mean Location Quotient	Major District Employer	Employer Location	Employment
Forestry and logging	113	10.61	Walsh Forest Products	Park Rapids	25
Crop production	111	7.13	RD Offutt, Co	Park Rapids	75
Wood product manufacturing	321	6.21	Norbord Minnesota, Inc.	Solway	140

Source: Bureau of Labor Statistics Location Quotient Data, 2013.

District 3

Table 3.6 shows the top freight-related industries, measured by location quotient, in District 3. In District 3, the primary employment is found in the wood products industry. As with other northern Minnesota districts, several smaller employers comprise the core of the freight related industries.

Table 3.6 Top Freight-Related District 3 Industries by Average Location Quotient

Industry	NAICS Code	Mean Location Quotient	Major District Employer	Employer Location	Employment
Animal production and aquaculture	112	7.07	Wilmar Poultry	Foley	37
Forestry and logging	113	5.06	Sylva Corp	Princeton	30
Wood product manufacturing	321	4.12	Woodcraft Industries	Foreston	200

Source: Bureau of Labor Statistics Location Quotient Data, 2013.

District 4

District 4 heavily favors animal production and aquaculture as a defining industry, as shown in Table 3.7. Companies engaged in animal production are nearly 13 times more likely to be located in District 4 than nationally. However

only one firm, Detroit Lakes-based Viking Hatchery, a poultry producer, reported more than 20 employees in these leading NAICS code areas.

Table 3.7 Top Freight-Related District 4 Industries by Average Location Quotient

Industry	NAICS Code	Mean Location Quotient	Major District Employer	Employer Location	Employment
Animal production and aquaculture	112	12.92	Viking Hatchery	Detroit Lakes	38
Machinery manufacturing	113	6.40	-	-	-
Crop production	111	5.20	-	-	-

Source: Bureau of Labor Statistics Location Quotient Data, 2013, and InfoUSA. Note: companies under 20 employees are not represented in the InfoUSA data set.

Metro District

The Metro District is defined generally as the greater Minneapolis-St. Paul area and is home to several Fortune 1000 company headquarters. These headquarters however generally are not included as freight related industries for purposes of this summary.

The Metro District is three times more likely to have computer and equipment manufacturers than the national average and over 2.5 times more likely to house printing operations (Table 3.8).

Table 3.8 Top Freight-Related Metro District Industries by Average Location Quotient

Industry	NAICS Code	Mean Location Quotient	Major District Employer	Employer Location	Employment
Computer and electronic product manufacturing	334	3.30	Seagate Technology	Bloomington	3,500
Printing and related support activities	323	2.87	Deluxe Corporation	St. Paul	800
Plastics and rubber products manufacturing	326	2.47	Minnesota Rubber and Plastics	Minneapolis	1,100

Source: Bureau of Labor Statistics Location Quotient Data, 2013.

District 6

District 6 is heavily biased towards animal production, with a location quotient of nearly 10, as shown in Table 3.9. The primary employers that are freight related include both dairy and pork producing companies. It is important to

note that IBM's manufacturing is combined here and represented across several NAICS codes.

Table 3.9 Top Freight-Related District 6 Industries by Average Location Quotient

Industry	NAICS Code	Mean Location Quotient	Major District Employer	Employer Location	Employment
Animal production and aquaculture	112	9.87	Pace Dairy Foods Co	Rochester	390
Food manufacturing	311	4.67	Quality Pork Processor, Inc. (Hormel)	Austin	1,500
Manufacturing	31-33	2.09	IBM	Rochester	4,800

Source: Bureau of Labor Statistics Location Quotient Data, 2013.

District 7

Table 3.10 shows the top freight-related industries, measured by location quotient, in District 7. District 7 is also a higher than average animal production location. NAICS code 112 is nearly 19 times higher than national averages. In addition, a cluster of electrical equipment manufacturers is also evident. JBS is a food manufacturer, specializing in beef, turkey, and pork production under the Swift Premium label and over a dozen other brands.

Table 3.10 Top Freight-Related District 7 Industries by Average Location Quotient

Industry	NAICS Code	Mean Location Quotient	Major District Employer	Employer Location	Employment
Animal production and aquaculture	112	18.94	Miller Manufacturing Co.	Glencoe	150
Electrical equipment and appliance manufacturing	335	12.53	Extron Co	Gaylord	75
Food manufacturing	311	8.00	JBS	Worthington	1,800

Source: Bureau of Labor Statistics Location Quotient Data, 2013.

District 8

District 8 is also an animal and food products location (Table 3.11). While several firms comprise the animal production facilities in District 8, over 20 times more clustered than national averages, the production and employment of Jennie-O is the dominant freight related industry for the District.

Table 3.11 Top Freight-Related District 8 Industries by Average Location Quotient

Industry	NAICS Code	Mean Location Quotient	Major District Employer	Employer Location	Employment
Animal production and aquaculture	112	20.10	Willmar Poultry	Willmar	55
Food manufacturing	311	4.73	Jennie-O Turkey	Willmar	2,200
Utilities	22	3.37	Sioux Valley Energy	Pipestone	100

Source: Bureau of Labor Statistics Location Quotient Data, 2013.

4.0 Industry Utilization of the Transportation System

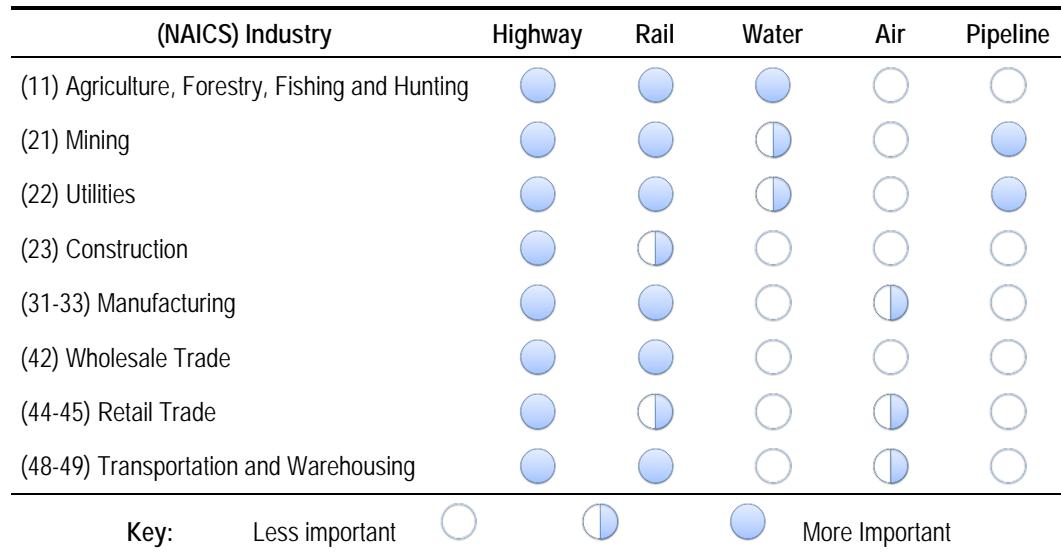
Minnesota's freight-related industries are related in a complex network of supply chains and business-to-business and business-to-consumer transactions. Many of these may occur within the state, but others depend on imported products or produced goods ultimately destined for export. This section examines the link between Minnesota industries' supply chains and the transportation system. Case studies of three key freight-related industries within Minnesota are presented herein to "tell the story" of how freight moves through Minnesota.

4.1 OVERVIEW OF INDUSTRY SECTOR RELATIONSHIPS

Industry Use of Transportation Modes

Table 4.1 examines the modal usage of Minnesota's freight-related industries. Truck is a key element of all industries, as even goods moving via other modes often use truck for last mile connections. Rail and water serve the agriculture, mining, manufacturing and trade sectors, while air is mostly used for the transport of high value manufactured goods and consumer products. Pipeline transport is important for moving crude oil and other energy sector goods.

Table 4.1 Modal Usage of Minnesota's Freight-Related Industries

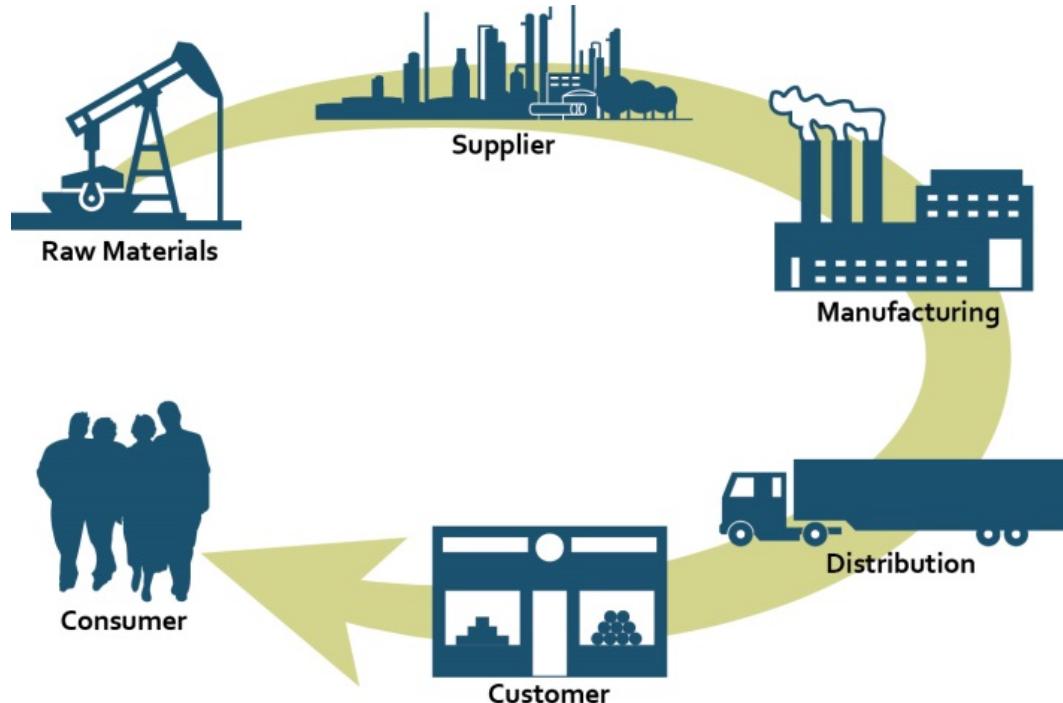


Source: InfoUSA, 2014

Interdependence between Minnesota's Industries and the Transportation System

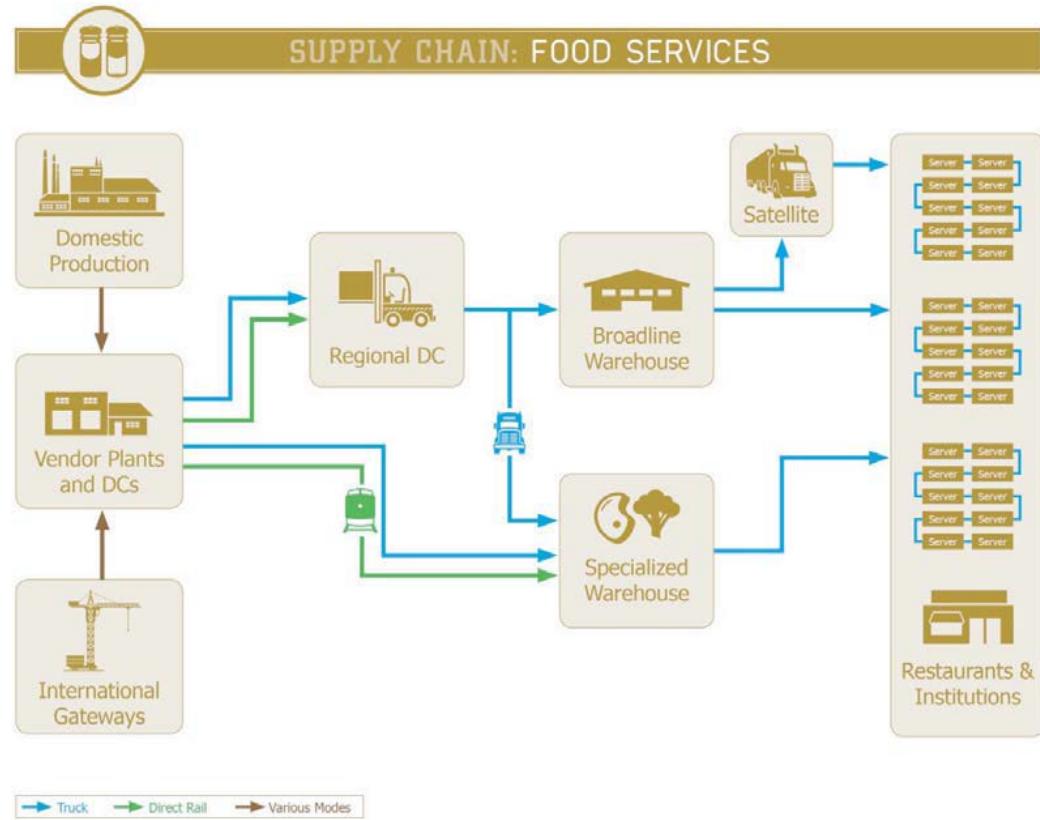
Supply chains are developed by goods moving from producers, to intermediate suppliers, manufacturers, distributors, and other businesses, and finally to the consumer or end recipient. As such, the functionality of supply chains is dependent on access to reliable and cost-effective transportation networks. Figure 4.1 illustrates a conceptual supply chain.

Figure 4.1 Visualization of a Supply Chain



As a specific example, an agricultural supply chain might begin with farmers and ranchers who receive inputs via rail or fertilizer and grain, and may then send cattle and dairy products to Minnesota's food processing and food manufacturing industry. These industries may also receive other inputs - manufactured equipment, packaging material, and other materials - that are either shipped locally or travel via water, rail, and truck internationally, often from Asia or Latin America. A food manufacturer might then move products to a regional distribution center who distributes them to retailers within the state, or ship their products cross-country for export via rail or waterways. An example of such a supply chain is in Figure 4.2.

Figure 4.2 Food Services Supply Chain Example



Source: Transportation Research Board of the National Academies, NCFRP Report 14: *Guidebook for Understanding Urban Goods Movement*, 2012.

4.2 REPRESENTATIVE INDUSTRY CASE STUDIES

All Minnesota-based industries are reliant upon the state transportation system to provide quality manufacturing, distribution, and marketing for products and services. Several industries are extremely reliant on a multimodal network. This section provides details on representative industries that highlight the critical pieces of the supply chains. These case studies represent significant niches in the Minnesota economy and demonstrate reliance on varied components of the transportation infrastructure. While not the largest employers or highest value, the selection of these three cases present important lessons for transportation officials.

Corn and Corn-derived Products

Minnesota is the fourth largest producer of corn in the U.S. The combination of abundant water, rich soil, and the right climate for growing corn has been a cornerstone of Minnesota's agricultural efforts throughout the state's history. Minnesota is the nation's fifth leading state in annual farm income, with corn being the state's most valuable crop. Over 8 million acres of corn are harvested each year within the state. Once harvested, corn is transported throughout the state by truck, rail, and river transportation.

Harvested corn primarily originates in the Southwest Region of the state as shown in Figure 4.3. Minnesota exports approximately 42 percent of harvested corn to international and other domestic locations, principally used for animal feed. 39 percent of the corn grown in Minnesota is processed within the state. This local processing includes ethanol production and use in food production supply chains. 17 percent of the corn production is used for animal feed uses within the state.

Iowa remains a primary market for Minnesota corn products. Iowa, the largest corn producing state, also consumes the most corn for processing in ethanol related facilities. In 2013, Iowa consumed nearly 70 percent of its corn production within the state, exporting only 17 percent of its harvested corn.

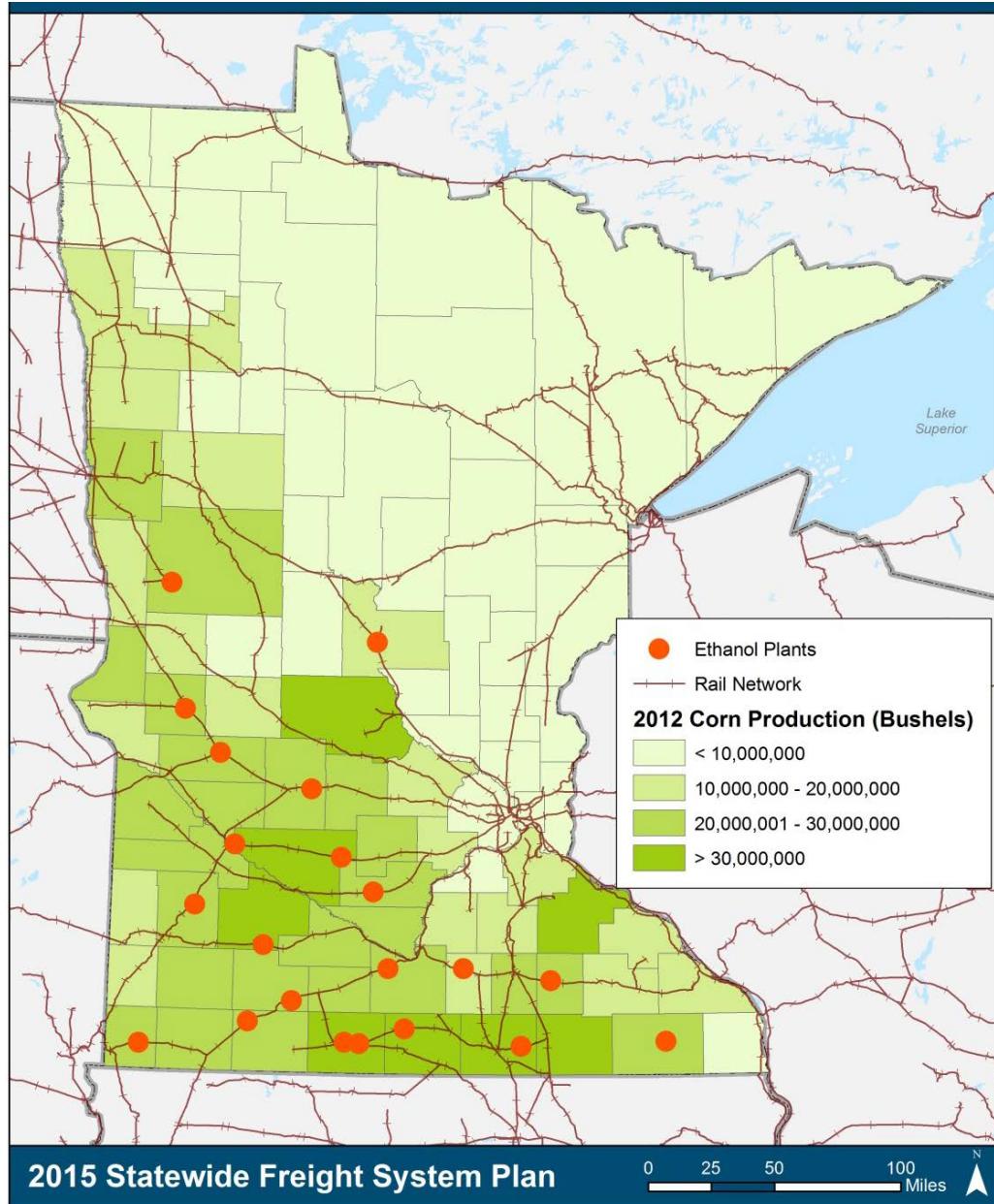
Corn represents 12 percent of Minnesota's international agricultural exports. In 2012, this represented \$941 million in product value with principal markets being in Latin America and the Asia-Pacific region. Over half is used for feeding. To reach these international markets, approximately 2/3 of corn is moved by barge in the Mississippi River watershed with the remaining third destined for the Pacific Northwest by rail.

Twenty-one operating ethanol facilities are located within the state. These facilities generally are most reliant on the rail network for processing both inbound corn and finished ethanol products. The locations of these ethanol facilities and the rail network are shown in Figure 4.3. In addition to finished ethanol, a co-product of the processing, dried distillers' grain (DDG) is also prepared for export and consumption for animal feed production including livestock and poultry feeds. This DDG is principally moved in identity preserved containers on the rail network after being dried.

Cargill, General Mills, and Malt-o-Meal production facilities also receive corn from certain locations throughout the state for cereal and food product uses. These facilities primarily receive the inbound corn products by truck, although some rail service is provided to these facilities.

Recent additions to meet the demand for Minnesota's export corn shipments include additional shuttle trains between Minnesota and the Pacific Northwest. Both UP and BNSF have added additional shuttle trains to move grains from Minnesota elevators.

Figure 4.3 Minnesota Corn Production and Ethanol Plant Locations, 2012



Source: USDA National Agricultural Statistics Service, 2012.

Recreational Machinery

Two market leaders in the recreational machinery industry are based in Minnesota. Arctic Cat and Polaris both produce recreational and utility machinery including snowmobiles, motorcycles, and all-terrain vehicles.

Arctic Cat, based in Thief River Falls, Minnesota, designs, engineers, manufactures and markets snowmobiles, all-terrain vehicles (ATVs) and Side by Side utility vehicles under the Arctic Cat brand name, as well as related parts, clothing and accessories. The company markets its products through a network of independent dealers located throughout the contiguous U.S. and Canada, and through distributors representing dealers in Alaska, Europe, the Middle East, Asia and other international markets. Arctic Cat also has a production facility in St. Cloud. Arctic Cat has an engine production factory in St. Cloud and uses a third party logistics and full service transportation logistics provider, Ruan, to manage its inventory and distribution from a Brooklyn Park facility. The Brooklyn Park facility is located in the Twin Cities metro area and provides access to a variety of dealer and retail locations.

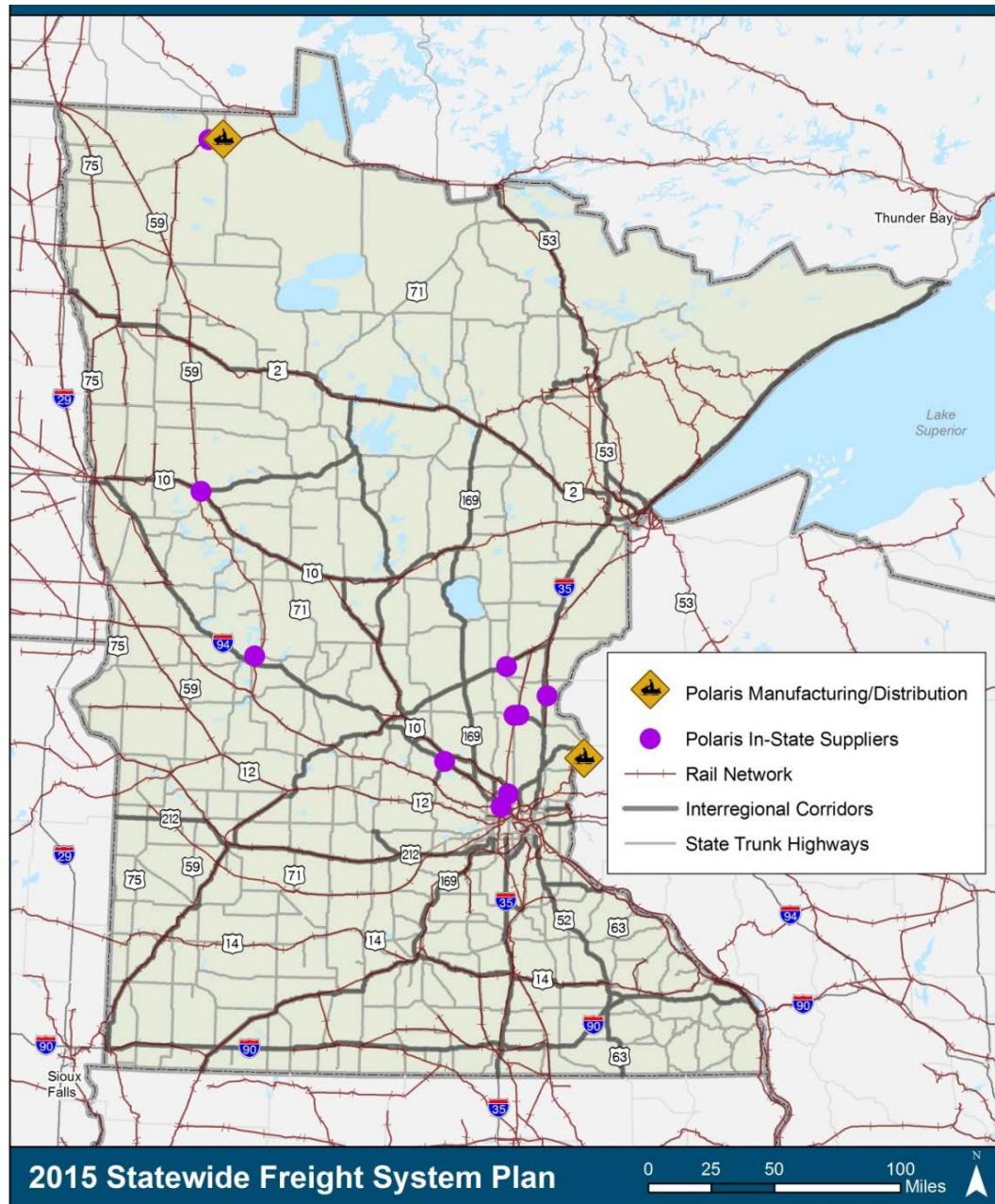
Polaris Industries, based in Medina, designs, manufactures and markets high-performance motorized products for recreation and utility use. Polaris product lines consist of all-terrain vehicles (ATVs), snowmobiles, side-by-side utility vehicles, Victory Motorcycles and related parts, garments and accessories. In addition, Polaris has begun to manufacture a new three wheeled side-by-side motorcycle at a Spirit Lake, Iowa facility approximately 10 miles across the southern border of Minnesota. The Spirit Lake facility manufactures select ATV and Victory Motorcycles. Polaris uses numerous Minnesota-based suppliers for its manufacturing production. Polaris has an engineering facility in Wyoming, Minnesota and a Medina operations location. Most of Polaris's worldwide distribution is managed from a Vermillion, South Dakota facility. Figure 4.4 illustrates the locations of manufacturing/distribution centers and in-state suppliers for Polaris, primarily located in the Metro District as well as the northwest part of the state.

Both Polaris and Arctic Cat have extensive dealer networks across the Midwest and Minnesota, creating a wide variety of distribution channels. Large retailers, including Cabela, stock limited products and are regularly restocked based on customer demands. Both companies are reliant on the highway network versus other modes. Both receive internationally-imported components in addition to domestically sourced materials. Imports for both company's manufacturing processes arrive in the Chicago region and are drayed to Minnesota (or other production) facilities.

Specifically, US-10 and US-59 are critical routes for connecting Polaris's network of Minnesota-based suppliers with its production facilities just outside of Minnesota and its main facility in Roseau. Arctic Cat relies upon the I-29 and I-94 corridors for its supply chains.

The Polaris production facility employs over 1,400 people in Roseau and hundreds of others throughout its Minnesota suppliers. Arctic Cat employs over 2,000 people in Minnesota. Each facility generates 10-20 truck movements per day.

Figure 4.4 Polaris Manufacturing/Distribution Center and In-State Supplier Locations



Source: Twin Cities Business Magazine (<http://tcbmag.com/Industries/Manufacturing/Polaris-On-a-Tear>)

Taconite

Taconite is a low-grade iron ore. In earlier eras, iron ore was mined directly and was plentiful. During this time period, taconite was considered a waste rock and not used for production or processing. The costs of extracting the small amount of iron from taconite was prohibitive. As the supply of high-grade natural ore decreased, the steel industry began to view taconite as a resource. The largest taconite production in Minnesota is in Mountain Iron, Minnesota at the U.S. Steel Minntac facility. Mountain Iron bills itself as the Taconite capital of the world.

Taconite rock typically contains about 28 percent iron ore with the rest a combination of sand and silica. Taconite is mined in northeast Minnesota in the Mesabi Iron Range, processed into pellets typically at nearby locations, and shipped via the Great Lakes to steel mills in Indiana, Ohio and Pennsylvania. The processing of taconite generally includes grinding the mined rock into a fine powder, using magnets to extract the powdered iron concentrate, and then combining the powder with a binder (generally clay) and limestone. The mixture is rolled into pellets about one centimeter in diameter that contain approximately 65 percent iron. The higher quality iron can then be processed into steel. This "pelletization" process produces an easier to handle product for shipment.

Taconite represented 67 percent of Minnesota's total Great Lakes shipping tonnage in 2012. Due to the seasonal nature of Great Lakes shipping, the availability and access to lake transportation is essential. The Mesabi range facilities include some all-rail movements during the winter season to steel facilities in Ohio and Pennsylvania, however, the norm is to stockpile and ship via the Great Lakes due to the cost efficiency of the ship-based movement. The Port of Two Harbors is the leading taconite export dock in Minnesota at 16,547,843 net tons in 2012. Duluth is the next major facility for aggregating and shipping taconite to steel production facilities. Silver Bay is a smaller shipping source, with approximately six million tons of iron ore pellets shipped annually.

Within the state, taconite is reliant on rail shipping to move goods from mining facilities to ports. Much of the processed taconite is carried on CN operated rail line to Two Harbors or Duluth with three facilities being exclusively served by CN. The Minntac facility in Mountain Iron is largest pellet plant in the U.S. Pellets mainly go to the port of Two Harbors with four to five loaded trains per day from the plant. Each train is generally 116 hopper cars in length. The Virginia Minorca plant moves one train per day to Two Harbors. Winter production is typically moved by rail to Escanaba, Michigan for stockpiling. The United Taconite facility in Hibbing uses 1-2 CN trainsets per day for shipment into Duluth for loadings.

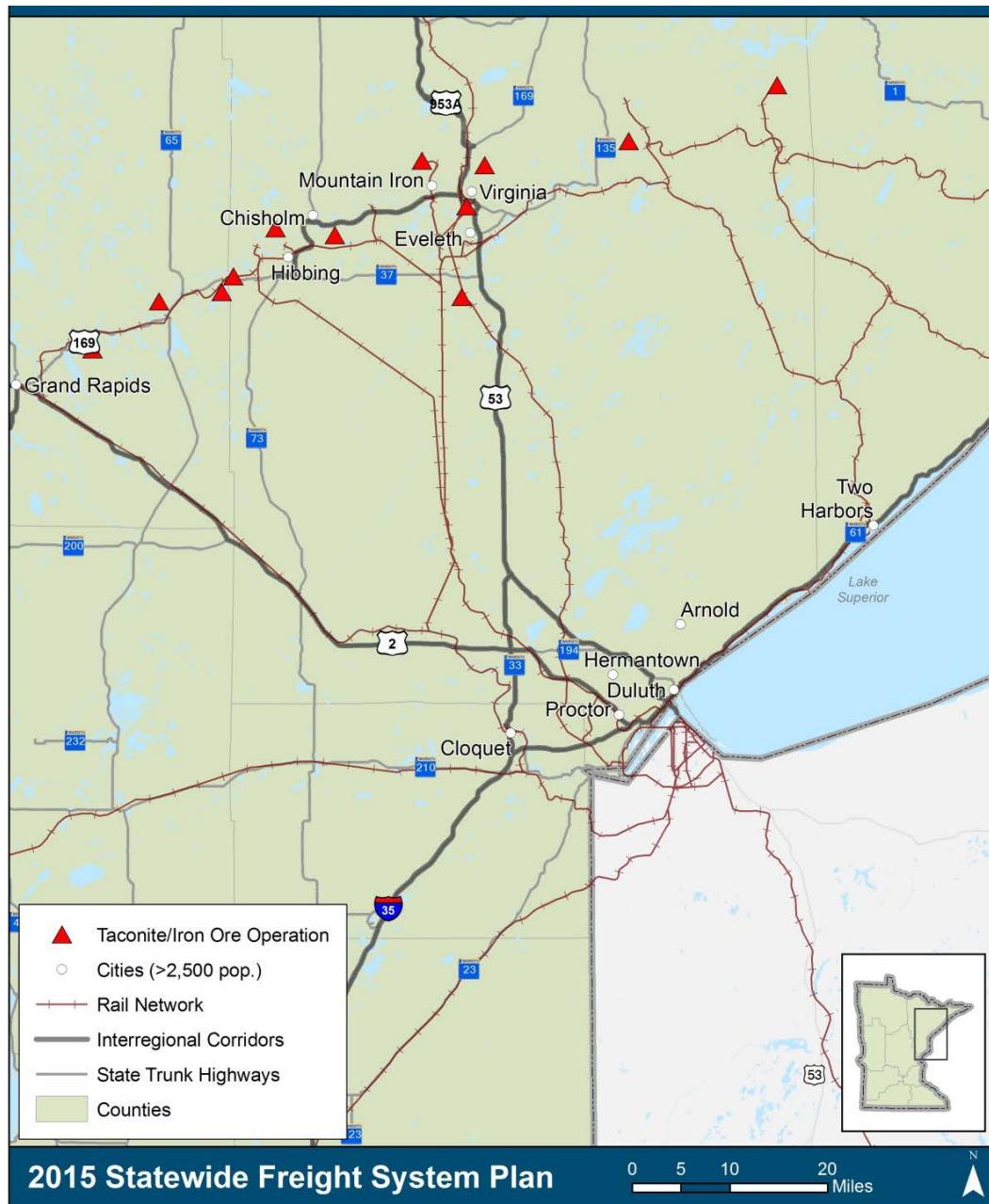
Recently, Minnesota's iron ore mines report that they are having trouble getting pellets to market due to a shortage of rail service, leading to heavy stockpiles at

industrial facilities in the region. Two Minnesota mines have reportedly begun sending taconite pellets via truck from the Mesabi Iron Range to Duluth.⁴ US 53 serves as a highway link for the industry and is essential for mining operations, including repair services for mining equipment. In addition, some of the materials for producing pellets, including clay binders are brought to processing facilities by truck.

According to the mining trade association for Minnesota, approximately 3,900 people are employed directly in Minnesota's iron ore industry. This represents nearly an 8 percent increase over 2007. Most of Minnesota's production is shipped via the Great Lakes to dedicated U.S. steel mills owned by the same companies that own the taconite mines. Six major operators form the core of Minnesota's taconite production. This includes U.S. Steel's Minntac and Keetac operations located in the Mountain Iron area and ArcelorMittal's Minorca mine located outside Virginia. Hibbing Taconite is the next largest mining facility. Northshore Mining (operated by Cliffs Natural Resources) in Silver Bay and United Taconite in Eveleth and Forbes round out the Mesabi based operations.

⁴ "Rail congestion hits taconite shipments" *Trains Magazine*, September 15, 2014.

Figure 4.5 Taconite/Iron Ore Operations in Northeast Minnesota



Source: Iron Mining Association of Minnesota

5.0 Freight Trends: Minnesota and Beyond

Freight movements affecting Minnesota are increasingly national and global in scope, and are sensitive to market forces as well as the decisions of supply chain and logistics professionals both within and outside the state. Industries may make business decisions based on these national and global trends, which may often result in effects that are felt locally and can have profound impacts on goods movement within the state. Regional or national decisions made by other transportation agencies and operators can also be felt locally. This section discusses key trends that affect Minnesota's freight-related industries now and in the future.

5.1 RENEWABLE ENERGY

Minnesota is among the nation's leaders in wind energy production, ranking in the top five by most measures. Some analysis places Minnesota as the third most productive wind energy state, while others place Minnesota sixth behind California, Texas, Illinois, Iowa, and Oregon. Over 60 wind farms are currently in operation across Minnesota with a total wind energy capacity of over 2,717MW. This wind energy requires substantial freight intensive movements to erect farms, including movement of oversize and overweight loads from Great Lakes ports to Western Minnesota. Nacelles (the generating unit atop a wind tower) require pre-fabrication off site and are typically trucked to their final locations. Blades and tower pieces are also manufactured elsewhere and moved via the highway system to their final destinations within Minnesota.

Buffalo Ridge is a glacier-deposited rise that runs diagonally across southwestern Minnesota and is the primary resource for wind capacity in Minnesota. Ten years ago, no production scale wind farms existed in this area. Most of the land was traditional, archetypal farmland, "with barns, silos, and expansive fields divvied up by dusty county roads." Today over 470 wind generators are producing over 1000MW of power along the Ridge. Substantial infrastructure is required to facilitate the construction of these farms. Many areas have not yet reached capacity for wind generation; however it is at this time unclear how many additional sites will be developed in the future.

On the renewable fuels side, trucking relies nearly exclusively on diesel fuel. Continuing improvements in the viability of bio-diesel fuels directly impacts trucking and with Minnesota's vast agricultural resources, the biofuels industry remains critically important. As discussed in Section 4.0, the corn-derived ethanol industry is spread throughout the southwestern part of the state. The 21

production facilities account for over 300 jobs and \$500 million in economic activity.

5.2 HYDRAULIC FRACTURING

Among the surprising industries to emerge over the course of the last ten years is related to the hydraulic fracturing of rock. Induced fracturing, or fracking, allows for the recovery of “captured” gases and petroleum products. The technique is commonly applied to shale gases. The proliferation of shale gas exploration has allowed substantial increases in freight related movements associated with this extraction across the Midwest.

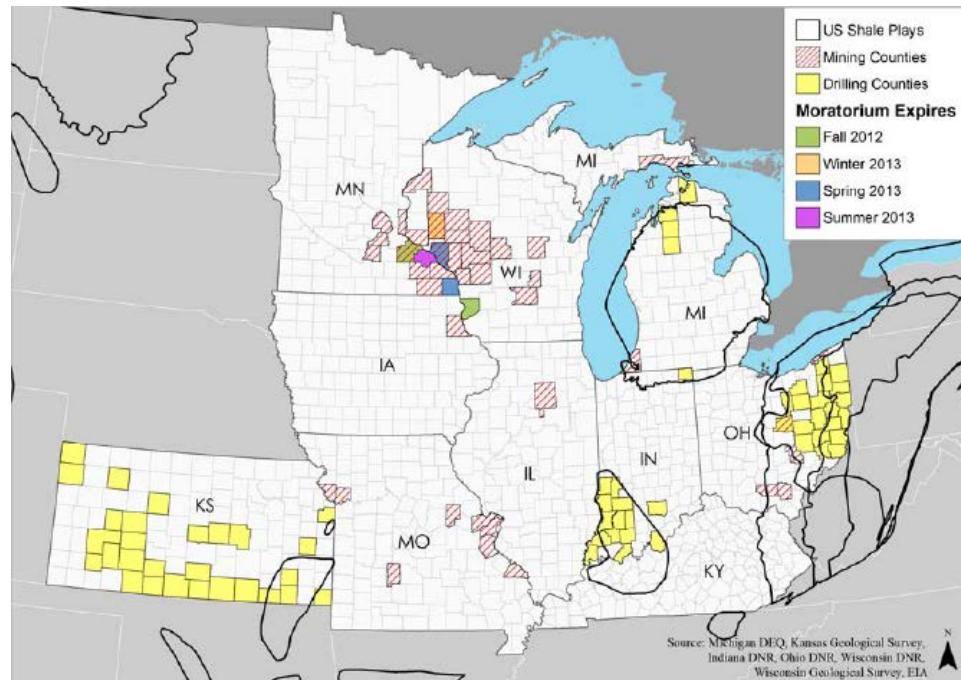
For Minnesota, the freight related impacts of fracking occur in two distinct manners – both as a result of the increased petroleum related movements but also for the direct inputs to the fracking process – sand, water, and other chemicals. A single horizontal well typically uses between 3,000 and 10,000 tons of sand. A typical rail car of frac sand contains around 100 tons. In 2009, Class I railroads originated nearly 112,000 carloads of sand and are on track to originate approximately 375,000 carloads in 2013, likely driven by increased frac sand use at drilling wells.⁵ Figure 5.1 highlights areas where sand mining is currently underway in Minnesota. The Southeastern part of the state includes the edges of the premium sand deposits needed for hydraulic fracturing. Nine mines are in production in Minnesota.

Sand processing consists of moving sand through a series of steps to sift it into size groups for market. A single sand mine may produce several products for different markets across the country. Product differentiation requires separate trucks or rail cars and different final destinations.

The Mid-America Freight Coalition completed a case study of Chippewa County, Wisconsin (east of the Minnesota border) for sand mining related to hydraulic fracturing and the related consequences for the freight transportation network (Figure 5.2). Heavy utilization of the roadway infrastructure by sand and gravel haulers, an increase in loaded train cars, and increases in noise were observed outcomes after the addition of a new sand mine.

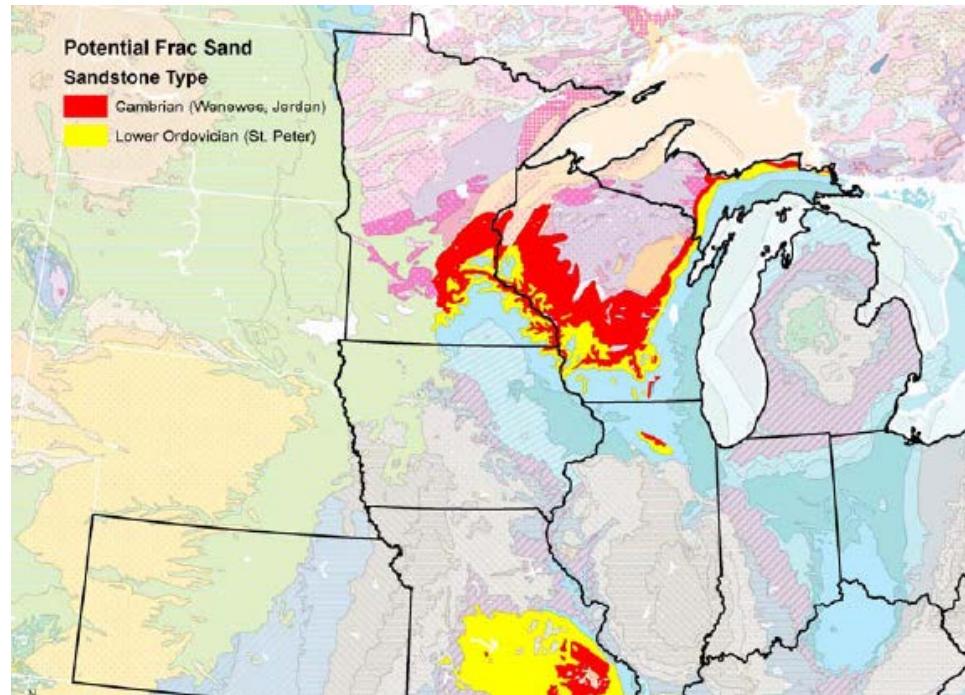
⁵ Association of American Railroads, December 2013. *Moving Crude Oil by Rail*. https://www.aar.org/safety/Pages/crude-by-rail-facts.aspx#.UxdfuIXYO_c.

Figure 5.1 Sand Mining and Horizontal Drilling



Source: Mid-America Freight Coalition.

Figure 5.2 Current Mining and Drilling in the Midwest (August 2012)
(adapted from MAFC, 2013)



Source Mid-America Freight Coalition; USGS Database of Geological Formations.

5.3 THE MOVEMENT OF CRUDE BY RAIL

With the increase of shale oil drilling in the Bakken Region of North Dakota, the Alberta tar sands, and others, Minnesota's rail system is seeing large increases in crude by rail. According to the AAR, in 2008, U.S. Class I railroads originated just 9,500 carloads of crude oil. In 2012, they originated nearly 234,000 carloads and were forecast to originate around 400,000 carloads in 2013.⁶ Although transportation costs for shipment by train are higher, rail offers competitive advantages over pipeline transfer. Rail serves major refineries on the coasts, as well as inland and Gulf markets, allowing companies the flexibility to ship their products to the highest-margin market. In addition, rail allows for uncontaminated shipment of different grades of petroleum, whereas pipeline shipments may result in mixing grades of oil.

Safety and security issues are at the forefront of many minds, as a series of recent disasters involving unit trains of oil have occurred. Minnesota has responded to these trends and the unknown nature of future shipments by passing laws to increase the safety of crude by rail movements in the state. The State is requiring the DOT to take action by conducting studies on highway crossing that have significant safety risks due to increased crude by rail activity, providing \$2 million for improving rail grade crossings, and hiring additional rail inspectors, among other actions.

Throughout 2013-2014, the increased crude traffic in North Dakota in conjunction with a record harvest throughout the upper Midwest drove up demand for rail service and led to significant railway congestion. The current "boom" in rail related to extraction of petroleum (not only rail movements of crude itself of the shipping of chemicals and sand components for hydraulic fracturing) has limited the capacity of freight railroads to handle traditional industries in Minnesota. Grain shippers, paper manufacturers, ethanol manufacturers, taconite and forestry industries have complained about the availability and access to rail shipping as a result of the capacity consumed by the rail services by the oil and gas industry. Due to slower travel times and longer turn-arounds leading to a lack of rail cars available for grain shipment, grain is currently being stored on the ground at facilities for extended periods of time while waiting for shipments. A recent study by the University of Minnesota's Center for Farm Financial Management estimated delays in railroad shipping have cost Minnesota's corn, soybean, and wheat farmers nearly \$100 million due to lower prices.⁷

⁶ Association of American Railroads, <https://www.aar.org/keyissues/Documents/Background-Papers/Crude-oil-by-rail.pdf>.

⁷ *Star Tribune*. "Rail shipping delays cost Minnesota corn, soybeans, wheat farmers nearly \$100 million." July 10, 2014.

It is anticipated that the crude oil shipments will continue to be significant, however, some recent trends have indicated that more of the production from these fields is being slated for export via West Coast ports. Approximately 50 oil trains per week transport Bakken crude oil across Minnesota. In addition, Canadian over 140,000 crude oil tankers were mixed in with other traffic on Canadian Pacific or Canadian National lines in 2013.⁸ With the trend to export a higher percentage of Bakken crude, shipments through Minnesota for refining elsewhere in the United States may be reduced slightly. In June 2014, through an executive order signed by US President Barack Obama, the US modified language restricting unrefined crude exports. The net result of this change will likely see some increased production, but rather than shipments for refining, a larger percentage of crude oil will be sent west from the Bakken region for export on the West Coast.

5.4 GLOBAL SHIPPING TRENDS

Since opening in 1914, the Panama Canal has been a critical element of the global transportation network. The Panama Canal expansion project, projected to be completed in 2016, will allow larger ships to pass through the canal and will increase the annual capacity of the canal by more than 75 percent. The effect of the expansion on U.S. ports and trade is a much debated topic and will affect future goods movement throughout the U.S.

As of 2014, the expansion project is behind schedule, and concerns remain about the viability of larger container ships utilizing East Coast ports due to continuing draft and dredging requirements. The likely impact of the canal expansion effort will be that a greater number of container movements will bypass the landbridge of rail service from the West Coast for select Eastern north American markets. Research findings suggest that the canal expansion may decrease overall transit times to Midwest destinations, incentivize export of grains and agricultural products to Asia via Gulf Coast ports, promote greater containerization of grain, and increase the total energy costs of transportation. However, Minnesota's direct markets will likely remain through its West Coast connections (Figure 5.3).

⁸ *Star Tribune*. "Canadian crude taking rail through northern Minnesota." August 4, 2014.

Figure 5.3 Cost Advantage Regions by Ship Size



Source: Worley Parsons, Richard West

The Suez Canal is the primary Panama Canal competitor route for serving the East Coast of the U.S. The recently initiated Suez Canal expansion effort will allow ships to sail to both directions in the same time over much of the canal length. This will decrease waiting hours from 18 to 11 hours for most ships and double the capacity of the Suez Canal from 49 to 97 ships a day. Such improvements in efficiency may further drive down costs to serve the Asia-U.S. East Coast market. Construction on the expansion began in August 2014. It is expected to be completed within two years.

Each of these canal expansion efforts have the potential to allow containerized barge movements from the Gulf of Mexico via the Mississippi River system. While limited, Minnesota may see specific companies that benefit from the all-water containerized movements. Regular maintenance and upgrades to the locks, dams and landside infrastructure on the river network are likely necessary before any substantial container-on-barge operations would be available.

5.5 INTER-AMERICAN TRADE AND NEARSHORING TRENDS

Although Minnesota's primary trading partner remains Canada, trade between Minnesota and other states with Mexico and Central and Latin America are increasingly important to both Minnesota and the overall U.S. economy and changing supply chain structures. Increasing trends in Inter-American trade as

well as potential new trade agreements⁹ between these countries increase the potential for increased import and export trade for Minnesota's businesses.

As manufacturers seek methods to reduce production costs and the total landed cost of goods, they have increasingly been turning attention to manufacturing closer to market, namely in Mexico, the Caribbean and Central America (near-shoring) and the U.S. (re-shoring). Mexico appears to have the most to gain in terms of garnering the lion's share of near-shoring activity in the near-term. The main reasons, as reported by industry are lower freight and inventory costs, and improved speed-to-market. Recently, some Minnesota companies have moved production to Mexico and central America. IBM moved a production facility from Rochester to Mexico in 2013. Polaris operates a facility in Monerrey, Mexico with over 400 employees. Best Buy and Target both have increased sourcing through Mexico in the last five years.

These trends are expected to continue, as a recently completed survey performed in 2014 for World Trade 100 and the University of Tennessee by BNP Market Research observed that "nearshoring remains a strong part of company strategies with 92 percent of survey respondents saying they will increase or continue nearshoring."

5.6 ENVIRONMENTAL CONCERNS / AIR QUALITY

One of the most critical issues surrounding freight movements are related to impacts of freight-related emissions. Emissions along freight corridors can greatly impact the health and safety of local communities, which can experience some of the highest exposure levels to pollution that causes asthma and other respiratory ailments, heart disease, and other health problems. Through programs such as the Clean Air Act, states and regions are working to adopt strategies to improve air quality. For one major measure, the National Ambient Air Quality Standard (NAAQS) set by the Environmental Protection Agency to protect human health, Minnesota is in compliant with most measures, although some pockets of non-attainment do still exist.¹⁰

Minnesota also ranks 23rd out of U.S. states in terms of carbon dioxide emissions in 2014, according to the U.S. Energy Information Administration. As freight transportation is a key contributor to greenhouse gases such as carbon dioxide, U.S. States, as well as the EPA and other agencies have begun to address

⁹ *Miami Herald*. "U.S. Considering Deal to Expand Trade in the Americas." December 14, 2013. <http://www.miamiherald.com/2013/12/14/3819165/andres-oppenheimer-us-considering.html>

¹⁰ Minnesota Pollution Control Agency <http://www.pca.state.mn.us/index.php/air/air-quality-and-pollutants/general-air-quality/state-implementation-plan/minnesota-state-implementation-plan-sip.html>

environmental concerns related to heavy truck movements, bunker fuels in maritime trade, and vehicle emissions. The EPA and the National Highway Traffic Safety Administration (NHTSA) are working towards coordinating both passenger and freight-vehicles that are more fuel efficient and emit less greenhouse gas. The EPA is also developing and implementing regulations to increase the proportion of renewable fuels for transportation.

Another recent environmental issue affecting freight transportation is the introduction of invasive species in the water system, particularly in the Great Lakes. These species threaten Minnesota's water connections, as they can cause damage to ships, infrastructure, and the water system, and the threat of these species may lead to separation of waterway systems, reducing Minnesota's access to certain markets. The Great Lakes and Mississippi River Interbasin Study (GLMRIS) is a U.S. Army Corps of Engineers study that presents a range of options and technologies to prevent aquatic nuisance species movement between the Great Lakes and Mississippi River basins.¹¹ Similarly, the Great Ships Initiative (GSI) is a collaborative effort to end the problem of ship mediated introductions of invasive species in the Great Lakes-St. Lawrence Seaway. With the help of the Maritime Administration, the GSI has established a land-based Research, Development and Technology Evaluation (RDTE) facility in Superior, Wisconsin. The Duluth Seaway Port Authority is also partnered to test treatment systems under development by GSI.¹²

5.7 ADDITIONAL LONG-TERM INDUSTRY TRENDS

This discussion examines additional, longer-term logistics trends that will likely have increased impacts in industry and freight over the ten-year horizon. This time horizon allows for some substantial changes, which could will alter freight movements significantly as technology progresses.

Automation

Delivery mechanisms, including the limited use of airborne, unmanned delivery vehicles changes the last mile requirements of standard business to consumer delivery. Amazon has expressed interest in creating same day delivery options on goods that would require use of automated technologies. Due to the limited geographic scope of these airborne movements, high initial costs, liability concerns, and the approval processes required of the Federal Aviation Administration, only limited changes to standard package delivery services could be expected.

¹¹ U.S. Army Corps of Engineers *Great Lakes and Mississippi River Interbasin (GLMRIS) Study*, 2014. <http://glmrис.anl.gov/glmris-report/>

¹² Great Ships Initiative. <http://www.greatshipsinitiative.org/>

With respect to freight vehicles themselves, both rail and truck related, there is an increased likelihood that convoyed road trains may find uses throughout the industry in the next decade. These trucks, currently under testing by equipment manufacturer Volvo, require a lead driver with tractors controlled behind it by electronic automation. The current definitions of doubles and triples would need to be altered to consider the changes in vehicle technology.

The full automation of trucking could cause massive disruptions in the labor forces associated with the industry. Over 150 firms and over 13,000 employees are currently associated with the trucking industry in Minnesota. These firms account for over \$2.5 billion in economic activity plus the value of their goods. Associated industries, such as truck stops and truck repair services, would also be secondarily impacted.

3D Printing

3D printing has emerged as a viable option to distribute manufacturing widely as well as allow for new designs for engineered materials. Large-scale 3D printing has enabled entire houses to be printed in under 24 hours using this technology. Bridges can be “printed” in place and assembled with minimal disruption to the traveling public. The implications for large manufacturing, roadway construction and general architectural design are increasingly apparent. Cost savings from labor reduction, material recycling, and efficiency make this technology operational beyond the laboratory level.

Beyond highway construction, the emergence of 3D printing has substantial impacts for the production of goods. The proliferation of manufacturing sites, with on-site production capability, changes the dynamics of supply chains considerably. The ability of firms to “print” replacement pieces or highly manufactured devices (including medical equipment and machinery) rather than relying on the movement of freight alters the reliance on shipments of these components.