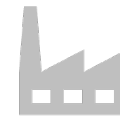




4. PLANNING CONSIDERATIONS

4.1 Safety | 4.2 Funding | 4.3 Regulations and trade | 4.4 Labor and workforce
4.5 Bottlenecks | 4.6 Market access and supply chains | 4.7 Technology | 4.8 Resiliency | 4.9 Energy





Proactively identifying and understanding key trends and issues impacting the freight transportation system is critical to implementing the most appropriate strategies and investments.

All trends and issues are subject to varying degrees of change and uncertainty. There are a number of things that have the potential to significantly disrupt current supply chains and freight corridors, including:

- Funding availability,
- Shifting reliance on global supply chains,
- Continuous growth of e-commerce,
- Acceleration of automation and emerging technologies,
- Increasing frequency and intensity of severe weather events,
- Global pandemics, and
- Sustained focus on infrastructure and supply chain resiliency.

Although uncertainty exists, it is necessary to attempt to forecast what should be considered and possibly addressed in the near- and long-term. Iowa Freight Advisory Council (FAC) members were asked to identify and prioritize trends and issues impacting the freight industry that should be considered when making planning and programming decisions. These items are listed in the priority order identified by the FAC below. The chapter mirrors this ranking, with its nine sections arranged accordingly. Section 4.1 examines the top-ranked issue, and each following section addresses the next topic in descending order.

1. Safety
2. Funding
3. Regulations and Trade
4. Labor and Workforce
5. Bottlenecks
6. Market Access and Supply Chains
7. Technology
8. Resiliency
9. Energy



4.1 Safety

Safety is always a top priority for the Iowa DOT and freight movers of all modes. With increased freight movement comes increased risks. Over time accidents on interstates and highways have increased and accidents between freight trucks and passenger vehicles have also gone up, making safety the number one planning priority in the 2026 State Freight Plan.

As **truck traffic** grows, the Iowa DOT's focus on highway safety is critically important. There are many places along the road network where freight traffic and passenger traffic can interact dangerously, and it is important for the DOT to identify and implement solutions for these problem areas. One such area is **traffic operations** focusing on maintaining safe and efficient travel conditions.

Another area is insufficient **truck parking**. Across much of the Interstate system, trucks are often forced to park at locations that are unsafe to both the driver and the traveling public. This is in part due to new hours of service (HOS) regulations being implemented to help mitigate **driver fatigue**. These new regulations require drivers to stop more often for rest times and can lead drivers to park illegally or at dangerous locations (e.g., on/off ramps, shoulders, etc.) to meet these requirements.

Expanding truck parking across the state will help to mitigate these safety concerns by allowing drivers to park either for their 15-minute break or for their off time, greatly reducing fatigue, improving rest time quality, and reducing unsafe parking on ramp shoulders and other dangerous locations. By allowing greater access to the amenities provided at rest areas and private truck stops, more drivers can have a comfortable and complete rest time.

Traffic Operations

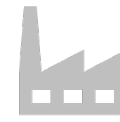
Traffic operations include several areas focused on maintaining safe and efficient travel conditions on Iowa's road network. These coordinated tools, technologies, and personnel ensure roadway capacity is used effectively and disruptions to traffic flow are minimized. Key components include:

Emergency Management uses pre-developed response plans for severe weather, flooding, hazardous materials incidents, and cybersecurity threats. These coordinated responses protect public safety and restore normal travel as quickly as possible, improving system resilience during major disruptions.

Traffic Incident Management addresses everyday crashes and vehicle breakdowns by promoting safe and rapid clearance. These efforts reduce secondary crashes, limit delays, and help keep people and freight moving reliably throughout the state.

Work Zone Management minimizes the impact of maintenance and construction through advanced planning, temporary traffic control, and traveler communication. Effective coordination prevents unnecessary congestion and maintains freight mobility during roadwork.

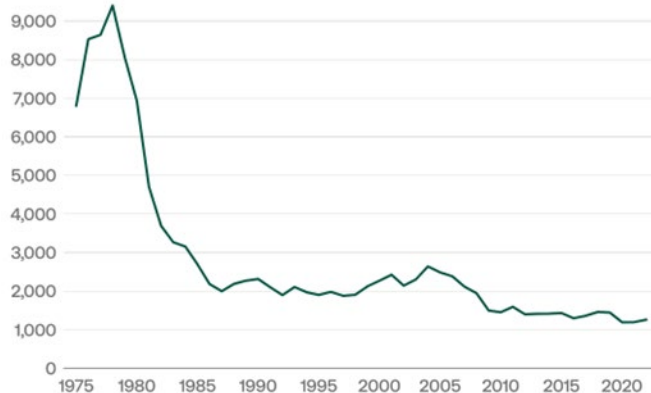
Together, traffic operations strategies reduce bottlenecks, maintain system performance, and support the efficient movement of freight which is essential to Iowa's economic competitiveness.



Another significant safety issue related to the freight industry is **human trafficking**. Traffickers typically target professions deemed “transient in nature” as consumers, and regularly travel across multiple states to places such as oil and gas fields, truck stops, hotels along highways, etc. The trucking industry is critical in helping to spot these types of activities. Law enforcement continues to reach out to the freight industry and others for partnering opportunities in the fight against human trafficking.

Rail safety is another primary concern. In 2024 there were a reported 742 derailments in the United States. This number is significantly lower than the peak of 9,400 derailments in 1978, as shown in Figure 4.1. However, the number of derailments and potential impacts are clear indications of how improvements still need to be made. One of the most noteworthy recent derailments was the 2023 East Palestine derailment in Ohio. The accident burned thousands of gallons of hazardous materials and brought focus to an ageing rail system and out of date safety mechanisms for rail and hazardous materials transportation.

Figure 4.1: Train derailments, 1975-2022



Source: US Department of Transportation

Rail crossing safety at grade crossings is also a major focus. Collisions at highway-railroad grade crossings have decreased but fatalities have been relatively flat over the past 10 years, making this a priority in states like Iowa. The Iowa DOT regularly updates the Highway-Railroad Grade Crossing Safety Action Plan, which focuses on crossings with multiple crashes or those that are “at risk” and identifies specific solutions, including closure and consolidation of at-grade crossings. It also focuses attention on trespasser hotspots.

The Iowa DOT is committed to seeking out and improving safety around all modes of freight and continuously monitoring freight related fatalities. The DOT’s goal is to seek out solutions and reduce the number of accidents and lives lost due to freight transportation.

See Chapter 2, System Inventory and Performance (Section 2.3, Inventory and Performance by Mode) for Iowa freight-related safety statistics.



4.2 Funding

The state of Iowa is fortunate to have a strong multimodal freight transportation system that facilitates safe and efficient movement of goods. This system provides industries in Iowa, and across the United States, with a competitive advantage in the global economy. However, this advantage is at risk of deteriorating due to an aging transportation network, rising maintenance costs, and the declining buying power of existing funding sources.

A well-maintained freight system reduces transportation costs and ensures reliable, consistent service—factors critical to how companies decide where to expand and how they move goods. Without sustained investment, Iowa’s freight infrastructure will weaken, diminishing the competitiveness of both the state and nation.

Infrastructure funding challenges continue to grow across the United States as costs for maintaining roadways and bridges rise while key revenue sources remain stagnant. Iowa’s **Road Use Tax Fund (RUTF)**—the primary state funding source for roads and bridges—faces long-term pressure as its ability to keep pace with construction and maintenance costs continues to erode, primarily due to **inflation**. Annual inflation measured by the National Highway Cost Construction Index (NHCCI) showed that inflation for construction cost was at 17.3% in 2021, 27.6% in 2022, and 11.9% in 2023. Addressing these challenges requires exploring all potential funding sources and maximizing the efficiency of existing programs.

To ensure **sustainable investment** in the freight system, Iowa must consider new or alternative funding mechanisms. Difficult decisions will be necessary to address the state’s funding shortfall. Prioritizing projects, emphasizing stewardship, and achieving the right blend of investment strategies in the multimodal system will be critical to ensure limited dollars are spent in the most beneficial way. Asset management and rightsizing practices will be necessary to help the system operate as efficiently as possible and maximize the benefits of each dollar spent. Targeting improvements at specific high priority areas such as freight bottleneck locations and focusing investments on the Iowa Multimodal Freight Network will help safeguard and strengthen Iowa’s economic output, positioning the state for future growth and funding stability.

In 2009, the TIME-21 legislation was passed and in 2015 the **fuel tax** was increased. Both helped to increase revenues raised for the state, but as shown in figure 4.2, these increases have not been enough to keep up with the increased cost of construction, and thus, the state’s buying power continues to diminish.

In addition to diminishing buying power, the long-term viability of the RUTF is challenged by advances in fuel efficiency and the rise of alternative fuel vehicles. Growth in electric vehicles and improvements in fuel efficiency mean less traditional fuel is purchased per mile traveled. As alternative fuel vehicles become more common, this imbalance is expected to widen further.

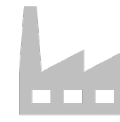
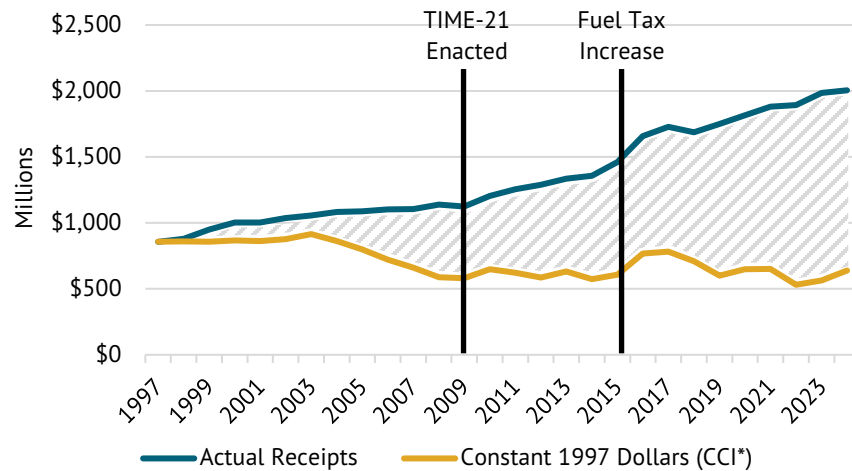


Figure 4.2: Historic trend in RUTF revenue buying power



** Iowa Construction Cost Index, which reflects the inflation of roadway costs in Iowa and corresponding loss in buying power*

Source: Iowa DOT

To address this growing mismatch between roadway use and revenue, many states have begun exploring or implementing a mileage-based user fee (MBUF) system. An MBUF charges drivers based on the number of miles traveled—and in some models also accounts for vehicle weight and axle configuration—more directly aligning revenue with actual roadway impacts and future maintenance costs.



4.3 Regulation and Trade

Regulatory alignment is critical, as the regulations intended to keep freight safe and reliable can become difficult to navigate when they vary across federal, state, and local levels. These regulations have firsthand effects on those doing business in Iowa. To provide as much ease in conducting business as possible, the state must have a complete understanding of regulatory requirements at every level of government. This understanding supports more consistent regulatory application and smoother freight operations.

Improved coordination, education, and streamlining of freight-related regulations is also needed. Although regulations (e.g., safety, environmental, economic, etc.) are developed with good intentions, some can become impediments to efficient freight movement. Barriers commonly cited by the industry include truck size and weight limitations, routing restrictions, HOS rules, fuel and emissions standards, and customs and border security rules.

One of the primary obstacles within the regulatory environment is the fragmented nature of federal and state authorities. Regulations and policies are developed across modes, sectors, and jurisdictions, often leading to misalignment. Insufficient coordination between these authorities contributes to inefficiencies and bottlenecks. Greater alignment and streamlining of freight-related regulations can help reduce conflicts, improve compliance, and minimize unintended impacts on shippers and industries.

Shippers in Iowa continue to encounter regulatory obstacles that hinder the movement of freight across all modes of transportation. If not addressed, these issues may lead to delayed shipping, increased congestion, reduced safety, and a broader drag on economic performance.

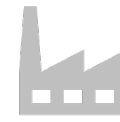
Truck size and weight standards are a blend of federal and state regulations controlling the maximum gross vehicle weights and axle loads on the highway system. Federal law controls loads on the Interstate Highway System and state law controls loads on non-Interstate highways, leading to inconsistent regulations from state to state.

HOS requirements refer to the maximum amount of time commercial drivers are permitted to be on duty, including driving time, and specifies number and length of rest periods to help ensure that drivers stay awake and alert.

An **Electronic logging device (ELD)** is technology that automatically records a driver's driving time, rest time, and other HOS data. The Federal Motor Carrier Safety Administration (FMCSA) requires most motor carriers and drivers required to keep records of duty status to use ELDs.

Positive Train Control (PTC) is a technology that uses global positioning systems and radio communication to prevent collisions or derailments caused by human error. Congress mandated in 2008 that PTC be adopted and implemented on Class I railroad main lines over which certain hazardous materials are transported and on lines with regularly scheduled passenger rail.

The **Jones Act** is a federal law that regulates maritime commerce, requiring that goods shipped between U.S. ports must be transported on ships that are built, owned, and operated by Americans or permanent residents.



Trade is central to Iowa's major economic industries, agriculture and manufacturing, which rely heavily on exporting goods out of the state, even as a growing share of products remain in Iowa for additional value-added processing. Currently, Iowa's industries are forecasted to continue increasing their exports, both domestically and internationally, making any future trade negotiations imperative to reduce trade limitations and improve Iowa's overall economic competitiveness.

Imports and exports are forecasted to make up a greater share of freight movement in the United States as international trade continues to grow and supply chains become increasingly global. This trend will result in increased freight activity and higher demand for containerized intermodal cargo. Monitoring international trade agreements and negotiations will be important for understanding potential implications for freight transportation in Iowa. For example, the United States-Mexico-Canada Agreement (USMCA), signed in 2019 as a modernized version of the North American Free Trade Agreement, is expected to support mutually beneficial trade, leading to increased efficiencies and robust economic growth for the U.S. and its two largest trading partners.

Potential challenges to growing international trade include existing bottlenecks on the freight system, growing congestion at U.S. trade gateways and border crossings, and infrastructure limitations at ocean ports. Multimodal bottlenecks are present throughout the transportation system and are exacerbated by increased freight movement, while consistent congestion at trade gateways resulting from inspections and security requirements. Additionally, some U.S. ports lack the capacity to dock, unload, and load larger megaships that can now transit the Panama Canal to access Gulf and East Coast ports. Ports that can handle these larger vessels have experienced significant growth, but the surge of cargo from megaships can strain connecting landside infrastructure and operations.

Iowa must be prepared for changes in both national and international trade. By closely monitoring trends such as rising demand for containerized freight, bottlenecks at major ports, and capacity challenges across the United States, the state can develop proactive plans and policies that help mitigate disruptions and prevent delays that could slow Iowa's economic activity.

U.S. industries may explore bringing manufacturing or production sites back to the U.S. (**reshoring**) or moving to nearby countries (**nearshoring**) to avoid longer transportation routes and congested ocean ports. Benefits of reshoring and nearshoring are:

- Shorter lead times,
- Increased production control,
- Improved time to consumers,
- Streamlined distribution of products, and
- Avoidance of taxes and tariffs

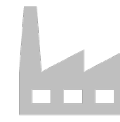
Tariffs are a current challenge in the economic sphere as they impact the cost of trade goods in the United States. These tariffs have been implemented to encourage domestic manufacturing and strengthen local economies, including Iowa's, which has a large manufacturing base. However, many Iowa manufacturers depend on imported materials and components to produce their goods. As a result, the implementation of tariffs has placed additional strain on freight transportation, as shippers face uncertainty about future demand and the flow of goods from foreign markets.

Many manufacturers have been forced to adjust what and how they produce goods in the United States, temporarily halting production and slowing economic activity. Although the long-term benefits of tariffs on the U.S. economy remain unclear, it is important to plan and prepare for disruptions like these, which can affect both the movement and production of goods.

Another consideration related to tariffs is the potential for retaliatory tariffs from other countries. These tariffs have already impacted local manufacturing and agriculture in Iowa, leading to the loss of advantage at certain foreign markets and forcing shippers to seek new customers until global trade conditions stabilize. These disruptions further contribute to uncertainty in freight transportation and limit the ability of shippers to plan beyond the short term. Sustained disruptions may lead to a long term, or even permanent, shift in trade practices, which could hurt Iowa shippers and farmers.

See Chapter 3, Industries and Commodities (Section 3.2, Commodity Movement), for Iowa domestic and international trade trends.

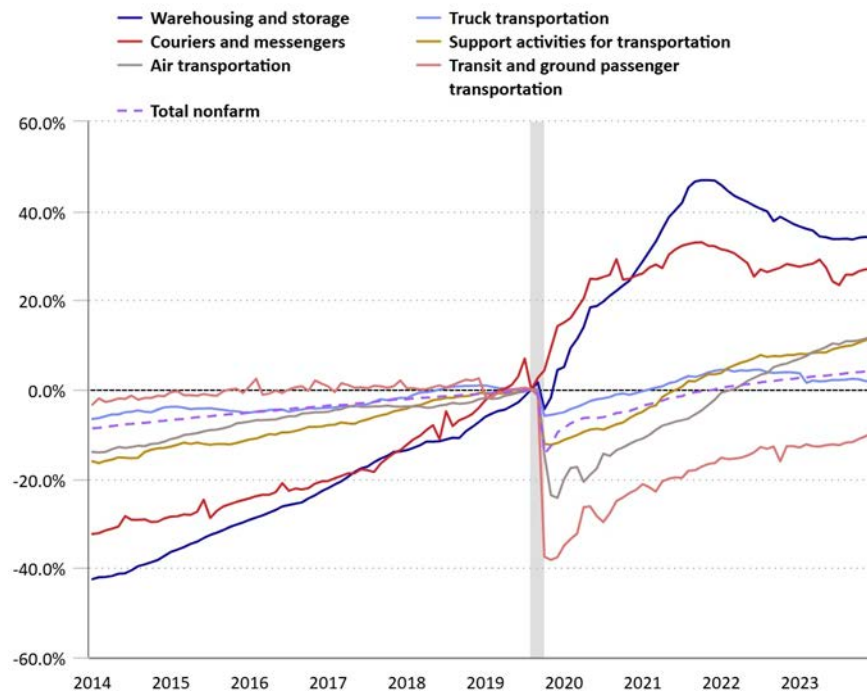




4.4 Labor and Workforce

Labor shortages in freight reached a critical point during and after the Covid-19 pandemic, exposing cracks in both global and national transportation infrastructure. These shortages have persisted, and retaining and recruiting qualified workers—particularly commercial drivers—remains a challenge. Even before the pandemic, labor shortages were already a concern. As shown in Figure 4.4, since February 2020, employment rates in truck transportation have only increased by 1.8%.

Figure 4.3: Percent change in employment relative to February 2020, selected transportation and warehousing industries, seasonally adjusted



Source: U.S. Bureau of Labor Statistics

Currently, about 25% of trucking firms cite workforce shortages as their biggest problem. The rise of e-commerce in the United States has further increased demand for freight transportation, straining supply chains and exacerbating the labor shortage. As recently as 2022, the industry projected a shortage of 80,000 drivers, with that number expected to grow to 160,000 by 2031.

Industry organizations offer differing perspectives on the root causes of these shortages. The American Trucking Association (ATA) attributes the problem to an aging workforce and a lack of younger generations entering the industry. In contrast, the Owner Operator Independent Driver Association (OOIDA) points to low wages, poor working conditions, and inadequate benefits as key contributors. Additional challenges include rapidly evolving technologies that reshape job expectations and a shift in workforce preferences toward being home nightly rather than on long-distance hauls.

These contrasting views also lead to divergent solutions. The ATA advocates for regulatory changes, including lowering the **commercial driver's license (CDL)** age requirement from 21 to 18. Meanwhile, OOIDA emphasizes the need for improved wages and better working conditions to attract and retain drivers.

Addressing the truck driver shortage requires looking at both sides of the debate for solutions. Regulatory changes such as lowering the CDL age requirement may increase the employment pool, but without addressing other underlying issues such as working conditions and pay, recruitment gains are unlikely to resolve the issue in the long term. If these issues are not addressed, labor shortages are likely to persist and intensify, and in turn could increase the strain on supply chains, freight costs, and ultimately impact the nation's economy.

4.5 Bottlenecks

A **freight bottleneck** is a location that experiences a repeatable, measurable disruption in the flow of freight. This could be caused by a physical barrier or limitation, a regulatory hurdle, or disruptions from excessive traffic. The Iowa DOT has identified lists of bottleneck locations for each mode of freight transportation. Highway bottlenecks include locations where operating speeds fall to at or below 60% of the roadway's reference speed. Railroad chokepoints include locations with structural constraints that restrict the size of cargo that can be carried, such as low clearance bridges; congested locations where a rail line is shared by more than one railroad; and low-lying areas that are at risk of flooding. Waterway bottlenecks include all lock and dam and swing span bridge locations on the Mississippi River.

These locations were collected through a mixture of stakeholder feedback and data analysis. Addressing and resolving these bottlenecks will help improve the flow of freight in the state. Targeted investment in operational and physical improvements at these bottleneck locations should be prioritized.

Monitoring how cargo is transported into and out of the state is important and can help guide where remediation efforts should be prioritized. **Rail cargo** has declined by approximately 3.4 million tons between 2017 and 2023. **Air cargo** also saw a slight decrease with about 10,000 fewer tons moved. **Waterways cargo** declined by approximately 3 million tons over the same period. It is unclear whether these decreases reflect a reduction in economic output, changes in data collection methods, or both.

See Chapter 2, System Inventory and Performance (Section 2.3, Inventory and Performance by Mode) for Iowa freight-related safety statistics.

First mile/last mile connections from the highway network, including the Iowa Multimodal Freight Network (IMFN), to freight generating facilities and final customers are important for the overall freight system. Distribution centers and other intermodal/multimodal facilities are even more important with the continuous growth of e-commerce, manufacturing, and agricultural production. These connections can be bottlenecks due to congestion, interactions with passenger vehicles and pedestrians, and design limitations on local roadways.

Rural infrastructure serves as the first mile/last mile connections for the agricultural industry. Rural highways and bridges are in poor condition, and these routes are critical for getting inputs to the field and outputs to market. Farmers are now using larger, heavier field equipment and shipping more commodities via truck directly to processors or export terminals, which increases the importance of rural routes. As changing urban-rural dynamics continue, more population and resources are in urban areas while more production areas and key freight corridors are in rural areas, further exacerbating rural infrastructure funding issues.

Figures 4.4 and 4.5 show Iowa mileage by roadway type and vehicle miles traveled (VMT) by vehicle type.

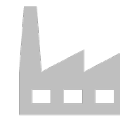
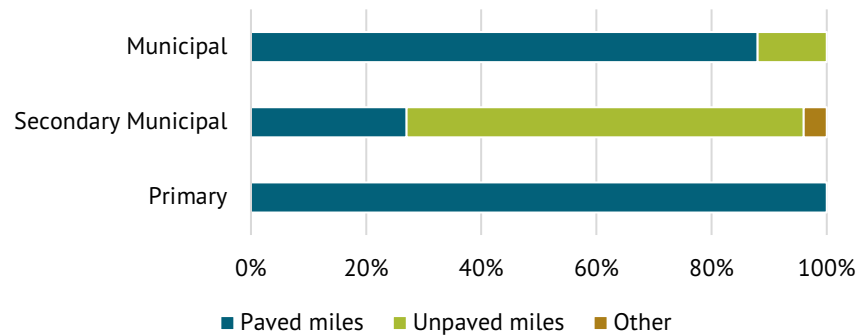
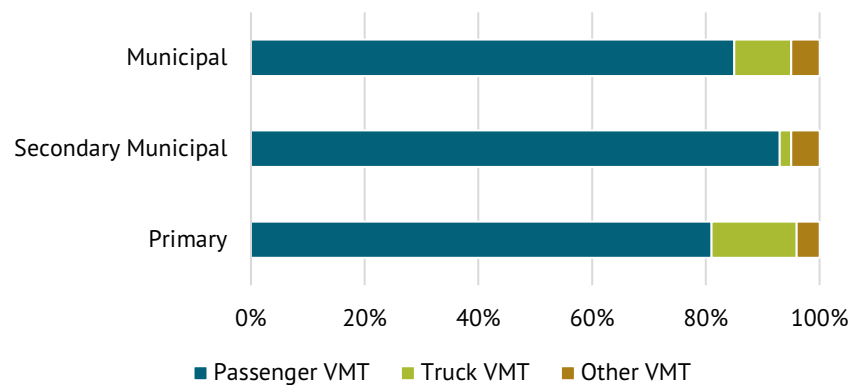


Figure 4.4: Paved miles by road system, 2024



Source: Iowa DOT

Figure 4.5: Vehicle miles traveled (VMT) by road system, 2024



Source: Iowa DOT

Developing freight-specific **highway design** considerations will help protect and enhance the IMFN and related first mile/last mile connections. Investments targeted for facilities that handle significant freight traffic, including **oversize/overweight (OSOW)** vehicles, should incorporate designs compatible with these types of freight movements, and avoid improvements that unintentionally create new obstructions to freight movement in urban and rural areas.

See Chapter 5, Action Plan (Section 5.1, Implementation strategies), for Iowa DOT freight design considerations.



4.6 Supply Chains and Market Access

Supply chains rely on Iowa's freight system as a critical tool for maintaining connectivity and keeping the economy flowing—from producers of raw materials to manufacturers processing those materials into goods, and ultimately to the end consumer. Without an efficient and well-maintained transportation system, Iowa's economic supply chains would bottleneck and could lead to loss of revenue and increased pricing for consumers. That is why it is not only important to pay attention to how or where our goods are produced but also important to pay attention to how materials are transported to production sites.

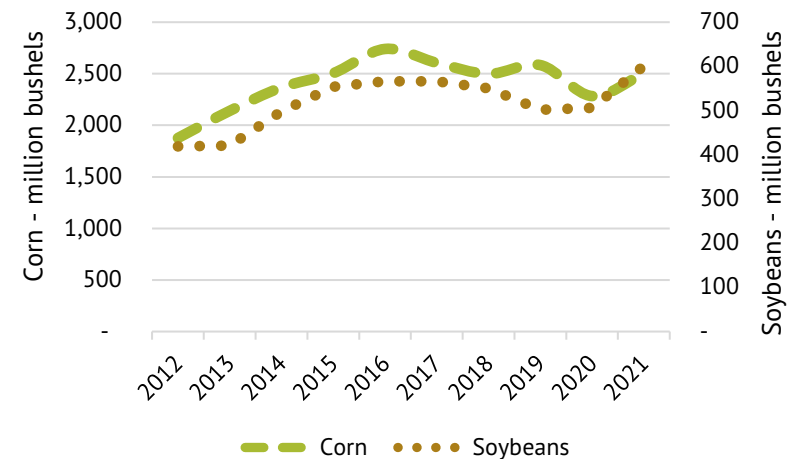
Although Iowa's economy is dominated by agriculture, the state does boast a diverse manufacturing industry. Manufacturing locations are scattered across the state in both urban and rural areas and range from food processing to agricultural equipment production. These manufactures rely on a combination of local and imported inputs in there manufacturing process to make their products. Monitoring how these inputs are transported into the state is essential to ensure the most efficient and cost-reducing freight movements. This will, in turn, help to keep Iowa's industries competitive in both national and global market.

See Chapter 3, Industries & Commodities (Section 3.3, Primary Supply Chains) for more information.

Maintaining and improving strong **market access** for shippers is essential for Iowa's economy to compete nationally and globally. An efficient and resilient transportation system allows Iowa's producers to export goods effectively within and beyond the state for both consumption and production. With **agriculture products** remaining Iowa's dominant export, maintaining a strong rural transportation system and reliable multimodal facilities is vital to efficiently transfer goods between modes and connect products to outside markets.

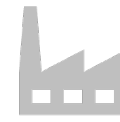
In recent years, Iowa's agricultural economy has shifted from small farms to larger, more corporate operations that increasingly focus on exporting their products outside the state. Combined with higher yields per acre, noted in figure 4.6, this growth places new demands on the state's transportation system, emphasizing the need for multiple reliable modes for producers to choose from in getting their products to market.

Figure 4.6: Iowa agricultural production, 2012-2021



Source: U.S. Department of Agriculture

Iowa is fortunate to have a highly connected multimodal transportation network that facilitates the movement of goods within and beyond the state. Des Moines, for example, is served by I-35 and I-80, three Class I railroads, and the Des Moines International Airport, which also features a Foreign Trade Zone. This allows for the import and assembly of goods without immediate customs fees or inspections, strengthening the city's role as a logistics hub.



For agricultural exports, producers have long relied on the highway system to move goods to elevators and barge terminals, inland waterways to reach Gulf Coast ports via barge, and railroads to ship to West Coast ports via unit trains. However, this trend is shifting. Producers—whether individual farmers or larger farming corporations—are increasingly achieving **economies of scale** by transporting products directly via truck, reducing reliance on local consolidation points and rail terminals.

As producers and shippers continue to adjust shipping practices, it may become necessary to reevaluate Iowa's freight transportation network, particularly the **Farm-to-Market System** and other rural infrastructure that serve as critical first-mile and last-mile connections. Optimizing the freight network in this way could improve infrastructure conditions and reduce costs and travel time while improving overall supply chain efficiency.

New connections will be essential to maintaining and improving Iowa's market access, requiring ongoing expansion and enhancement of multimodal transportation systems such as the one serving the Des Moines area. These efforts are key to supporting Iowa's growing agricultural production and preventing future bottlenecks. One example happened in 2025 when the Iowa Interstate Railroad completed development of a new 367-acre rail yard in Jasper County, creating jobs and strengthening Iowa's economic and freight transportation capacity. As Iowa looks to invest in new freight facilities and improve its transportation connectivity, these investments will have impacts on land use considerations around the state.

The need for continued investment in multimodal transportation will only increase as Iowa's **biofuel industry** expands. With abundant corn harvests, much of the crop now remains in-state to be processed into ethanol and other biofuel products. Strengthening the farm-to-market system and improving links between biofuel facilities and external markets will enhance Iowa's economies of scale and further establish the state as a leader in energy production.

Intermodal Connections

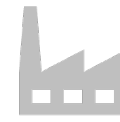
Intermodal is not the same as multimodal. While multimodal refers to the availability of different modes of transportation, intermodal focuses on specific locations where multiple modes converge. Investing in intermodal connections—such as transload facilities with direct access to the highway system, where goods can easily transfer from rail to truck—will help improve producers' access to multimodal transportation options, enhance the flow of goods, and reduce bottleneck issues across Iowa's freight network.

Container Availability

Iowa produces more products shipped via container than it receives, creating a significant imbalance of containers. To meet demand, empty containers must be transported into the state, adding extra transportation costs that ultimately increase prices for consumers. However, the issue is more complex than simply not having enough containers. Labor shortages, rapid changes in trading patterns, and shifts in global trading partners make it difficult to maintain a predictable container flow. As sellers wait for new buyers, containers often sit idle at ports or other facilities, further contributing to inefficiencies in the global trading system and driving up freight costs.

To support these efforts, Iowa utilizes a range of financing programs designed to invest in transportation infrastructure and foster new economic connections. The **Railroad Revolving Loan and Grant (RRLG) Program** provides funding to private businesses for constructing new rail yards and track improvements that create and sustain Iowa jobs. The **Revitalize Iowa's Sound Economy (RISE) Fund** promotes economic development through road and street construction and improvement projects focused on enhancing economic activity. These and other programs demonstrate Iowa's commitment to maintaining a robust, connected, and forward-looking freight network.





4.7 Technology

Artificial intelligence is technology that allows for machines or programs to learn from experience, adjust to new inputs, and perform tasks. Firms are looking to apply advances in artificial intelligence and machine learning to improve the performance of freight movement and delivery networks.

3D printing, also known as additive manufacturing, uses Computer Aided Drafting to create 3D models that are ultimately sent to a 3D printer to be created. Material categories include plastics, metal (powder bed, powder feed, or wire extrusion), ceramics, food, stem cells, and others. Industrial-scale 3D printing could alter supply chains as businesses wouldn't need to ship inventory but rather the raw materials to be used to print inventory.

Aviation trends are emerging that may influence freight movement, security, and economic activity. Most notable is the emergence of **unmanned aircraft systems**, or drones, which are being explored for freight related applications such as time sensitive deliveries, logistics support, and infrastructure inspection.

Teleoperation, also known as remote operation, uses computer and telecommunication systems to allow for the operation of freight modes. For trucking, this could support automation activities for primary operation or a fallback measure without a person in the vehicle.

Automated trucking concepts continue to be developed and tested, including truck platooning or automated following platooning (where the lead truck operates normally with driver assistance technology and the second truck operates at a higher level of automation). These emerging technologies have the potential to increase safety and efficiencies as well as hours of service (e.g., labor) and parking challenges by allowing drivers to rest in the truck while it's in operation and be on roadways for longer operations.

Commercial vehicle electrification offers many advantages over their petroleum powered counterparts. Electric trucks (like the one shown in Figure 4.7) emit zero tailpipe emissions and have a lower total cost of operation. Additionally, electricity prices have historically been lower and more stable than diesel and gasoline prices. However, transitioning to electric vehicles will require new charging facilities dispersed throughout the country, and the power generation to meet the new demand. Another challenge is the added weight of the batteries themselves. The batteries to power electric trucks can weigh several tons, creating a trade-off between travel distance and cargo capacity.

Figure 4.7: Tesla electric semi-truck



Source: Bloomberg

4.8 Resiliency

Infrastructure and supply chain **resiliency** are critical topics for both public and private stakeholders. The Iowa DOT defines resiliency as the ability to anticipate, prepare for, and adapt to changing conditions and withstand, respond to, and quickly recover from disruptions. A resilient freight transportation system is responsive and able to provide reliable services when it encounters small disruptions and returns to service quickly after large disruptions.

Increasing freight traffic is having a large impact on already aging infrastructure with limited capacity, reducing the overall resiliency of those corridors. Aging and deteriorating infrastructure is being further stressed by increases in **extreme weather events** such as flooding. Major events, such as the Missouri River floods of 2011 and 2019 in western Iowa, can disrupt or shut down critical infrastructure for days, weeks, or even months costing billions of dollars.

Infrastructure and supply chains must be resilient to smaller disruptions such as **traffic crashes** and larger events such as **cyberattacks** and **global pandemics**. The COVID-19 pandemic exposed vulnerable links in global supply chains that perhaps haven't been considered before, such as the implications of rapidly changing supply and demand situations in global supply chains and the importance of maintaining the health and safety of the freight labor force.

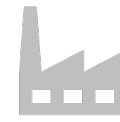
It is critical for infrastructure owners and operators to employ strategies and make necessary improvements to reduce the vulnerability of the infrastructure to extreme weather and other major disruptions. Without improvements, shippers will reassess their reliance on vulnerable freight gateways and corridors.

Consideration of resiliency in traffic operations and the overall project planning and programming process is critical for states to be prepared to address major disruptions and mitigate the impacts to freight industries. A resilient and reliable freight transportation system could ultimately lead to additional industries locating in the area.

Over the last couple of decades, Iowa has been increasingly impacted by natural disasters, including historic flooding, snowstorms, and tornadoes. This trend is likely to increase as climate data shows strong trends towards increasing temperatures, precipitation, stream flows, and flooding. Awareness of human-induced disruptions has also been amplified as vigilance of potential terrorism and cyberattacks has increased.

To address this, the Department has developed a **Resilience Improvement Plan (RIP)**. The RIP is the Iowa DOT's primary document to support integration of resiliency into the transportation system and the planning, programming, and project development processes. By focusing on resiliency, the Iowa DOT is supporting the ultimate purpose of the transportation system – getting people and goods where they need to go. The development of the RIP and resulting information produced to support the effort may help identify vulnerabilities, develop proposed resilience solutions, and schedule and prioritize resilience improvements to meet the needs of travelers.

The Iowa DOT's **Resiliency and Sustainability Committee** has also conducted a statewide network screening to identify locations vulnerable to a 100-year flood event by analyzing highway segments by robustness, redundancy, and criticality. Road closures due to flooding affect all highway traffic, from commuters to freight transportation to emergency services.



4.9 Energy

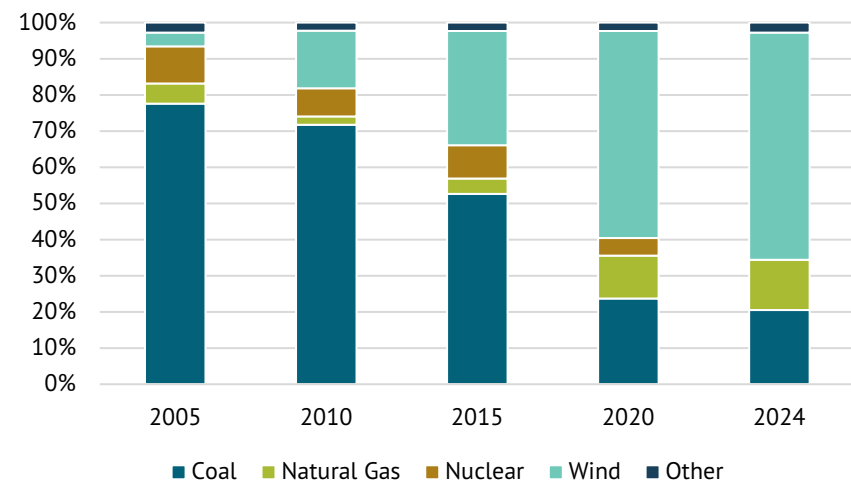
Energy production in the United States has grown significantly with one of the largest growing sectors being hydraulic fracturing of rock or “fracking.” This process allows for the recovery of deep sources of gas and petroleum products and has resulted in large amounts of gas and oil being extracted and transported elsewhere in the U.S. and abroad. The development of wind farms has also changed energy production and consumption in the U.S. Most of Iowa’s electricity is now generated by wind power, and the construction and maintenance of the wind farms means wind turbine components are regularly being moved on the freight network.

The **biorenewable** chemical industry is undergoing rapid transformation and growth. Due to Iowa’s abundance of feedstock, technical workforce, and biorenewable and plant genetic research, the state has an opportunity to be a major player in this growing industry.

Alternative transportation fuels are widely utilized in Iowa, specifically ethanol and biodiesel. Natural gas comes in the form of either compressed natural gas (CNG) or liquefied natural gas (LNG), both of which are being explored and adopted by transportation industries. Other fuel sources such as propane and renewable diesel are also being explored. Each of these alternative fuel sources produce lower emissions than gas/diesel traditionally used by freight vehicles. Adopting these would contribute to reduced air pollution.

As shown in Figure 4.8, **coal** use for energy production is declining significantly with the increased use of renewable energy (e.g., wind). This has impacted rail and barge tonnages as coal once represented a significant portion of tonnages being moved by each mode. Figure 4.9 shows energy production across the state.

Figure 4.8: Iowa utility generation by source, 2000-2024



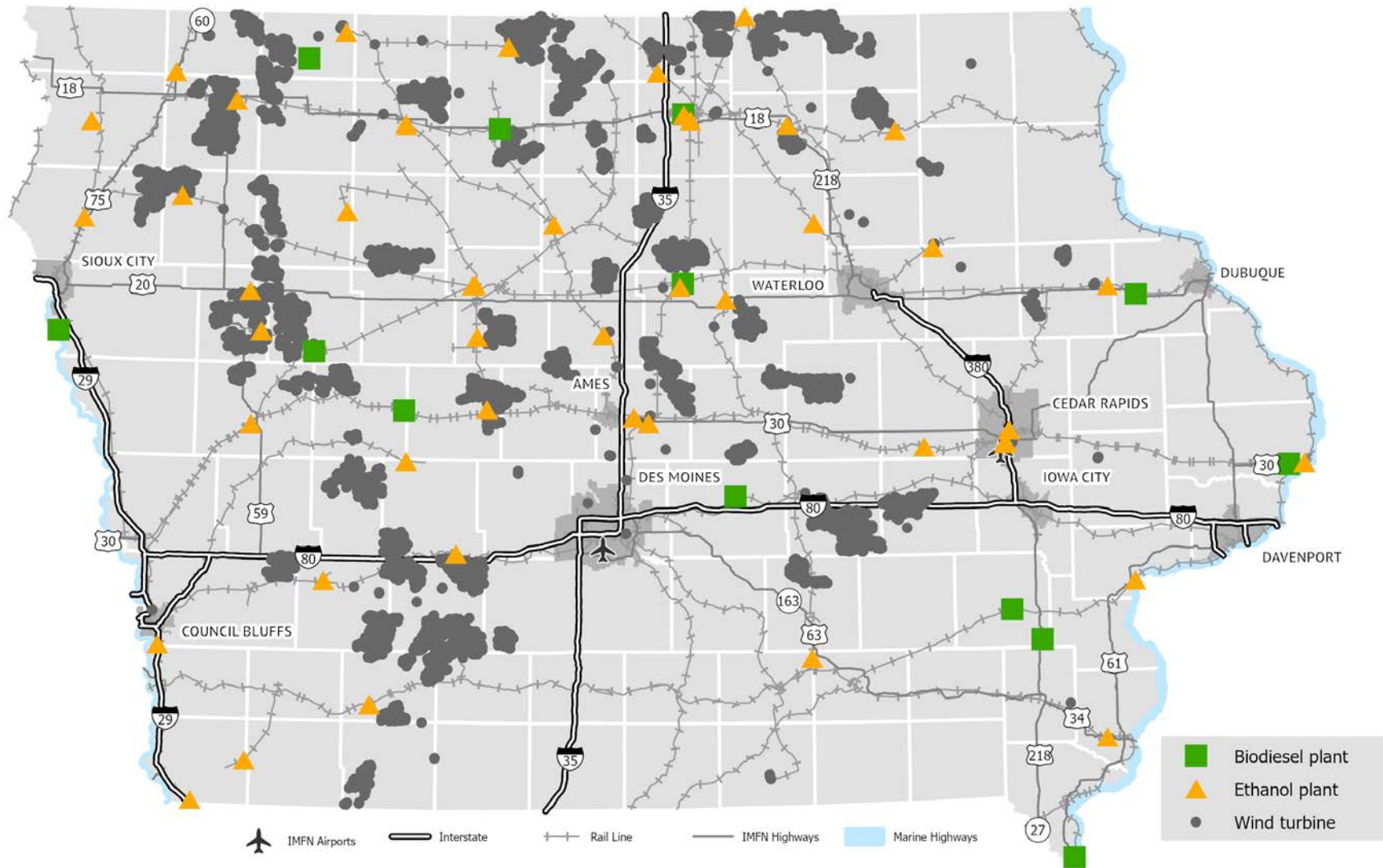
Source: U.S. Energy Information Administration

Emissions

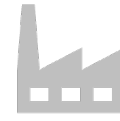
Since the Clean Air Act of 1970, vehicle emissions have faced growing scrutiny as regulations continue to tighten.

Iowa has the potential to be a leader in alternative renewable fuels that help reduce air pollution and smog. Biogasoline and biodiesel produce significantly lower emissions than traditional fuels, and expanding their production can strengthen Iowa’s agricultural economy, improve statewide air quality, and help freight shippers comply with federal standards.

Figure 4.9: Iowa Energy Production



Source: Iowa Renewable Fuels Association and U.S. Wind Turbine Database



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