

Executive Summary

The Importance of Highways to U.S. Agriculture

December 2020



United States Department of Agriculture



Highlights of Research Findings:

- 80% of domestic agricultural highway freight volume moves on 17% of highway mileage.
- State-planned highway freight investments are estimated to produce \$540 million per year in truck operating cost savings.
- Increased highway infrastructure investment, at a level 2-4 times current State Freight Plan investment levels, is modeled to be highly cost-effective (Benefit/Cost Ratio >2.0).

Read the full report:

<http://dx.doi.org/10.9752/TS295.12-2020>

ABOUT THIS REPORT

Agricultural commodities are among the Nation's largest and most important exports. The agriculture industry is the largest user of highway freight, and the industry relies on highway infrastructure for the safe and efficient transportation of goods.

This report offers insights to inform the transportation planning and project selection processes that build and maintain highway infrastructure used by the agriculture industry. The report introduces novel analysis techniques that illuminate how domestic agricultural commodities move on U.S. highways, and how the condition and performance of those highways may affect the movement of agricultural goods. Economic modeling described in the report highlights the potential for increased highway investment to benefit the agriculture industry by lowering truck operating costs and supporting improved highway performance. The report demonstrates the interconnected nature of agricultural freight, and highlights the importance of cooperation across State and jurisdictional boundaries.

This report includes:

- A summary of the economic significance of highway transportation to the agriculture industry;
- Identification of High-Volume Domestic Agriculture Highways (HDAH) based on 2018 commodity flows;
- Analysis of the performance of the HDAH and selected corridors within it;
- Modeled projections of future highway freight conditions and performance, based on planned investment levels and alternative scenarios;
- Case studies of State and local transportation agencies addressing the highway infrastructure needs of the agriculture industry; and
- A framework for conceptualizing and coordinating efforts to better address agricultural freight movement in highway planning and decision making.

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The Importance of Highways to U.S. Agriculture



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Who Should Read This Report?

This report contains valuable information for transportation and agriculture industry stakeholders alike.



State Departments of Transportation (State DOTs)

will find information about how agricultural commodities flow through corridors within their own States and neighboring States; they will also find notable practices demonstrating opportunities to incorporate agricultural data and considerations into planning and decision-making processes.



Local Public Agencies (LPAs)

will find information highlighting the importance of local and county roads in supporting a global supply chain for agricultural products, and strategies for overcoming funding, data, and coordination barriers.



Agricultural freight shippers and carriers

will find examples of the valuable role their perspective and knowledge can play in highway infrastructure planning.

U.S. AGRICULTURAL FREIGHT BY THE NUMBERS¹

\$3.1 Trillion

Annual value of agricultural freight moved across all modes in the United States in 2018.

4.5 Billion

Annual tonnage of agricultural freight moved across all modes in the United States in 2018.

27%

Agriculture industry's share of all freight ton-miles moved.

16%

Agriculture industry's share of all freight by market value.

23%

Projected increase in total freight volumes over the next 20 years.

83%

Percentage of all agricultural freight tonnage moved via the highway system in 2018.

Highways

56%

Share of agricultural freight ton-miles moved by truck in 2018.

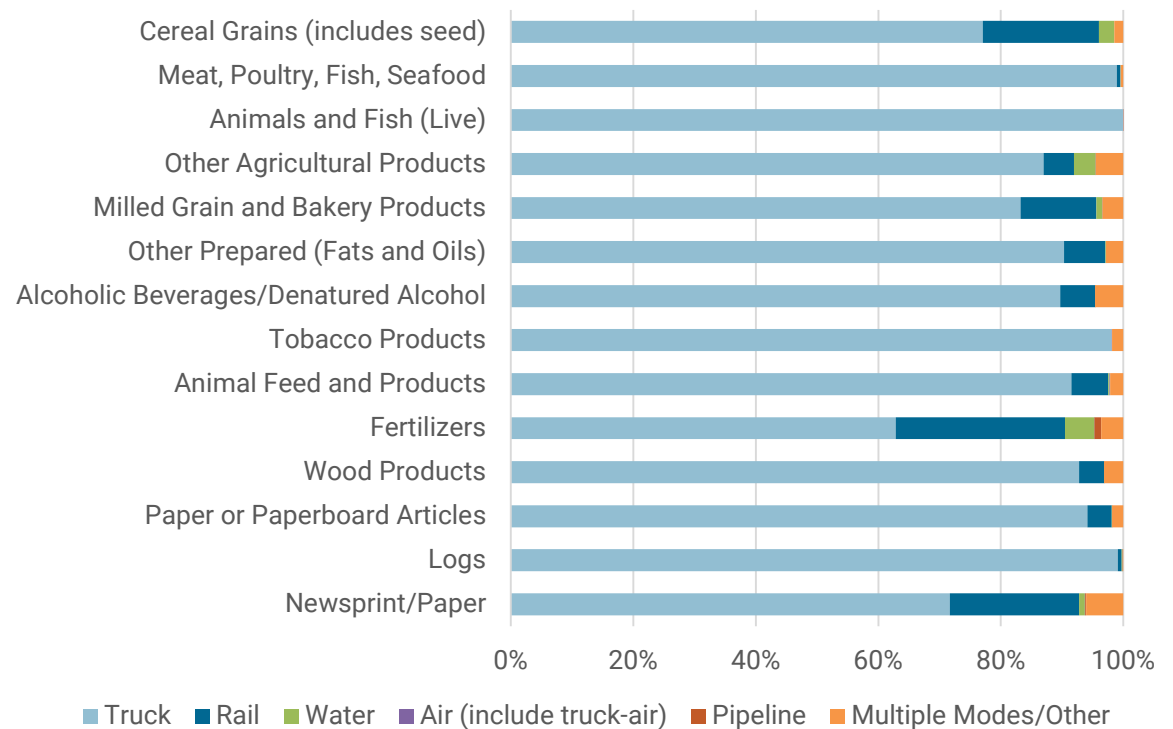
¹ All statistics are from Volpe Center analysis of Freight Analysis Framework version 4.5.1 (Bureau of Transportation Statistics (BTS) and Federal Highway Administration (FHWA), 2019).

Trucks move more agricultural freight than any other transportation mode.

Almost every agricultural freight trip includes at least one movement by truck in the full journey from farm to final destination.

Figure 1: Truck is the most common transportation mode for agricultural commodities. This is particularly true for Meat, Poultry, Fish, Seafood, and Live Animals and Fish. However, trucks carry more than 50% of the tonnage of all agricultural commodity categories.

Figure 1: Modal Transportation Characteristics of Agricultural Commodities by Tonnage, 2018



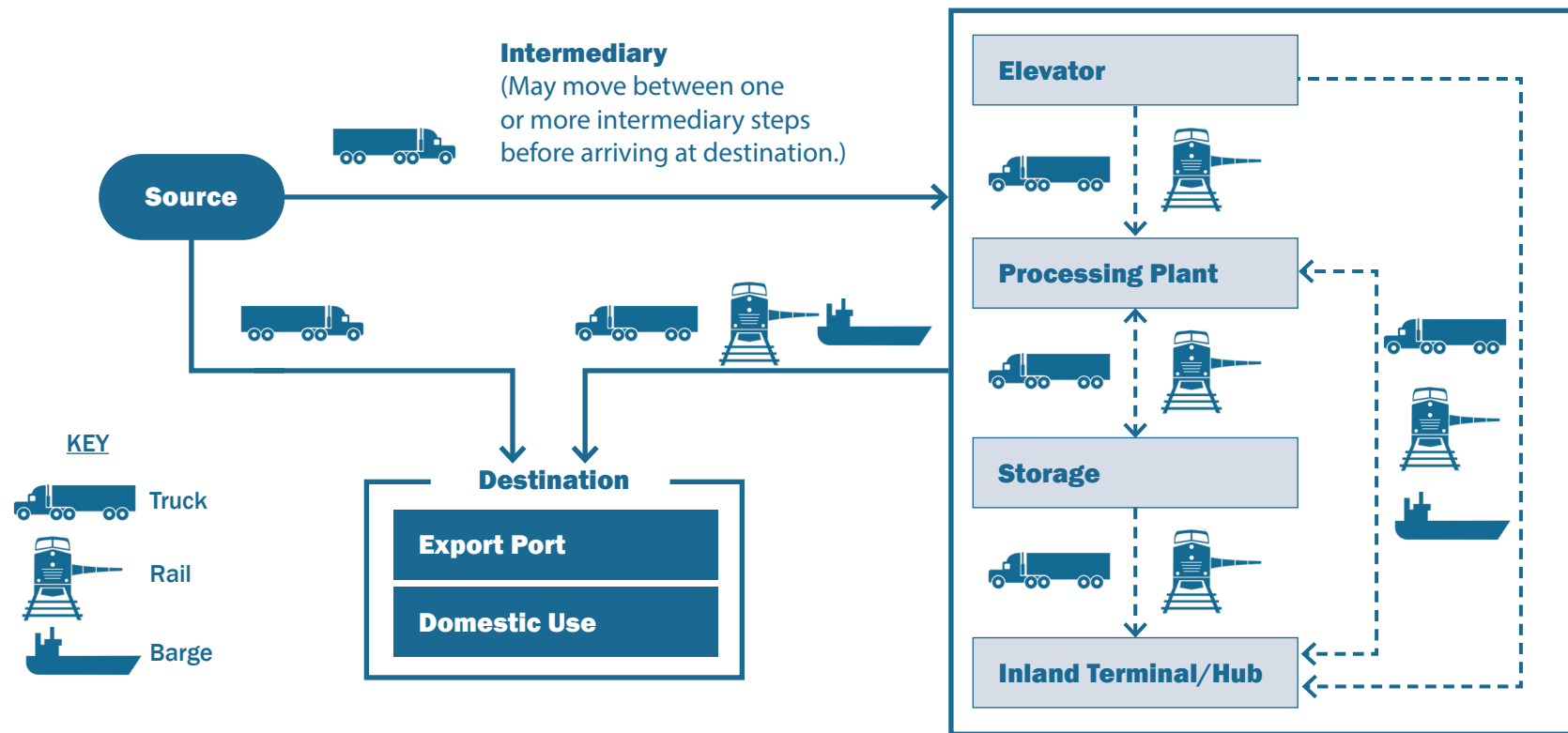
Note: Commodity categories based on Standard Classification of Transported Goods (SCTG) commodity codes. "Other Agricultural Products" includes soybeans and other oilseeds, vegetables, fruits and nuts, and fresh-cut flowers and plants.

Source: Volpe Center analysis of Freight Analysis Framework v4.5.1 (BTS and FHWA, 2019)

Trucks are an important part of almost every agricultural freight journey.

Trucks may move agricultural goods for an entire journey, through several intermediary steps, or as a part of a multimodal trip that includes rail or barge segments.

Figure 2: U.S. Agricultural Supply Chain for Raw and Processed Products



Source: Graphic adapted from "U.S. Agricultural Supply Chain for Raw and Processed Products." Study of Rural Transportation Issues (USDA, 2010)



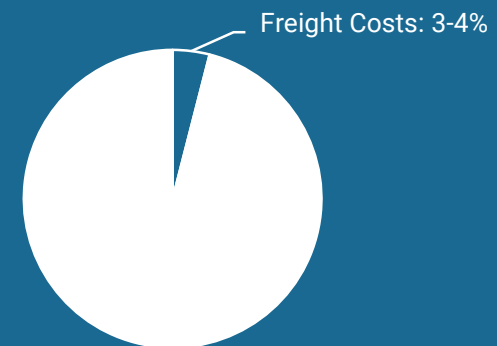
Credit: vitpho via 123rf.com

The Importance of Highways to U.S. Agriculture

Investment in highway infrastructure is critical to maintaining economic competitiveness.

Low transportation costs is one way that the U.S. agriculture industry has remained competitive with low-wage international competitors who have lower costs of production. Maintaining the performance of highways, which are often the most expensive leg of the journey on a per ton-mile basis, is essential to keeping freight costs low and supporting producers operating under tight profit margins. Should transportation costs increase, the United States could lose this competitive advantage, particularly if other countries continue to lower transportation costs by improving their infrastructure.

Figure 3: Transportation Costs as a Percentage of Overall Agricultural Costs

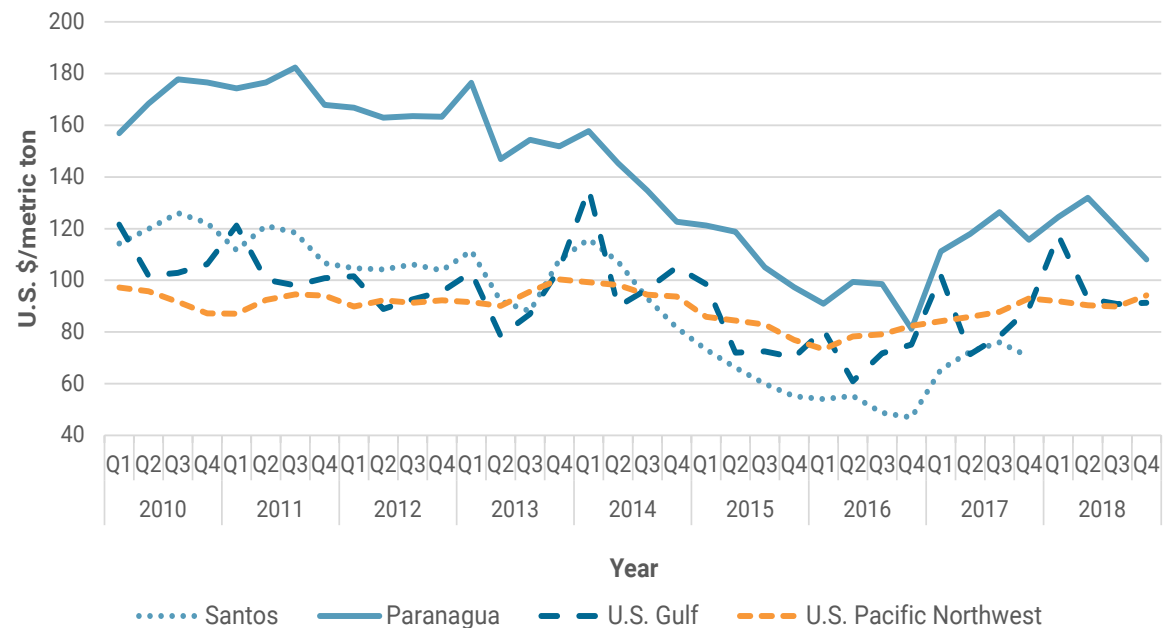


Source: *A Revised and Expanded Food Dollar Series: A Better Understanding of our Food Costs* (Canning, P., 2011)

Low transportation costs help U.S. agriculture remain competitive on the global market, but others are catching up.

The example of U.S. and Brazil soybean transportation costs shows that as Brazil's transportation costs have decreased, the United States' cost advantage has eroded significantly.

Figure 4: U.S. and Brazil Soybean Total Transportation Costs to Shanghai, China



Note: U.S. Gulf: From Minneapolis, MN, through the U.S. Gulf Coast; U.S. Pacific Northwest: From Fargo, ND, through the Pacific Northwest; Santos: From South Goiás, Brazil, data not available for 2018; Paranaguá: From North Mato Grosso, Brazil.

Source: Soybean Transportation Guide: Brazil Archive Reports (USDA, n.d.)

2013: Brazil overtook the United States as the largest exporter of soybeans.

2014: Total transportation costs for soybean shipments from Brazil dropped and began to track close to or below U.S. costs.

STAKEHOLDER PERSPECTIVES ON AGRICULTURAL FREIGHT

Stakeholder Input provided by:

The Agricultural Transportation Working Group (ATWG): which is comprised of a wide variety of food and agriculture industry groups representing agricultural shippers and receivers;

Six State Departments of Transportation (State DOTs): California DOT (Caltrans), Iowa DOT (Iowa DOT), Missouri DOT (MoDOT), North Carolina DOT (NCDOT), Texas DOT (TXDOT), and the Washington State DOT (WSDOT);

The St. Louis Regional Freightway: a regional freight planning organization, part of the Bi-State Development Corporation of Missouri and Illinois; and

The National Association of Counties (NACo).

- Continued investment in highway infrastructure is needed to maintain or improve freight performance.
- Decentralized local decision making is a barrier for agriculture industry stakeholders to communicate challenges and needs.
- Data gaps for rural roads and intermodal transfers limit transportation agencies' ability to understand how products move from farm to market.
- Building resiliency and redundancy in highway infrastructure is a critical issue.
- Developing State Freight Plans has encouraged State DOTs to think more deeply about highway freight performance.
- State DOTs study agricultural freight via corridor studies.

80% of domestic agricultural highway freight volume moves on **17%** of highway mileage

Figure 5: High-Volume Domestic Agricultural Highways (HDAH)

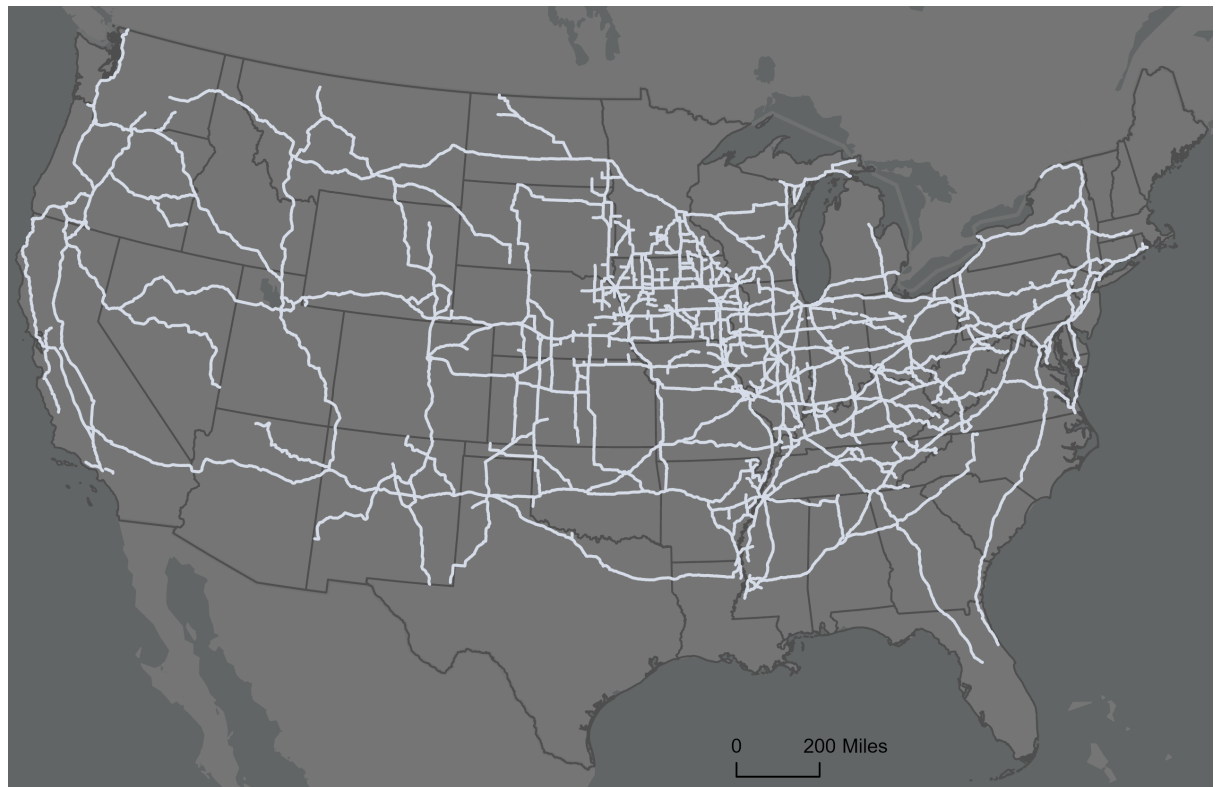


Figure 5: This report identifies High-Volume Domestic Agriculture Highways (HDAH), based on a modeled sample of detailed 2018 agricultural commodity movements. These highways are among the most important to the movement of domestic agricultural commodities.

Source: Volpe Center analysis of 2018 IHS Markit Transearch data

Analyses in this report are based on a representative sample of agricultural commodities.

The six major categories of commodities used to identify the HDAH are:



Grains

(corn, soybeans, and wheat)



Fruits and Vegetables

(apples, strawberries, oranges, watermelons, lettuce, dry onions, and potatoes)



Milk and Dairy Products



Meat

(Fresh or frozen Beef, Pork, and Poultry)



Livestock

(cows and hogs)



Poultry

(chicken and turkey)

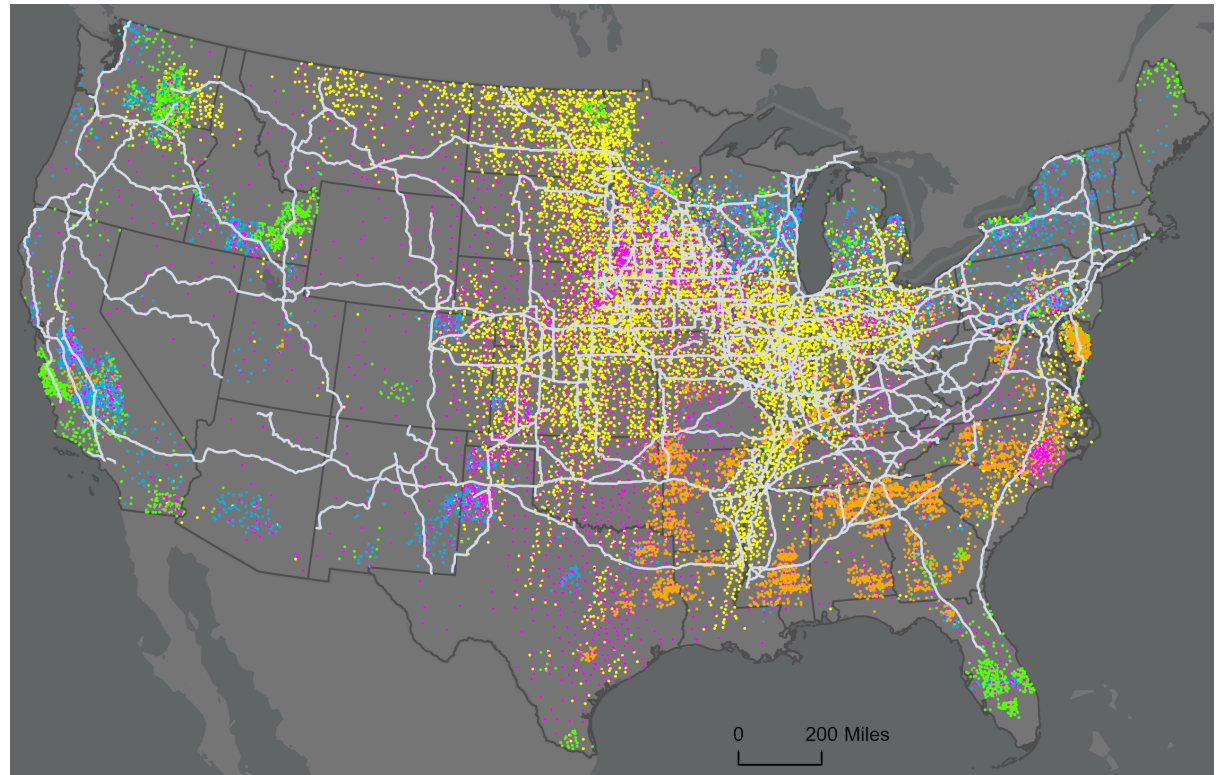


Credit: Ozgur Coskun via 123rf.com

Highways move agricultural commodities all over the country.

Agriculture is produced in virtually all States, and the HDAH include highways that connect high-producing agricultural areas with storage, processors, ports, other transportation modes, and more. The agricultural commodity flows along the HDAH comprise approximately 805 million tons and represent over \$428 billion in market value.

Figure 6: Map of HDAH overlaid with county-level production of selected commodities



Source: Volpe Center analysis of 2017 Census of Agriculture and 2018 IHS Markit Transearch data

Legend

- 1 dot ● = 1,000 Acres of Fruits & Vegetables Harvested
- 1 dot ● = 20,000 Acres of Grain Harvested
- 1 dot ● = 3,000 Heads of Dairy Cows
- 1 dot ● = 75,000 Heads of Livestock
- 1 dot ● = 400,000 Heads of Poultry
- High-Volume Domestic Agricultural Highways

Figure 6 shows that HDAH connect areas where key agricultural products are produced in high volumes, based on 2017 production.

High-Volume Domestic Agricultural Highways include more than Interstates and the National Highway System.

The HDAH consist of over 49,000 highway miles, and include both major and minor highways. They overlap significantly (but not entirely) with the National Highway System (NHS), demonstrating that some of the roads that carry the highest volumes of agricultural freight are more minor highways.

Figure 7: Percentage of HDAH Mileage On and Off the Interstate System

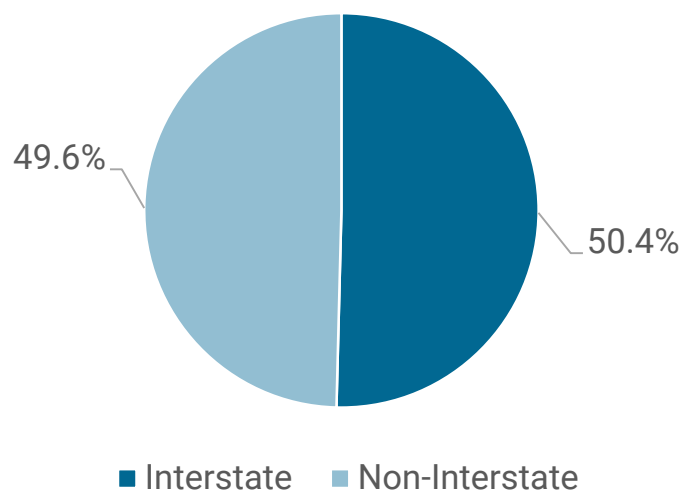
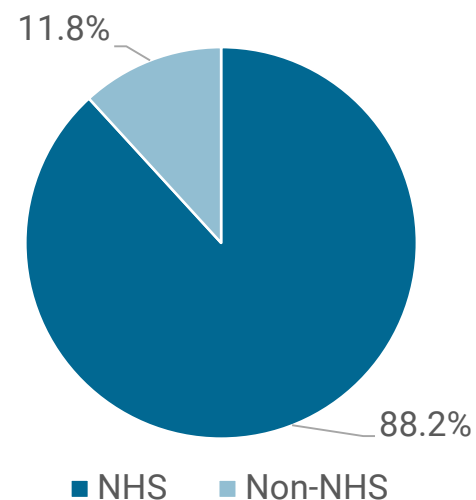


Figure 8: Percentage of HDAH Mileage On and Off the NHS



Source: Volpe Center analysis of 2018 Highway Performance Monitoring System data

Combining highway performance and agricultural freight flow data supports investment decision making.

The report demonstrates a novel approach to analyzing freight commodity flows and highway infrastructure performance, yielding new insights to inform highway investment priorities. It provides a model that may be applied by State DOTs and local transportation agencies to other corridors and at different scales. This approach draws largely from public datasets.

Seventeen analysis corridors within the HDAH were studied in detail to help illustrate how specific agricultural commodities move through important areas of the highway network. The report includes individual profiles describing the congestion, reliability, and safety performance characteristics of each of these corridors, including data visualizations for how these characteristics change throughout.

Figure 9: Analysis Corridor Data Charts Example

Example of the corridor data charts in Appendix B.

Context map of the corridor oriented horizontally to relate to the strip chart data locations on the corridor.

The first page of each corridor data chart includes strip charts showing data about the **physical infrastructure conditions and performance** of the corridor.

Individual pages showing movement of agricultural commodities by **Tonnage, Market Value, and Truck Units**.

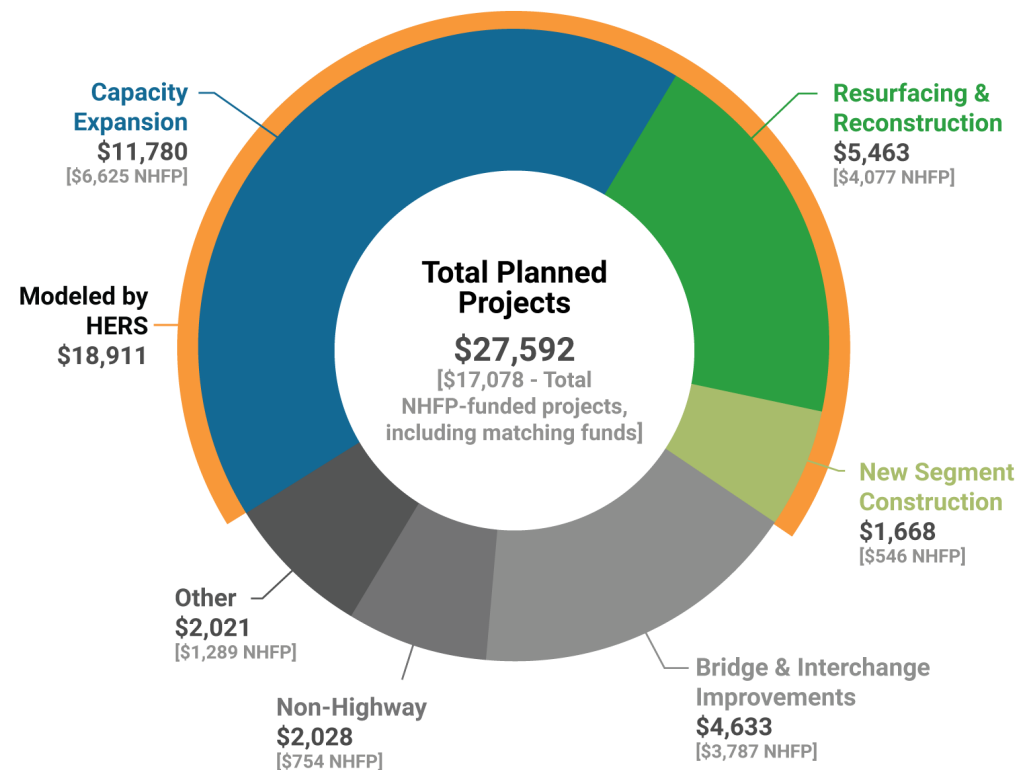


State DOTs are planning highway projects that improve freight performance.

The projects that State DOTs include in their State Freight Plans (SFPs) will have a significant impact on freight performance.

Figure 10: State Freight Plan Investments, 2016-2020, by Project Type and HERS Modeling Capability (Millions \$)

- \$17 billion of National Highway Freight Program (NHFP) funding and \$10.6 billion of other funding sources were programmed in SFP projects between Fiscal Years 2016-2020. 24% of these SFP projects were planned on the HDAH.
- Modeling with the Highway Economic Requirements System (HERS) suggests that projects of this type and at this level of investment will produce nearly \$540 million per year in truck operating cost savings relative to a baseline in which these investments are not made.



Note: NHFP figures listed include total project costs of NHFP-funded projects, which are made up of NHFP dollars, State matching funds, and other Federal funds. Appendix C includes information on the methodology.

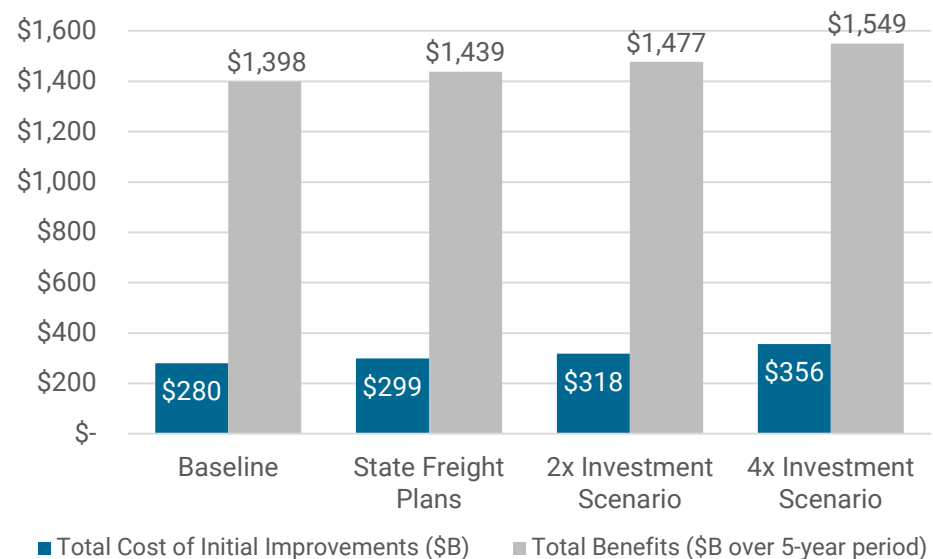
Source: Volpe Center analysis of 51 State Freight Plans as published in December 2019

- Modeled cost-effectiveness declines only slightly even if investment levels were doubled or quadrupled from the levels in the State Freight Plans, suggesting that many worthy projects could be funded if investment levels increase.
- HERS model outputs should be viewed as estimates of national-level impacts, rather than impacts for any individual project or sector.

Economic modeling highlights the potential benefits of additional investment in highway infrastructure.

The Federal Highway Administration's Highway Economic Requirements System (HERS) model was used to estimate the impacts of alternative scenarios for highway investment. Investment levels of *twice* and *four times* the current level in State Freight Plans were found to be cost-effective, with modeled incremental benefits exceeding incremental costs by a factor of 2 or more. The expanded benefits include avoided crashes, reduced congestion, and savings in vehicle operating costs.

Figure 11: Benefits and Costs (in Billion \$)



Source: Volpe Center analysis using HERS Model and State Freight Plans

Case studies of notable practices in freight planning and analysis demonstrate a range of innovations agencies are using.

State DOTs, regional planning agencies, and their local partners have developed innovative approaches to filling freight data gaps, engaging freight stakeholders, and analyzing the performance of the highway freight system to improve highway networks and multimodal connections in their jurisdictions.

Many of the practices highlighted in these case studies apply to highway freight generally. However, each case study also includes a description of the potential impacts that are specific to agricultural freight.

Table 1: Freight Planning and Analysis Case Studies

Freight Planning and Analysis Topic	Agency
1 Cross-Department Coordination for Improved Agricultural Freight Infrastructure	Missouri Department of Transportation
2 Advanced Freight Networks and Data Systems	Washington State Department of Transportation
3 State Grant Programs to Enhance Multimodal Freight Connectivity	Iowa Department of Transportation and others
4 Prioritizing Freight Projects with Data-Driven Methods and Tools	Iowa Department of Transportation
5 Collaborative Freight Project Identification and Prioritization	St. Louis Regional Freightway
6 State Freight Advisory Committees	Texas Department of Transportation

Source: Volpe Center

Challenges, Opportunities, and Strategies for Improvement

Agricultural highway freight is a complex system. In order to maintain or improve the system, many different types of stakeholders must work together, including State DOTs, Federal agencies, agriculture producers and shippers, and freight carriers.

This report synthesizes research, analysis, and stakeholder input to identify 10 challenges and opportunities, and suggests potential strategies to address them.

Agricultural Freight Data

1. Improving Data on Agricultural Freight Movements
2. Understanding and Communicating Seasonal Effects on Demand and Performance
3. Improving and Standardizing Freight Data and Analysis Tools

Freight Planning and Analysis

4. Enhancing Corridor Analyses to Identify Agricultural Freight Performance Challenges
5. Accessing Local and Industry Knowledge to Inform Infrastructure Planning
6. Analyzing Performance in the Context of National and International Supply Chains
7. Identifying Redundant Routes to Avoid Disruptions

Project Identification and Prioritization

8. Addressing County and Local Infrastructure Condition
9. Optimizing Highway Investment Decision-Making to Benefit Freight Supply Chains
10. Cooperating Across Jurisdictions in Planning and Project Development



Credit: Aleksandr Dombrovskiy via 123rf.com

The efficient movement of agricultural commodities is important to the continued health, prosperity, and economy of the United States.

As the U.S. population continues to grow and our economy continues to evolve, freight volumes are forecast to grow by nearly 25% over 20 years. Continued investment in highways that support the movement of agricultural freight during this period of growth will be critical to the health and competitiveness of U.S. agriculture.

This report provides a piece of a larger puzzle in understanding the complex multimodal system that moves agricultural commodities across the country, emphasizing the importance of highways to U.S. agriculture.

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