informa economics

Heavier Semis: A Good Idea?

An Update of the 2009 Study

Prepared for:
U.S. Soybean Export Council
and
Soy Transportation Coalition

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Disclaimer

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Acronyms

ADM (Archer Daniels Midland)
ALL (American Latina Logistica)
APROSOJA (Association of the Producers of Soy)
BEA (Business Economic Analysis)
CBOT (Chicago Board of Trade)
CIF (Cost, Insurance, Freight)
CIH (Comision Intergubernamental de la Hidrovia)
CNT (National Confederation of Transportation)
CONAB (Companhia Nacional de Abastecimento)
DDGS (Distillers Dried Grains)
FOB (Freight on Board)
GDP (Gross Domestic Product)
GO (Goiás)
GVW (Gross Vehicle Weight)
H1N1 (Swine Flu)
IBGE (Instituto Brasileiro de Geografia e Estatística)
ICMS (Merchandise Circulation Tax)
IDB (Inter-American Development Bank)
IMEA (Mato Grosso Institute of Agricultural Economics)
MGY (Million Gallons per Year)
MT (Metric Ton)
MMT (Million Metric Tons)
PAC (Program to Accelerate the Economy)
PAC 2 (Program to Accelerate the Economy 2)
PNW (Pacific Northwest)
PPPs (Public-Private Partnerships)
PR (Paraná)
PUWB (Public Use Waybill)
RS (Rio Grande do Sul)
TEU (Twenty-Foot Equivalent)
USDA (United States Department of Agriculture)
USITC (United States International Trade Commission)

Unit Conversions

Bushel of Corn = 56 pounds
Bushel of Soybeans = 60 pounds
Bushel of Wheat = 60 pounds
Metric Ton of Soybeans = 36.74 bushels
Metric Ton of Corn = 39.37 bushels
Short Ton of Soybeans = 33.33 bushels
Short Ton of Corn = 35.17 bushels
One Pound = 2.2046 kilograms
Metric Ton = 2,204.6 pounds
Short Ton = 2,000 pounds
Long Ton = 2,240 pounds
Cargo Ton = 40 cubic feet
Metric Ton = 1.2204 short tons
Acre = 0.4046 hectares
Hectare = 2.471 acres
Meters = 3.28 feet
Kilometer = 0.6214 mile
Mile = 1.6093 kilometer

I. Executive Summary

Federal and state regulations govern the weight and physical dimensions of trucks, buses, and trailers on U.S. highways. In 1975, the U.S. Congress increased truck weight limits as a means to promote greater efficiency in transportation given the energy crisis that was occurring at that time. The weight limit for trucks with single axles increased to 20,000 pounds, to 34,000 pounds for tandem axles, and the overall weight limit was raised to 80,000-pound gross vehicle weight (GVW). These limits remain in effect today.

From 1975 to 2013, technological breakthroughs have occurred at such a pace that society underestimates the significance of such developments. Such developments begs the question, does it really make sense that the regulations meant for 1975 technology are being applied to 2013 technology? The improvements in safety training, equipment and communications have fundamentally changed how businesses operate.

By not increasing truck weights in parallel with technological advances does create bottleneck in the flow of agricultural goods, which reduces America's competiveness in the world market. The regulations are impacting trade with Canada and Mexico; each of which has higher weight limits than the U.S. Industries that are directly tied to soybean and grain consumption, such as meat and beverage operations, are impacted through higher feedstock costs and higher transportation costs that result in higher landed costs and ultimately, lost sales. For example, the U.S. meat industry is dependent on exports for growth, which means domestic soybean meal and grain consumption is tied to the success of the meat export program. Lowering landed prices in global markets is a key component to higher meat exports and eventually domestic soybean meal and grain consumption, which results in increased employment and revenues.

Nonetheless, changes to truck weight limits are a highly-charged, often emotional issue. Few automobile drivers look forward to the prospect of sharing the road with vehicles weighing upwards of nearly 50 tons, particularly since highway truck accidents involving passenger cars are often devastating, and are commonly fatal. Furthermore, when wrecks do occur between a semi-tractor trailer and an automobile, the video footage makes great fodder for media of all types (the evening news and posting on the internet), which amplifies the public's concern about all highway safety in general.

This report is an update to the report prepared in 2009, analyzing, from an economic standpoint, the pros and cons of allowing higher weight limits. It considers not only efficiency and cost savings from proposed higher limits, but also provides a thorough review of highway safety considerations and infrastructure integrity issues that could be associated with allowing heavier trucks.

The key takeaway is that efficiency gains from higher truck weight limits could be substantial, although the benefits will vary by industry depending on the characteristics of the cargo shipped. Informa also found little substantive evidence that heavier trucks would pose a safety hazard, since the addition of another axle would provide the necessary braking capacity to handle the added weight. Furthermore, the reduction in vehicle miles traveled (VMT) will reduce the number of accidents by a corresponding amount. Industry stakeholders are deeply divided on raising the federal truck weight limit. The issue being debated is safety concerns. Regarding infrastructure integrity, the results are mixed. The additional axle would mitigate pavement damage that might be associated with heavier trucks, but the stress on bridges would depend on how the bridge was constructed. Most bridges would likely be able to handle the additional weight, but a third of the older bridges could be in need of replacement or reinforcement to safely handle these trucks. On a square foot basis, 85% of the bridges would be able to accommodate heavier vehicles.

A. Perspective from Various Industry Organizations

Interviews and a review of public statements from various government and industry organizations reveal a diverse set of opinions on the issue of Truck Size and Weights. Not surprisingly, industry organizations' positions differ depending on the potential gains and the additional exposure to risk that their respective constituencies or members would face. Several organizations that have reservations of increasing truck size and weights on the Interstate system or have not taken a position have expressed that the reason is due to the complexity of the issue, rather than an objection to larger trucks in principle. Gaining support from these organizations would likely be predicated on having the proper regulations, standards, and strategic plans in place to successfully implement and manage heavier trucks. Having adequate data is a significant constraint in objective analysis of reforming truck size and weight policy. There are several efforts taking place, both in the private sector and with the government to better capture and analyze data that is relevant to the issue. Many sources indicate that an update to the comprehensive study that the U.S. Department of Transportation (DOT) published more than a decade ago that is scheduled to be completed in 2014 will be significant to the policy discussion. Department of Transportation officials involved with the study have indicated that collecting the appropriate data for a comprehensive analysis poses a challenge for the study, which they are attempting to address as best as possible.

B. Future Estimates of Freight Movements by Semis

According to the DOT, the volume of freight demand by all modes (air, truck, rail and water) is expected to increase from 18.5 billion tons in 2010 to more than 27.5 billion in 2040, an increase of 9.2 billion tons or 50%. Truck volumes are expected to register the largest increase, rising from 12.5 billion tons in 2010 to 18.5 billion in 2040, an increase of 6 billion tons or 48%. Moreover, only 34% or 3.2 billion tons of the growth will come from modes other than truck.

By increasing weight limits from 80,000 pounds on five-axle truck semi-tractor trailers to 97,000 lbs. on six-axle truck semi-tractor trailers would reduce the number of truck trips and total truck miles, and result in substantial savings in fuel costs. It is assumed the average ton-mile distance is 75 miles for all trucks, 150 for semi-tractor trailers and that

80% of semi-tractor trailer cube out versus weigh out. By 2022, due to the large size of the truck market, even a small percentage decrease in the number of trips will save approximately 39.3 million trips annually, reduce miles driven by 5.9 billion annually, and save 1.1 billion gallons of diesel annually.

C. Motorist Safety

Research indicates that if truck weight limits are increased, adding an extra axle with the accompanying brakes increases excess brake capacity and improves stopping performance. Also adding an axle increases the number of tires on a truck from 18 to 22 reducing the load weight per tire that improves tire surface and braking friction.

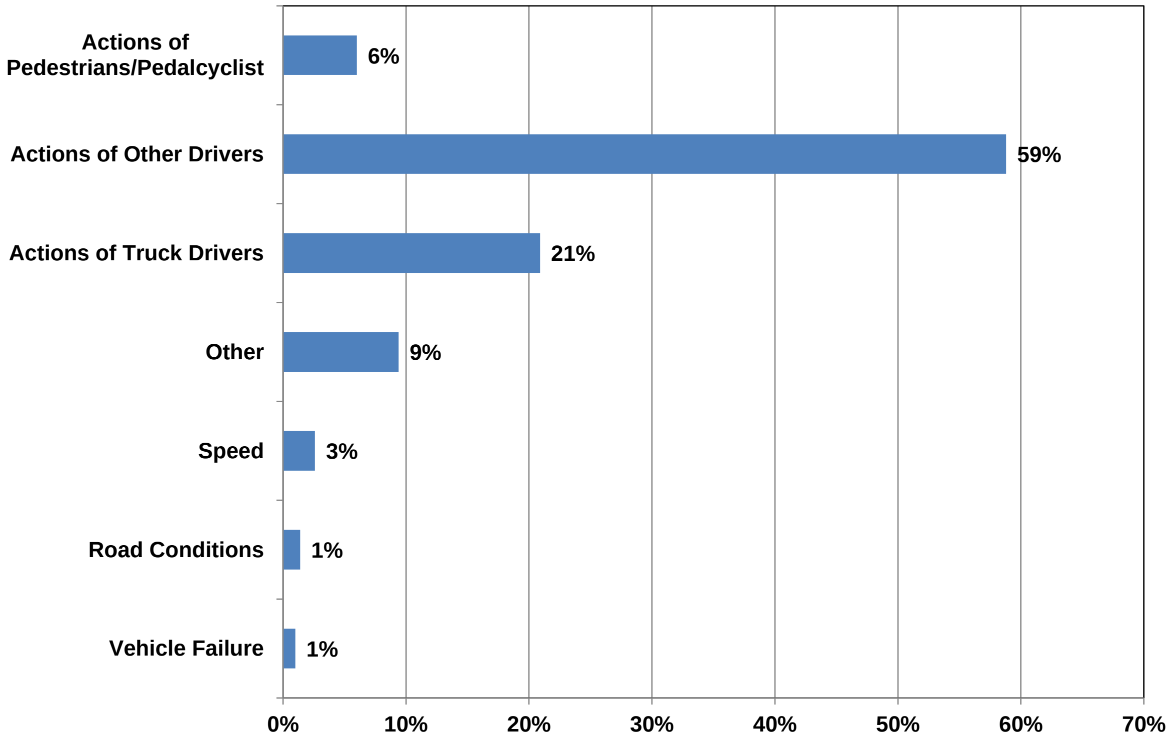
Accordingly, there is very little difference between five-axle 80,000 pound semi-tractor trailers and six-axle 97,000 pound semi-tractor trailers in terms of key characteristics of crash dynamics, such as static roll stability, load transfer ratio and rearward amplification.

Still, proposals to increase truck size and weight maximums likely face opposition because automobile drivers think they are much more dangerous. In reality, fatalities and injuries in accidents involving trucks have been declining steadily for several decades despite greater traffic congestion and much higher highway speeds for all vehicles.

There is no compelling evidence to suggest that the higher truck weights would themselves lead to an increase in fatality or injury rates, so long as the additional axle is also included to provide added braking power.

The Federal Motor Carrier Safety Administration (FMCSA) and the National Highway Traffic Safety Administration (NHTSA) reported in 2001 that vehicle failures were only responsible for one percent of fatal crashes as shown in Figure 1. Since 2001, the problem of "distracted driving" has increased dramatically as the use and adoption of smart phones has grown in popularity. Associations opposed to higher truck weights freely admit distracted driving is a serious issue. To tackle the problem of distracted motorists, states have passed laws, such as making it illegal to text and drive, or special requirements for teenage drivers. Over the same time period, NHTSA has issued new braking guidelines and Federal Motor Carrier Safety Administration (FMCSA) issued new hours of service (HOS) regulations aimed at increasing highway safety. The bottom line is that a 97,000 pound gross vehicle weight (GVW) truck will not enter interstate service without meeting the same safety standards as an 80,000 pound GVW truck. Lastly, the primary cause of accidents is not vehicle failures but human error.

Figure 1: Critical Events in Large Truck Fatal Crashes



Source: Federal Motor Carrier Safety Administration (FMCSA) and the National Highway Traffic Safety Administration (NHTSA)

Research also suggests that increasing maximum truck weights could make U.S. highways safer and reduce the number of highway truck crashes by reducing the number of VMT required to move any given amount of freight. It follows that fewer trips and reduced truck mileage will also translate to fewer accidents involving trucks. In 2011, for every 100 million vehicle miles traveled by combination trucks, traffic accidents resulted in 1.7 fatalities.[1] A combination truck is defined as a truck tractor pulling any number of trailers (including a "bobtail" truck tractor not pulling any trailers) or a straight truck pulling at least one trailer. Applying these same accident rates to the estimated 4.1 billion mile reduction calculated by Informa for 2012 suggests a net reduction of 68 fatalities in 2012 and 98 fatalities by 2022.

FMCSA reported in 2011 that combination trucks were involved in accidents that killed 2,724 people as shown in Table 1. The estimate for VMT was 164 billion miles in 2011. Total fatalities divided by VMT equals 1.66 fatalities per 100 million VMT. Assuming 80% of combination trucks are semi-tractor trailer moves, total fatalities would total 2,179. A 97,000 pound GVW truck will require 20% less trips than an 80,000 pound GVW on loads that are constrained by weight. According industry interviews, approximately 20% of freight is constrained by weight, which results in a 4% decline in

[1] Source: *Large Truck and Bus Crash Facts 2011*, January 2009, Analysis Division Federal Motor Carrier Safety Division.

all semi-tractor trailer vehicle miles, which in turn results in a 4% decline in fatalities or 87 saved lives.

The 87 saved lives assumes if a truck does not leave the parking lot, it will not be involved in an accident. It is argued that a heavier vehicle is inherently more dangerous. So, how much more would fatalities per 100 million VMT have to be for a 97,000 pound truck to have the same number of fatalities as an 80,000 pound truck? Based on the data, a 97,000 pound truck's fatalities per 100 million VMT rate would have to be 25% greater than an 80,000 pound truck to prevent lives from being saved. A 97,000 pound truck with an extra axle having comparable handling characteristics as an 80,000 pound truck combined with similar safety parameters that indicate a very small percentage of wrecks are the result of equipment failure results in the likelihood of a 25% increase in accidents as highly unlikely.

Table 1: Safety Comparison (80,000 GVW versus 97,000 GVW in 2011)

	All Combination Trucks	Semi-Tractor Trailers	80,000 Pounds or Less	97,000 Pounds
Cubes Out Versus Weights Out	100%	80%	64%	16%
Total Fatalities	2,724	2,179	1,743	436
Million Vehicle Miles Traveled	163,692	130,954	104,763	26,191
Fatalities per 100 Million VMT	1.66	1.66	1.66	1.66
Million Vehicle Miles Saved	3%	0%	0%	20%
Adjusted Vehicle Miles Traveled	158,454	125,715	104,763	20,953
Fatalities per 100 Million VMT	1.66	1.66	1.66	1.66
Adjusted Fatalities	2,637	2,092	1,743	349
Fatalities Lowered	87	87	-	87
Break Even Rate	1.72	1.73	1.66	2.08
Break Even Percent Increase	**3%**	**4%**	**0%**	**25%**

Source: Large Truck and Bus Crash Facts 2011, Analysis Division Federal Motor Carrier Safety Administration, Department of Transportation, and Informa

For a truck driver, the increase in efficiency is viewed as either unemployment or driving a truck with a greater chance of harm. The options are not very attractive. Truck drivers are paid to move freight and if they move more freight, they want more money.

D. Infrastructure Integrity

Increasing the allowable weights of trucks has implications for wear-an-tear on bridges and roadways, but the relationship is complicated and the magnitude is uncertain. Pavement and bridge impacts are major concerns associated with changing truck weight limits because of the magnitude of Federal and State investments in pavement on the Nation's highways and in repairing or replacing bridges. Wear-and-tear on paved surfaces (including on bridges) depends on both the volume of traffic and the number of axles over which the weight of the traffic is distributed. The structural integrity of bridges depends not only on the weight of the vehicles that pass over it, but also the number of axles that carry the weight and the distance between those axles, a relationship used to establish the "bridge formula" that guides current weight restrictions.

The additional axle would mitigate pavement damage that might be associated with heavier trucks, but the stress on bridges would depend on how it was constructed. Most bridges would likely be able to handle the additional weight, but a third of the older bridges could be in need of replacement or reinforcement to safely handle these trucks. On a square foot basis, 85% of the bridges would be able to accommodate heavier vehicles. The principal cost for bridges associated with heavier trucks lies in ensuring that the bridge can safely accommodate the trucks. This involves replacing or strengthening bridges. In addition, bridge replacement or repair disrupts traffic and increases motorist time requirements as traffic patterns change. As a general rule, most bridges constructed after 1965 can support heavier trucks than are allowed under current rules.

Research shows that the use of six-axle 90,000 pound semi-tractor trailers would not increase stress on bridges at maximum weight compared with five-axle tractor semi-tractor trailers. However, the heavier six-axle 97,000/98,000 pound semi-tractor trailers would exceed current bridge formula limits and might cause stresses exceeding bridge design. The removal of the current bridge formula cap of 80,000 lbs. on gross vehicle weight would allow minimal or no increase in gross weight of a five-axle tractor semi-tractor trailer, but could allow vehicles with additional axles to operate substantially above 80,000 lbs. However the bridge formula has not been updated since it was developed in the mid-1970s.

The six-axle 90,000 and 97,000 pound semi-tractor trailers were found to cause the same or less road damage than the five-axle semi-tractor trailer. Unit pavement costs and pavement costs per unit of payload-mile are also the same or lower for six-axle semi-tractor trailers than for five-axle semi-tractor trailers.

E. Enhanced Efficiency of Transporting Soybeans and Products

The U.S. soybean farm to market value chain and logistics flow provides a framework to analyze the journey of a soybean from its initial production region to end consumer. The marketing chain provides the starting point to determine the amount of fuel and volume of emissions transporting soybeans and soybean products from origin to destination that can be reduced by higher truck weights. Not all savings will be accomplished in one year, but the greater efficiencies will partially offset the increase cost of diesel. In addition, as soybean yields increase, fuel and carbon dioxide (CO2) emissions will increase without an offsetting increase in transportation efficiencies. The primary greenhouse gas is carbon dioxide.

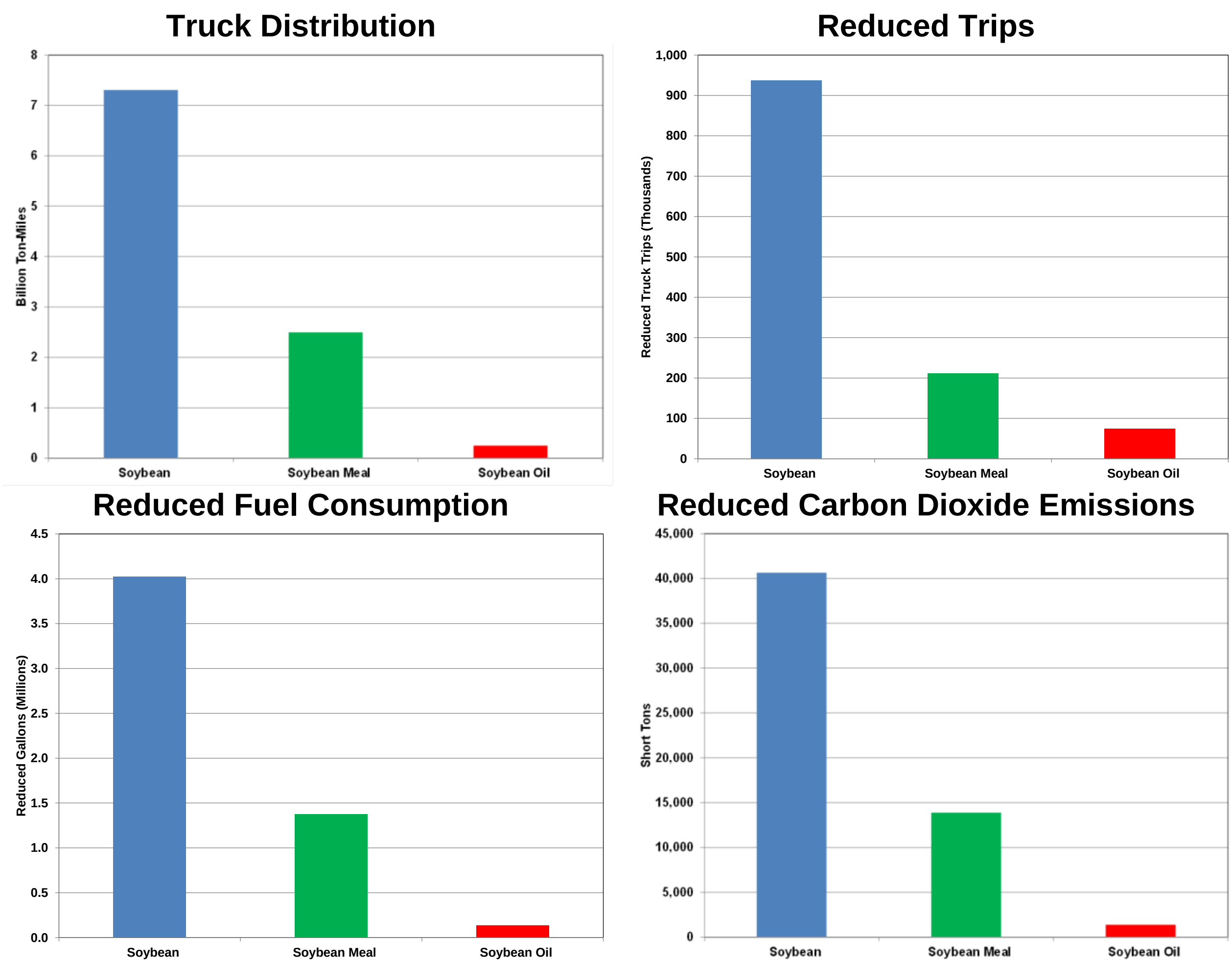
Assuming soybean meal and soybean oil are a continuation of the soybean, the average distance traveled to an end user or export position is 955 miles. Truck accounts for 101 miles, rail 588 and barge 266. Transporting soybeans requires an average move of 667 miles, soybean meal requires 590 miles and soybean oil requires

463 miles. Soybeans account for approximately 70% of the ton-miles while the soybean products account for remaining 30%.

U.S. distribution of soybean and soybean products with heavier trucks could reduce truck traffic by 1.2 million trips. Transporting soybeans requires over 75% of the ton-miles. The first moves for soybeans have the largest impact on farmers.

U.S. distribution of soybean and soybean products with heavier trucks could reduce fuel and carbon dioxide emissions by 6 million and 56 thousand tons, respectively. Higher truck weights would save the soybean industry $11 million to $28 million, depending on the price of fuel alone.

Figure 2: U.S. Combined Soybean and Soybean Products Distribution by Truck, and Reduced Trips, Fuel Consumption and Carbon Dioxide Emissions using Higher Truck Weights to 97,000 Pounds

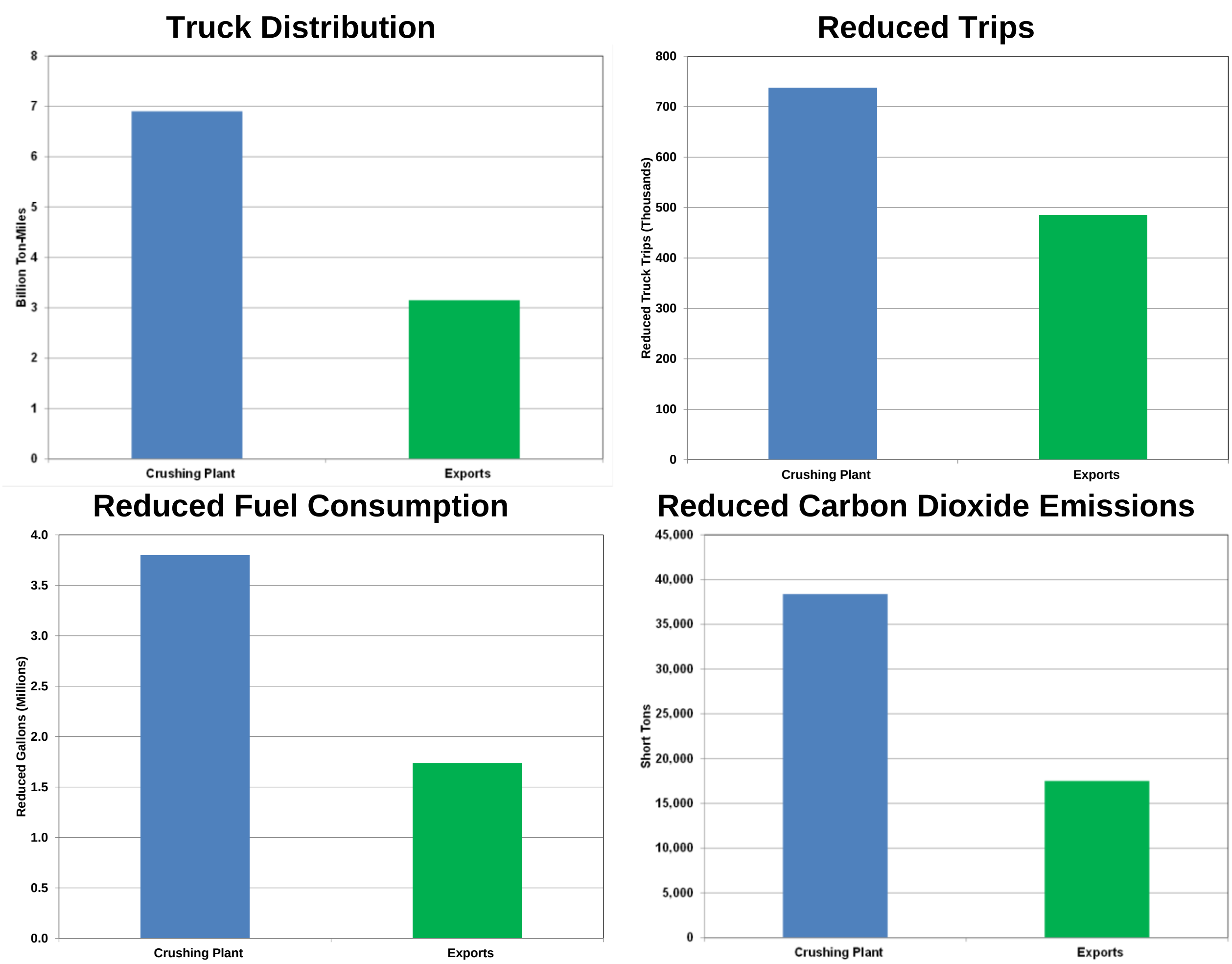


Source: USDA, USACOE, USITC, Informa

When accounting for the soybean moves to export or a crushing plant, the average distance is 1,227 miles and 699 miles; respectively. The average move from farm through a crushing plant to market position requires 135 miles by truck, 444 miles by rail, and 120 miles by barge. The average move from farm to export position requires 66 miles by truck, 739 miles by rail, and 422 miles by barge.

U.S. distribution of soybean and soybean products with heavier trucks could reduce truck traffic by 1.2 million trips. Crushing plants save $11 million while exports moves save $19 million. Crushing plant operations produce valued added products and jobs that benefit the U.S. significantly more than the export market.

Figure 3: U.S. Combined Soybean and Products to Export or Crushing Plant Distribution by Truck, and Reduced Trips, Fuel Consumption and Carbon Dioxide Emissions using Higher Truck Weights to 97,000 Pounds



Source: USDA, USACOE, USITC, Informa

II. Introduction

Federal and state regulations govern the weight and physical dimensions of trucks, buses, and trailers on U.S. highways. In 1975, the U.S. Congress increased truck weight limits as a means to promote greater efficiency in transportation given the energy crisis that was occurring at that time. The weight limit for trucks with single axles increased to 20,000 pounds, to 34,000 pounds for tandem axles, and the overall weight limit was raised to 80,000-pound gross vehicle weight (GVW). These limits remain in effect today. Most legislative efforts to increase truck weight limits currently focus on providing an option for individual states to increase allowable truck weights on a single-trailer truck to 97,000 pounds on federal interstate highways, provided the truck has a sixth axle to improve braking and handling.

There has been long-standing interest in further increasing federal truck weight limits, and these efforts now appear to be deadlocked between efficiency gains and safety concerns. Although the efficiency gains from allowing trucks to carry heavier loads are self-evident these heavier trucks raise concerns about motorist safety and the possibility of accelerated wear-and-tear on bridges and roadways. It is clear that changes to truck weight limits is a highly-charged, often emotional issue. Few automobile drivers look forward to the prospect of sharing the road with vehicles weighing almost 50 tons, particularly since highway truck accidents involving passenger cars, when they occur, are often devastating, and are commonly fatal.

Nevertheless, it is also true that practically all modes of the nation's transportation sector are approaching capacity, while freight volume will continue to grow in lock-step with economic prosperity. An increase in truck weight limits is a quick, low-cost approach to effectively increasing the capacity of the trucking industry even if the number of trucks that adopt these higher weights is small relative to the total truck inventory.

From 1975 to 2013, technological breakthroughs have occurred at such a pace that society underestimates the significance of such developments. The old adage, "a picture is worth a million words" applies in the road weight debate as shown in Figure 4. Such developments begs the question, does it really make sense that the regulations meant for 1975 technology are being applied to 2013 technology? The improvements in safety training, equipment and communications have fundamentally changed how businesses operate.

By not increasing truck weights in parallel with technological advances does create bottleneck in the flow of agricultural goods, which reduces America's competiveness in the world market. The regulations are impacting trade with Canada and Mexico; each of which has higher weight limits than the U.S. Industries that are directly tied to soybean and grain consumption, such as meat and beverage operations, are impacted through higher feedstock costs and higher transportation costs that result in higher landed costs and ultimately, lost sales. For example, the U.S. meat industry is dependent on exports for growth, which means domestic soybean meal and grain consumption is tied to the success of the meat export program. Lowering landed prices in global markets is a key component to higher meat exports and eventually domestic soybean meal and grain consumption, which results in increased employment and revenues.

Figure 4: Grain Harvesting Operations, Then and Now, 1975 and 2013

Source: Allaboardwheatharvest.com

Trucking accounts for about 80% of expenditures on freight transportation in the U.S. And approximately 80% the trucks loaded with cargo cubes out before weighing out. So, the impact of increasing truck weights is concentrated on certain industries rather than across the entire trucking industry.

Agriculture and food processing are two industries that would benefit from an increase in truck weights. The farm gate to food plate value chain is the most diverse of any industry in terms of origination points and delivery points because agriculture production is tied to the land and consumption is tied to population centers. As a result, agriculture is more dependent on the county or local roads than industries, as compared to an automobile manufacturing plant that selects a location with interstate access instead for example.

Senator Collins from Maine has been a strong proponent for an increase in truck weights. In Maine, a pilot program expired in December 2010 that allowed six-axle trucks weighing 100,000 pounds to travel on all interstates throughout the state as well as Vermont. A review of the Maine and Vermont programs is provided in this report.

On February 2, 2012 the U.S. House Committee on Transportation and Infrastructure committed further study to a truck weight reform proposal that had been included in the American Energy and Infrastructure Jobs Act. The truck weight reform measure was part of a broader section of truck productivity measures that the Transportation Committee decided to include in a three-year study. This action effectively delays the prospect for higher truck weights on interstates until the FHWA MAP-21 “Comprehensive Truck Size and Weight Limits Study” is complete in April 2014. The public release is slated for November 2014. The report will focus on safety, pavement, bridge, compliance, and modal shifts. Additionally, after the study is completed, there will be much discussion and debate to usher higher truck weight legislation through Congress, which in essence prolongs the time for an increase in the road weight limit on interstates.

This report is an update of the 2009 study, and includes additional economic analysis of allowing higher weight limits. Reflecting current legislative proposals, most of the analysis considers a weight limit increase to 97,000 lbs. GVW, although the results are easily generalized to consider limits with a range from 90,000 lbs. to upwards of 100,000 lbs. This report considers not only efficiency and cost savings from the proposed higher limits, but also provides a thorough review of highway safety considerations and infrastructure integrity issues that could be associated with higher truck weights.

Following this introduction, the report is organized as follows:

- Chapter III is a general recap on the truck weight situation.
- Chapter IV considers the overall demand on the nation's transportation infrastructure, freight shipments by mode, and capacity constraints that currently exist in the system. Freight shipment volumes, by mode, are forecast to 2022.
- Chapter V reviews and analyzes information that could link truck weights with motorist safety, considering such variables as braking distance with the added weight and the effect on truck stability or potential for roll-over.
- Chapter VI explores the stakeholders perspectives on safety issues related to increasing truck weights.
- Chapter VII considers the relationship between truck weights and infrastructure integrity, including wear-and-tear on roadways and the relationship between truck weights and bridge stress.
- Chapter VIII examines the effect of higher truck weight limits on the efficiency in transporting soybeans and soybean products.

III. Truck Weight Background and Developments

Federal regulations passed in 1975 govern the weight and physical dimensions of trucks, buses, and trailers on interstates, but over the past 37 years, the world has experienced technological advances that have changed all aspects of life. The current truck weight issues go beyond safety and efficiency issues and entangle state and local governments. Not surprising, budgetary issues are at the heart of many of the disagreements over increasing gross vehicle weight (GVW), especially at the local level. Although increasing the federal truck weight impacts federal aid for roads, it is viewed as the first step towards increasing truck weights on state and eventually, county and local roads. Because agriculture is tied to the land, understanding the local government interactions with shippers and manufacturers is very important. A list of studies concerning higher truck weights is provided in Appendix D.

A. National Commercial Vehicle Weight Standards

- National weight standards apply to commercial vehicle operations on the Interstate Highway System, an approximately 47,000-mile system of limited access, divided highways that spans the nation.

- Federal commercial vehicle maximum standards on the Interstate Highway System are:
  - Single Axle: 20,000 pounds
  - Tandem Axle: 34,000 pounds
  - Gross Vehicle Weight: 80,000 pounds

- Off the Interstate Highway System, states set their own commercial vehicle weight standards.

B. National Commercial Vehicle Size (Length and Width) Standards

- National vehicle size standards apply on what is known as the National Network of highways. The National Network includes: (1) the Interstate Highway System and (2) highways, formerly classified as Primary System routes, capable of safely handling larger commercial motor vehicles, as certified by states to the Federal Highway Administration (FHWA) as shown in Table 2.

Table 2: Federal Commercial Vehicle Size Limits on the National Network

Overall Vehicle Length	No federal length limit is imposed on most semi-tractor trailers operation on the National Network. **Exception:** On the National Network, combination vehicles (truck tractor plus trailer) designed and used specifically to carry automobiles or boats in specially designed racks may not exceed a maximum overall vehicle length of 65 feet, or 75 feet, depending on the type of connection between the tractor and trailer.
Trailer Length	Federal law provides that no state may impose a length limitation of less than 48 feet (or longer if provided for by grandfather rights) on a semi-tractor trailer operating in any semi-tractor trailer combination on the National Network. (Note: A state may permit longer trailers to operate on its National Network highways.) Similarly, federal law provides that no state may impose a length limitation of less than 28 feet on a semi-tractor trailer or trailer operating in a truck tractor-semitrailer-trailer (twin-trailer) combination on the National Network.
Vehicle Width	On the National Network, no state may impose a width limitation of *more or less* than 102 inches. Safety devices (e.g., mirrors, handholds) necessary for the safe and efficient operation of motor vehicles may not be included in the calculation of width.
Vehicle Height	No federal vehicle height limit is imposed. State standards range from 13.6 feet to 14.6 feet.

Source: U.S. Department of Transportation, Federal Highway Administration

C. Bridge Formula Weights

- The bridge formula was introduced in 1975 to reduce the risk of damage to highway bridges by requiring more axles, or a longer wheelbase, to compensate for increased vehicle weight.
  - The formula may require a lower gross vehicle weight, depending on the number and spacing of the axles in the combination vehicle.

D. State Commercial Weight Standards

- At the state level there is disagreement as to what is the acceptable weight limits; often within a state.
  - Heavier GVW routes are currently available in the vast majority of states.

- A list of truck weights by state is shown in Table 3. In 2010, Iowa increased its allowance for truck weights to 90,000 pounds with sixth axle and 96,000 pounds with a seventh axle, and during harvest, some states allow a 10% overweight policy for grain trucks on non-interstate roads.

- Although the National Network system handles 55% of the total traffic, because agriculture is tied to the land, the agriculture value chains are more dependent on county roads than other industries.

- The different methodology used between states for the bridge formula results in truck configurations being legal in some states and illegal in others.
    - For example, the Illinois weight limit is based on total weight per truck, which is 80,000 pounds maximum, while Michigan's weight limit is based on an axle weight distribution formula. The Illinois bridge formula might find the heavier six-axle 97,000-pound semi-tractor trailer to exceed current bridge formula limits and would cause stresses exceeding bridge design.
        - The removal of the current bridge formula cap of 80,000 pounds on GVW would allow minimal or no increase in gross weight of a five-axle semi-tractor trailer, but could allow vehicles with additional axles to operate substantially above 80,000 pounds.

- In cases of an emergency, the governor of individual states can allow overweight semi-tractor trailers to be driven on highways.
    - Typically the weight allowance is 10% of the gross weight and the speed limit usually drops to 30 miles per hour on bridges.
    - In addition, drivers are not allowed to drive over posted or closed bridges.

Table 3: Gross Vehicle Weight by State for 5- and 6-Axle Semi-Tractor Trailers

State	GVW Limit on Interstate for 5 & 6 Axle Tractor Semi-Trailers	GVW Limit on other State Roads for 5 & 6 Axle Semi-Tractor Trailers	Comments
Alabama	80,000 100,000 containers w permit, 5 axles	84,000 6-axles 100,000 containers w permit, 5 axles	10% scale Tolerance
Alaska	No gross weight limit. Weight governed by axle and bridge formula limits.	No gross weight limit. Weight governed by axle and bridge formula limits.	
Arizona	80,000	80,000	
Arkansas	80,000	85,000 5 axle, certain commodities w permit	50,000 tridem
California	80,000	80,000	51,450 tridem
Colorado	80,000	85,000 5-axles	54,000 tridem
Connecticut	80,000	80,000	
Delaware	80,000	90,000 containers w permit, 5 axles	
Dist. Of Columbia	80,000	80,000	
Florida	80,000	95,000 containers w permit, 5 axles 88,000, 5 axles w permit	44,000 tridem
Georgia	80,000	80,000 100,000 containers w permit, 5 axles	
Hawaii	80,000	88,000 5 axles	
Idaho	86,000 5-axle FBF 88,000 6-axle FBF	86,000 5-axle FBF 88,000 6-axle FBF	
Illinois	80,000	80,000	
Indiana	80,000	90,000 selected highways, 5 axles 95,000 containers w permit, 5 axles	50,000 tridem
Iowa	80,000	86,000 5-axle livestock 90,000 6-axle	
Kansas	80,000	95,500 5-axle 120,000 containers w permit, 5 axles	
Kentucky	80,000	96,000 certain commodities w permit, 5 axles 120,000 certain commodities w permit, 6 axles	48,000 tridem 5% tolerance
Louisiana	83,400 6 axle with tridem 100,000 6-axle hauling sugarcane w permit 95,000 containers w permit, 6 axles	88,000 6 axle with tridem 100,000 6-axle hauling sugarcane w permit 120,000 6 axle certain commodities w permit 95,000 containers w permit, 6 axles	
Maine	80,000 100,000 6-axle on Turnpike	90,000 5-axle 100,000 6-axle	50,000 tridem
Maryland	90,000 container 5-axle w permit	90,000 container 5-axle w permit	1,000 lb gross wt tolerance
Massachusetts	99,000 5-axle w permit	99,000 5-axle w permit	
Michigan	80,000	95,500 5 axles 90,000 6 axles	
Minnesota	80,000	90,000 5-axle certain commodities w permit	10% increase w winter freeze
Mississippi	80,000	95,000 5-axle container w permit	
Missouri	92,000 5-axle w permit 112,000 6-axle w permit	85,500 certain commodities 92,500 5 axle w permit 112,000 6-axle w permit	2% gross weight tolerance non-interstate
Montana	86,000 5-axle FBF w permit 88,000 6-axle FBF w permit	86,000 5-axle FBF w permit 88,000 6-axle FBF w permit	53ft trailer length limit
Nebraska	80,000	85,500 5 axles 90,000 6 axles	
Nevada	92,000 5-axle FBF 96,000 6-axle FBF	92,000 5-axle FBF 96,000 6-axle FBF	
New Hampshire	99,000 5-axle (I-89,93,95) 100,000 container w permit	99,000 5-axle (i-89,93,95) 100,000 container w permit	5% tolerance
New Jersey	90,000 container w permit, 5 axle	90,000 container w permit, 5 axle	5% tolerance 56,400 tridem
New Mexico	80,000	86,400, 5 axle	
New York	102,000 5-axles w permit 120,000 6-axles w permit	102,000 5-axles w permit 120,000 6 axles w permit	
North Carolina	94,500 5-axle container w permit	94,500 5-axle container w permit	
North Dakota	86,000 5-axle FBF w permit 88,000 6-axle FBF w permit	90,000 5-axle w permit 94,000 6-axle w permit	
Ohio	94,000 5 or 6 axles container w permit	94,000 5 or 6 axles container w permit	5% tolerance
Oklahoma	80,000	85,500 5 axles 90,000 6 axles	
Oregon	90,000 5-axle container w permit 96,500 6-axle container w permit	90,000 5-axle container w permit 96,500 6-axle container w permit	
Pennsylvania	90,000 5-axle w permit	100,000 5-axle w permit, certain commodities	54,000 tridem w 73,280 GVW
Rhode Island	104,800 5-axle w permit	104,800 5-axle w permit	
South Carolina	100,000 5-axle container w permit	100,000 5-axle container w permit	

Source: Compiled from various sources

Table 3: Gross Vehicle Weight by State for 5- and 6-axle Semi-Tractor Trailers (continued)

State	GVW Limit on Interstate for 5 & 6 Axle Tractor Semi-Trailers	GVW Limit on other State Roads for 5 & 6 Axle Semi-Tractor Trailers	Comments
South Dakota	86,000 5-axle FBF w permit	86,000 5-axle FBF w permit	
	88,000 6-axle FBF w permit	88,000 6-axle FBF w permit	
Tennessee	90,000 5-axle container w permit	90,000 5-axle container w permit	
Texas	80,000	80,000	5% tolerance over GVW
Utah	86,000 5-axle FBF w permit	86,000 5-axle FBF w permit	
	88,000 6-axle FBF w permit	88,000 6-axle FBF w permit	
Vermont	90,000 5-axle container w permit	90,000 5-axle container w permit	10% tolerance
	99,000 6-axle specific commodity w permit	99,000 6-axle specific commodity w permit	
Virginia	90,000 5-axle container w permit	90,000 5-axle container w permit	
	115,000 7-axle container w permit	115,000 7-axle container w permit	
Washington	86,000 5-axles	86,000 5-axles	
	88,000 6-axles	88,000 6-axles	
West Virginia	90,000 5-axle container w permit	120,000 5-axle specific commodity (coal)	10% tolerance
Wisconsin	80,000	80,000	
Wyoming	86,000 5-axle FBF		
	88,000 6-axle FBF		

Source: Compiled from various sources

E. Local Government General Funding

- The more significant political problem is at a time that local governments are reducing funding for essential programs, such as education, fire and police protection, that the idea of increasing truck weights and in turn, perceived higher maintenance costs is highly unpopular among local government officials.

- County engineers are keenly aware of existing budget limitations and the prospect of heavier trucks that in perception cause more damage to the roads without a corresponding increase in funding is not welcome.

- Ideally, the country engineers would like a county road system that could handle 97,000-pound semi-tractor trailers, but their primary goal is to maintain the existing infrastructure.
    - So, although truck size and weight studies are in disagreement as to the amount of damage done by a heavier truck with an extra axle when loaded to recommended weights, the county engineers are cautious about adopting higher road weights.

- Country engineers are quick to point out that when state governments raised the truck GVW to 80,000 pounds (in Illinois for example), the states improved state roads to accommodate 80,000 pound trucks but improving the county roads was left to the counties.
    - Due to the variability in county revenues, not all counties were in a position to upgrade the quality of the roads to handle higher weights; one poor county can negatively impact the surrounding wealthier counties.

- Government agencies are more aware of the cost of maintaining the infrastructure.

  - For example, in response to hydraulic fracturing for extraction of natural gas, states are realizing a need to ensure energy companies are paying enough in taxes to repair the roads. The Pennsylvania Department of Transportation (PennDOT) has placed weight limits on state roads; companies whose vehicles exceed the limit must post a bond to use the road, which is then used to fund repairs.

- Historically, governments would pay for the infrastructure as an incentive to locate facilities in their jurisdiction. Increasingly, governments are demanding the companies pay for the environmental and infrastructure damages that result from a facility.
  - Mining, energy and agriculture production is tied to the land and therefore, the industries must transport product on local roads.
  - The location of existing infrastructure surrounding a potential facility site is becoming more important in the eyes of the government, company and investors.

F. Overweight Permits

- The variance in the rules governing overweight permits from state to state is dramatic. Some states have a statewide annual fee while in other states local municipalities can increase overweight fees anytime.
  - Municipalities that are collecting fees are more nimble in their ability to adjust the regulations to meet their needs.
  - Shippers would prefer a set annual fee in terms of managing costs.

G. Constraints to Increasing Truck Weights

- The challenging hurdles to increasing truck weights are political and financial.
  - The political opposition is driven by the Teamsters Union, AAA, National Troopers Coalition, National Sheriffs Association, National Association of Police Organizations, Owner-Operator Independent Drivers Association, Association of American Railroads, Railway Supply Institute, and individuals and organizations whose arguments are based on heavier truck weights being unsafe and reducing the number of truck drivers.
  - Teamsters and driver associations opposition is straight forward.
    - Higher truck weights would result in greater efficiency that stems from fewer loads for equivalent volumes, which requires fewer drivers.
    - Additionally, the remaining drivers would be paid at the same rate although they are transporting more freight.
    - Teamsters and driver associations would likely not oppose an increase in truck weights if a corresponding increase in drivers pay is included.

- Railroads are opposed to any provision that will make a competing transportation mode more competitive. That being said, the Association of American Railroads (AAR) claims the safety issues and funding issues stemming from "massive" trucks are the reason for opposing increasing truck weights. "Americans don't want 97,000 pound trucks or huge multi-trailers up to 120 feet long on our nation's highways," said AAR President and CEO Ed Hamberger. "Nor is it fair that even more of the public's tax dollars will be used to pay for the road and bridge damage inflicted by massive trucks."

- Police organizations are primarily oppose heavier trucks on local roads. The perception is that by allowing states the option to increase truck weight on the interstate system, it will lead to higher truck weights on local roads. Many states allow truck weights to exceed 80,000 pounds without an overweight permit and all states issue overweight permits for specific routes as shown the section D. Another concern of police organizations is a higher truck weight limit could lead to more double and triple trailers on the roadways.

- The greatest political challenge or hurdle is more of a social challenge in that the general public does not recognize the benefits of a more efficient transportation system through higher truck weights, but instead views higher truck weights as a safety issue.
    - The general public is in favor of fewer semi-tractor trailers, less traffic congestion and better air quality, but not heavier trucks. Connecting the dots for the general population is a challenge for business groups and shippers to overcome.

H. Legislative Efforts to Increase Truck Weights

- Most legislative efforts to increase truck weight limits at the federal level are focused on providing an option for individual states to increase allowable truck weights on a semi-tractor trailer to 97,000 pounds on federal interstate highways, provided the truck has a sixth axle to improve braking and handling.

- Senator Collins from Maine has been a strong proponent for higher truck weights. In Maine, a pilot program expired in December 2010 that allowed six-axle trucks weighing 100,000 pounds to travel on all interstates throughout the state as well as Vermont.

- On February 2, 2012, the U.S. House Committee on Transportation and Infrastructure committed further study to a truck weight reform proposal that had been included in the American Energy and Infrastructure Jobs Act.
    - The truck weight reform measure was part of a broader section of truck productivity measures that the Transportation Committee decided to include in a three-year study. This action effectively delays the prospect for higher truck weights on interstates until the FHWA MAP-21 "Comprehensive Truck Size and Weight Limits Study" is complete in April

2014. The public release is slated for November 2014. The report is supposed to focus on safety, pavement, bridge, compliance, and modal shifts.
  - After the study is completed, time will be required to push higher truck weight legislation through Congress, which if successful, will delay further the time without raising the road weight limit.

I. Maine and Vermont Interstate Highway Heavy Truck Pilot Program

The FHWA published a report evaluating the impacts of heavy truck pilot programs implemented in Maine and Vermont that was conducted December 2009 through December 2010. The FHWA report reviewed the findings after 6-months of implementation. The pilot program allowed each state to apply regulations for commercial-vehicle weight laws to the respective interstate highways.

- During the pilot program, the following regulations were adopted:
  - Maine allowed up to 100,000 pounds on six-axles
  - Vermont allowed up to 99,000 pounds on six-axles
  - Also increased weight on other classes of trucks

- The FHWA report noted there were constraints to gather appropriate data on actual truck weights that moved over the highways during the course of the study, and the limited time period the study team had to gather empirical evidence to evaluate.

- The study was unable to address shifts in truck traffic from state roads to the interstate system, and how this related to empirical evidence gathered at the national level that truck crash rates on rural interstate roads are lower than on non-interstate rural roads.

- Lastly, the study acknowledged a limited ability to analyze crash data in these two states due to the relatively low occurrences of crashes involving trucks in Maine and Vermont during the study period.

- There were two major conclusions to the study:
  - Bridges are built to standards greater than the specified truck weight limit. Allowing heavier trucks on the interstate system reduces the weight margin between how much weight the bridge can sustain and the weight of the truck. As a result, there would be an increased need for more frequent bridge inspection, higher level of maintenance needed, and more detailed load rating analysis.
    - The increased monitoring of bridges would mitigate the risk of permanent bridge damage and concerns over sudden bridge collapse.

- Pavement life on interstate highways would be reduced by the heavier axle loads. However, this is also offset by redirecting traffic from state and local roads to interstates, which will preserve non-interstate roads.
    - In the pilot programs the semi-tractor trailers did have an extra axle, according to engineering studies results shown in Table 23 through Table 25, a 97,000 pound GVW truck configuration should have similar pavement wear.
    - The heavier axle loads are primarily from straight trucks, such three single unit dump trucks.

J. Vermont Pilot Program Report

In a separate report on the Vermont Pilot program, the Department of Transportation reported in February 2012 the effects of heavier trucks on the interstate system in the state of Vermont. The analysis was part of a 1-year pilot program, which was completed in December 2010. The program allowed commercial-vehicle truck weights that apply to Vermont state roads to be extended to Vermont's interstate system. The gross vehicle weight for trucks was allowed up to 99,000 pounds on 6-axles.

The study analyzed the following categories:

- Truck volumes
- Safety implications
- Commerce impacts
- Pavement durability
- Bridge durability
- Energy impacts

The study evaluated the effects of the pilot program in comparison to a control case. The control case was an estimate of 2010 conditions if the pilot program had not been in place using traffic data from 2006 to 2009. The control case is a plausible alternative, but does not take into account fluctuations in economic conditions, fuel prices, weather, amount of road repair, or regulatory changes.

The study acknowledged the constraints in their analysis due to the short-duration of the study. The study's team recommended that at least three years of safety data be collected to make significant conclusions on how heavier trucks impact highway safety. Impacts on pavement and bridges would require even further study. Additionally, the study acknowledged the limited ability of the results to apply toward permanent changes in Vermont, due to the unusual state of growth in the economy during the program, or other states due to atypical economic conditions and Vermont's unique geographic, economic, and highway (relatively high occurrence of state highways traveling through historic towns without bypass alternatives, for example) characteristics.

The report contained the following findings:

- There was variation by industry and company as to the investment or leasing of equipment to fully utilize the increased capacities allowed under the program.
    - Many truck operators did not take advantage of the 1-year window due to the investment cost relative to the duration of the program.
        - Few carriers purchased new equipment for the pilot program. Instead, short-term lease arrangements or increased loading of existing capacities were more common to address the regulations.
    - Carriers indicated they would likely purchase additional or more productive equipment within the first few years if a weight limit change was permanent.

- Truck traffic increased 2% on Interstate highways over the course of the study, while non-interstate truck traffic decreased by the same amount.

- There were variations in shifts by vehicle class. There was a considerable increase in the interstate traffic of 5 and 6-axle trucks (65% and 106%, respectively) and corresponding decreases of these classes on non-interstate roads (6% and 56% decreases, respectively). It is not certain, however, if these changes were the result of statistical aberration though. The effect that the new regulations had on truck traffic transiting through Vermont was unknown.

- Effects on highway safety were inconclusive, due to the short duration of the study.
    - The total number of truck crashes on interstate highways increased 10% between 2009 and 2010, when the pilot program was being conducted. This compared with a 4% increase nationally over the same period of time.
    - Crashes involving property damage increased 27%, involving injuries decreased 35%.

- Truck-crash related fatalities increased from 1 in 2009 to 3 in 2010. None of the 2010 crashes involved vehicles that qualified under the pilot-program. Non-interstate highway crashes increased 24%, which was an unexpected result due to the decrease in total vehicle miles traveled on these roads.
    - More study is needed to conclude if the changes in safety data are related to the changes in regulation or if the results were the result of stochastic noise.

- The study occurred during an atypical economic fluctuation for Vermont and the U.S. Carriers participating in the study reported savings in operating costs, while the impacts on freight rail were inconclusive.
    - The duration of the study though was not considered adequate to make strong conclusions on the impacts of commerce and the

economy, particularly since operational changes were only made for a single year.

- Pavement damage on interstate highways increased by about 12% due to the heavier loads carried. The increase in interstate highway pavement damage was only offset by a decrease of less than 0.5% in the estimated pavement damage to non-interstate highways.
  - Most of the 12% damage was attributed to the straight truck classes, not combination trucks.

- Negligible impacts were found on interstate bridges as a result of the program.
  - Two secondary bridges were noted as needing to be strengthened if heavier loads were allowed to continue in the future.
  - Effects on bridge decks may exist, but those additional costs were believed to be minimal relative to overall state highway expenditures.

- Long-term infrastructure costs would be less in Vermont than for other states due to the relatively small truck volumes on Vermont's bridges.

- A reduction in fuel consumption was concluded due to the shift of truck VMT moving from non-interstate to interstate highways. On a per-mile basis, higher truck weights improve fuel consumption 15% to 20% on interstate highways, which results in significant cost savings for carriers.

- Vermont's economy is relatively small and the amount commodities transported within the state is very small in scale in comparison with national figures.

IV. The U.S. Freight Transportation System

The U.S. economy depends on an efficient freight system to link businesses, their suppliers and retail outlets throughout the nation and the world. The volume of freight shipped across the United States is a direct function of the size of the economy, and freight volume shipments tend to increase in proportion to economic growth since nearly every product produced (with exceptions to information, services and intellectual capital) includes a significant freight component to assemble supplies and transport finished goods to their point of sale.

- According to the U.S. Department of Transportation (DOT), the U.S. transportation network (all transportation modes) moved an average of 52 million tons of freight worth $45.6 billion per day in 2007, while in 2011 the volume of shipments decreased to about 48 million tons worth nearly $46 billion per day (in 2007 dollars).

- The majority of shipment volume is transported by truck: truck shipments account for over 64% of the freight tonnage and 63% of the total value of shipments.
  - Much of this large share of total volume (and value) shipments reflects the fact that nearly every land-based supply and delivery point in the continental U.S. is accessible by road, so practically all freight shipments of modest distance (e.g. less than 100 miles) are moved by truck, along with a significant proportion of longer-distance deliveries that compete to varying degrees with rail, air, waterways and pipelines.

- Railways account for about 11% of the total volume of shipments in the U.S. (1.9 billion tons annually, or 5 million tons per day).
  - Although truck transportation accounts for the most ton-miles per year[2], shipments between 750 and 2,000 miles rely more on rail than truck.
  - For 2007 (the most recent year for which official estimates were compiled by the Bureau of Transportation Statistics) trucks moved 2.3 trillion ton-miles of freight, compared to 1.5 trillion ton-miles for railroads.
    - Combined, trucks and railways account for nearly two-thirds of U.S. ton-mile freight shipments, and both show strong, consistent growth in demand as ton-miles hauled by each of these modes has more than doubled since 1980.

- Most of the nation's freight transportation network was developed before 1960, and capacity growth since then has proceeded at a modest pace.
  - Although the U.S. transportation infrastructure remains one of the most modern and efficient in the world, its physical extent and capacity has not increased at nearly the rate of freight transportation demand.

[2] A ton-mile is defined as one ton of freight shipped one mile, so it is a standardized measure of freight demand that reflects both volume and distance.

    - In fact, since 1990 to 2011, the miles of public roadways have increased by about 5% and the mileage in the railway system has actually declined by close to 23%.
        - Meanwhile, the railroads are investing billions of dollars annually making precise improvements that yield the greatest increase in volume.

- With freight increasing faster than capacity, the transportation system has become more crowded and congested, and these conditions are expected to worsen over time as freight volume shipments continue to increase.

- Some of the congestion is being off-set by a more efficient transportation system. The movement of products and goods by intermodal transportation has seen the greatest increase in volume for railroads in recent years. By putting containers on train, truck carriers are able to save fuel and the railroads gain volume.

- Freight congestion is detrimental to the economy in many ways. Aside from the nuisance of added driving time that affects all vehicles including passenger cars, it also directly increases costs across the economy while providing no offsetting benefits. These added costs ultimately reduce economic output and waste resources that could otherwise be put to more productive use. For instance:
    - Congestion anywhere in the transportation system slows the movement of freight and increases the average time to ship products, especially over long distances. It also can increase the variability in the time needed to ship products a given distance, since traffic volume is highly variable by location and often shows considerable daily, weekly and seasonal differences. For any business that depends on delivered inputs, delayed supply shipments can be a considerable risk that in extreme cases can impede production and force temporary shutdowns of production facilities. To offset this risk, firms must maintain larger supply inventories, which add directly to costs in terms of added warehouse space requirements as well as the capital (i.e., financing) costs of investing in and carrying larger inventories to guard against supply risk.
    - Traffic congestion increases labor costs, and these higher costs are ultimately passed on to businesses and consumers. By slowing the movement of freight, the labor hours required for each shipment increase while those extra hours are spent in stopped traffic or moving at a slow, inefficient pace.
    - Congestion increases fuel costs. For any mode of transportation, but especially trucks and trains, the greatest energy requirements are associated with starting the vehicle from a stopped position and accelerating to a cruising speed. Stop-and-go traffic results in a dramatic reduction in fuel economy. Fuel economy is also compromised by slow-moving traffic since less inertia is produced at lower speeds and trucks must operate in lower gears, thereby increasing the engine RPMs per distance traveled. And, any amount of time spent idling in standing traffic

wastes fuel directly. In addition to fuel costs, the environmental consequences of inefficient fuel use are self-evident.

- Across the national highway system today, traffic congestion is most pronounced in the densely populated urban areas of the Northeast, Southern California, and in and around Chicago and other major metropolitan areas.
  - Most of the major traffic arteries that extend through the Corn Belt and other agricultural areas remain largely uncongested as shown in Figure 5 and Figure 6.
  - Nevertheless, agricultural shipments to many currently-congested areas are substantial, especially to reach processors and export terminals, so even today roadway congestion is a concern for at least some agricultural firms and industries.

- However, projecting freight demand on the current highway system into 2040 suggests roadway congestion will become widespread, extending far into the Midwest and affecting most major arteries between population centers as shown in Figure 7.

Figure 5: Peak-Period Congestion on High-Volume Parts of the U.S. Highway System: 2002

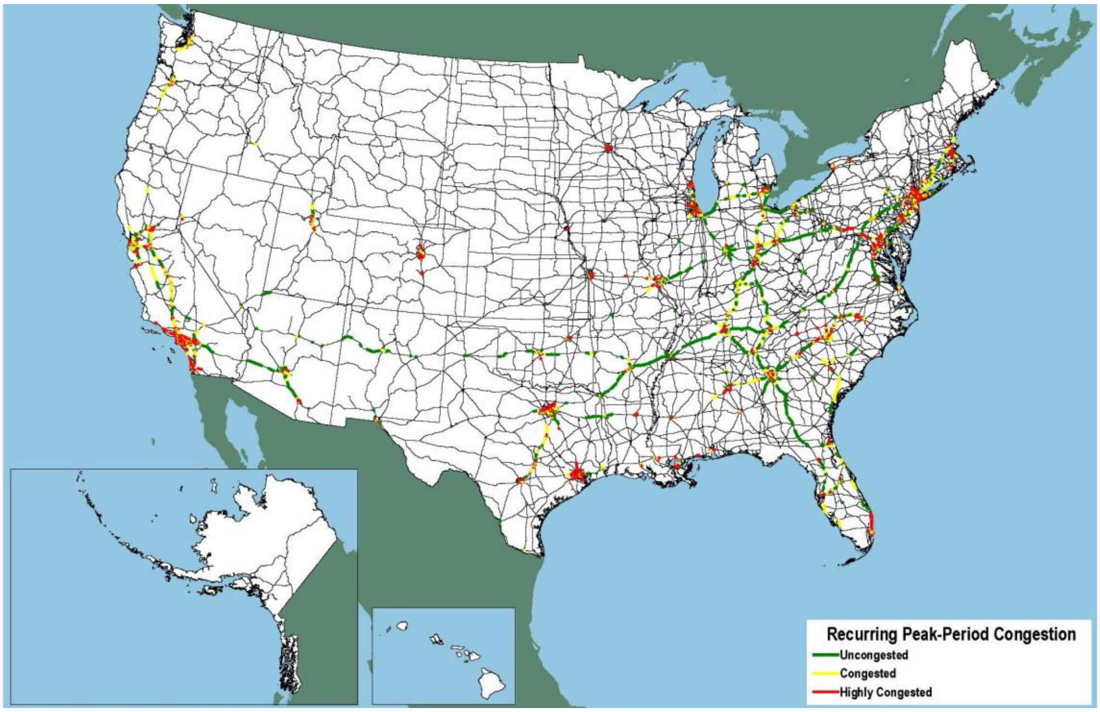


Figure 6: Peak-Period Congestion on High-Volume Parts of the U.S. Highway System: 2007

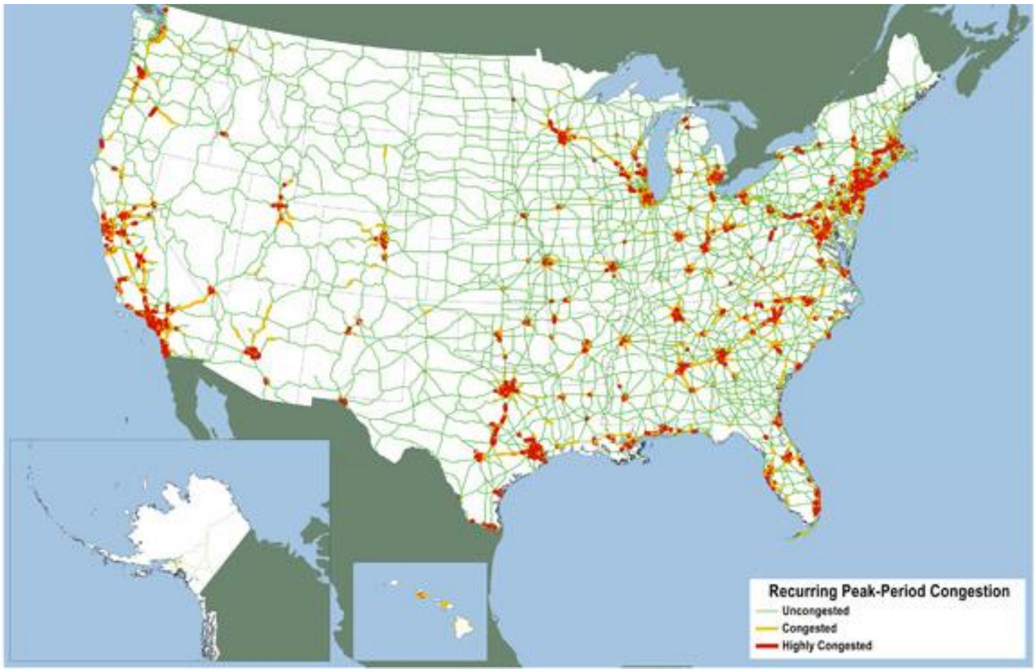
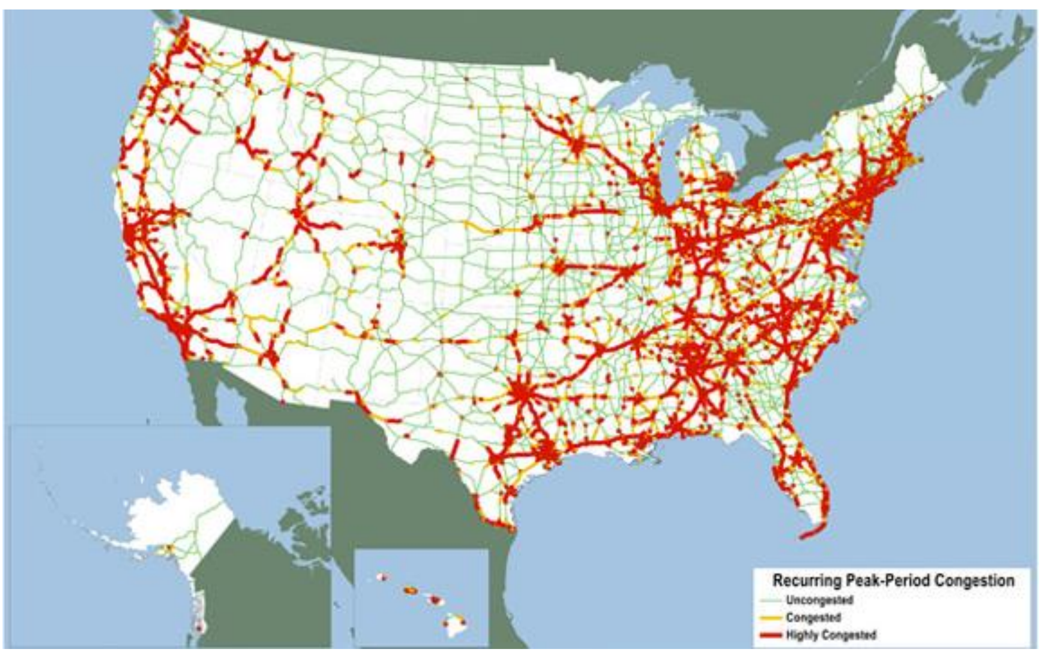


Figure 7: Peak-Period Congestion on High-Volume Parts of the U.S. Highway System: 2040



Notes: High-volume truck portions of the National Highway System carry more than 10,000 trucks per day, including freight-hauling long-distance trucks, freight-hauling local trucks, and other trucks with six or more tires. Highly congested segments are stop-and-go conditions with volume/service flow ratios greater than 0.95. Congested segments have reduced traffic speeds with volume/service flow ratios between 0.75 and 0.95.

Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework, version 3.4, 2012.

A. Road Weight Limits

Since 1975, the maximum allowable gross vehicle weight (GVW) for semi-tractor trailers operating on the Federal Highway System has been 80,000 pounds (lbs.) distributed over a minimum of five axles. Prior to 1975, the maximum GVW was set at 73,280 lbs., and the increase to 80,000 lbs. was driven by a desire to increase efficiency in the trucking industry especially given the record-high fuel prices at that time. Today, high fuel prices and a shortage of truck drivers are increasing the cost of freight transportation. In addition, a bevy a new regulation on truck carriers is limiting the available pool of qualified drivers, reducing the number of hours drivers can work.

- The result of higher weight limits on trucking efficiency is unambiguous. The ability to haul a greater quantity of freight on a single truck that is currently at its maximum weight limit will decrease the number of trips required per truck, leading to reduction in the per-unit cost of transportation and fewer trucks on the highway, all else equal. However, the magnitude of the system-wide cost savings and the reduction in truck volume on U.S. highways is limited by several factors including:
    - The existing data was discontinued in 2002, but interviews indicate approximately 80% of truck shipments cube out (filling the cubic capacity) before they weigh out (maximizing the payload weight before cubing out). Based on 2002 data, truck shipments are currently constrained by weight, instead of volume. Although there are over 5 million trucks on U.S. roads today traveling more than 285 billion miles per year,[3] a relatively small share of those (less than 25%) currently exceed 60,000 lbs. gross average weight as shown in Table 4.
        - Even among the heaviest trucks, many likely are constrained by the physical dimensions of their cargo as opposed to the weight of the cargo, so the opportunity to benefit from the higher truck weights is limited to a relatively small proportion of the total U.S. truck inventory.
        - Nevertheless, as illustrated in Table 4 the heaviest trucks (those exceeding 60,000 lbs. GVW) still account for more than half of the miles traveled by all trucks on the road today, and the growth of this category is among the fastest, so even a small share of trucks hauling heavier loads should result in a significant net reduction in truck mileage (i.e., density), all else equal.
    - Will heavier weight limits attract new volume to the trucking industry, away from competing modes, particularly rail? This is one of the fundamental controversies associated with raising the weight limits, as opponents argue that higher weight limits will simply cause the trucking industry to attract modal share from railroads, so that the volume of trucks on the

[3] Based on 2010 statistics (the most recent year of the US Census Vehicle Use Survey), the most current numbers are 2002. The number of trucks on the road and mileage today certainly exceeds these estimates, but Informa assume the share of truck volume by weight class is roughly the same.

road will stay the same, or even increase, as it becomes more economical to ship products by truck instead of rail.

- Economic theory suggests there could be some increase in truck shipments at the expense of railroads, but the amount of substitution is likely to be very small.
    - For products shipped long distances, the cost advantages of rail far exceeds shipments by truck, and rail, where it is currently an option, will likely continue to be more cost effective despite a relatively modest increase in maximum truck weights.
    - Furthermore, the rapid increase in containerized shipments that are shipped long distance by train and locally delivered by truck, as well as the use of RoadRailer systems in which truck trailers are specially equipped for railroad intermodal service, highlights the extent to which efficiencies are gained by an increasingly coordinated transportation system, which the higher truck weight limits is unlikely to change.
    - For many products, particularly when shipping distances are less than a few hundred miles, trucks are often the only viable shipping method since railroads tend to have less flexibility and connectivity to reach all markets, quickly.
- To the extent that higher truck weight limits attract any freight volume from railroads, the positive effect of this competition should benefit all industries and consumers.
    - Railroads are unlikely to simply allow a decrease in their freight volume without adopting some measures to attempt to regain that business. Hence, there would likely be some downward pressure on freight rates as well as efforts to increase rail capacity and/or reduce shipment times to better compete with trucks.
    - This would buffer even the modest potential for trucks to gain market share from railroads. The key point is that markets and competition are dynamic, and any improvement in the efficiency of one transportation mode is likely to encourage greater efficiency in competing modes, as well.
        - For example, in the refrigerated transportation market, railroads have to lower freight rates or lose business.

Table 4: Truck (over 10,000 lbs) Mileage by Average Weight

Average Weight (Pounds)	1987		2002		Percent change, 1987-2002	
	Number (1,000)	VMT (millions)	Number (1,000)	VMT (millions)	Number	VMT
Total	3,624	89,972	5,415	145,624	49	62
Light-Heavy	1,030	10,768	1,914	26,256	86	144
10,001 to 14,000	525	5,440	1,142	15,186	119	179
14,001 to 16,000	242	2,738	396	5,908	64	116
16,001 to 19,500	263	2,590	376	5,161	43	99
Medium-Heavy	766	7,581	910	11,766	19	55
19,501 to 26,000	766	7,581	910	11,766	19	55
Heavy-heavy	1,829	71,623	2,591	107,602	42	50
26,001 to 33,000	377	5,411	437	5,845	16	8
33,001 to 40,000	209	4,113	229	3,770	10	-8
40,001 to 50,000	292	7,625	318	6,698	9	-12
50,001 to 60,000	188	7,157	327	8,950	74	25
60,001 to 80,000	723	45,439	1,179	77,489	63	71
80,001 to 100,000	28	1,254	69	2,950	144	135
100,001 to 130,000	8	440	26	1,571	238	257
130,001 or More	4	185	6	329	43	78

Source: U.S. Census, 2011 Freight Facts and Figures (Most recent data is 2002)
VMT = Vehicle Miles Traveled

- Typical characteristics of freight shipments across different modes are described in Table 5. The products that could benefit from an increase in truck weights include high density, low value commodities, including agricultural commodities, gravel, iron, and others.
  - Nearly half of the volume of all bulk commodities is shipped by modes other than truck, including rail, pipeline and water transport, a relationship that is unlikely to change with an increase in truck weight limits.
  - Nevertheless, there are several categories of high-value, time sensitive products shipped primarily by truck for which higher weight limits could lead to substantial cost savings.
    - These would include dense consumer products such as canned (or bottled) beverages, dairy products, vehicle parts, and various industrial products and machines.
    - Owing to the high-value, time sensitive nature of these products, trucks already hold a majority share of shipments so there could be substantial efficiency gains (in terms of reduced truck trips per year) from an increase in weight limits.

- For many high-value products, including furniture, electronics and various consumer goods, trucks are limited by volume constraints instead of weight, so higher weight limits will have no direct effect on shipping patterns or costs. However, indirect cost savings are still possible, particularly if higher weight limits, by improving efficiency at the upper end of the weight spectrum, increase the relative availability of trucks (and drivers) across the lower weight classes.

Table 5: Freight Characteristics of Product and Commodity Shipments, and Average Modal Share in 2011

	High Value Time Sensitive	Bulk
Top 10 Commodity Classes	Machinery Electronics Motorized Vehicles Mixed Freight Pharmaceuticals Textiles/leather Miscellaneous Manufactured Products Gasoline Plastics/Rubber Articles of Base Metal	Gravel Cereal Grains Coal Non-metallic Mineral Products Waste/Scrap Natural Gas, Coke, Asphalt Gasoline Crude Petroleum Fuel Oils Natural Sands
Share of Total Tons	16%	65%
Share of Total Value	57%	19%
Key Performance Variables	Reliability Speed Flexibility	Reliability Cost
Share of Tons by Domestic Mode	Truck: 72% Rail: 11% Other: 17%	
Share of Value by Domestic Mode	Truck: 75% Rail: 3% Other: 22%	

Other Modes includes “Multiple modes and mail, which is 12% of volume and 13% of value

Source: US Department of Transportation, Federal Highway Administration, Office of Freight Management and Opera

B. Estimates of Future Freight Movement via Semis

Historic freight shipment trends for truck, rail, water and air, and future projections of macroeconomic conditions help guide lawmakers as to the type of infrastructure needed to meet demand for transportation.

- According to the DOT, the volume of freight demand by all modes will increase from 18.3 billion tons in 2010 to 27.5 billion in 2040, an increase of 9.2 billion tons or 50% as shown in Table 6.
  - Truck volumes are forecast to increase the most, from 12.5 billion tons in 2010 to 18.5 billion in 2040, an increase of 6 billion tons or 48% over that time. Only 34% or 3.2 billion tons of the growth will come from modes other than truck.

Table 6: Transportation Demand by Mode, 2010 and 2040 (million tons)

	2010				2040			
Mode	Total	Domestic	Exports	Imports	Total	Domestic	Exports	Imports
Total	**18,313**	**16,394**	**762**	**1,156**	**27,484**	**23,081**	**1,824**	**2,579**
Truck	12,490	12,309	95	86	18,503	18,005	272	226
Rail	1,776	1,645	57	74	2,353	2,038	155	159
Water	860	464	67	328	1,263	594	113	556
Air, air & truck	12	2	4	5	43	7	16	19
Intermodal	1,380	400	496	485	2,991	595	1,171	1,225
Pipeline & Unknown	1,796	1,574	44	178	2,332	1,842	96	393

Sources: USDOT-FHWA.
Notes: Intermodal includes U.S. Postal Service and courier shipments and all intermodal combinations, except air and truck. Intermodal also includes oceangoing exports and imports that move between ports and interior domestic locations by modes other than water. Pipeline and unknown shipments are combined because data on region-to-region flows by pipeline are statistically uncertain. Data do not include imports and exports that pass through the United States from a foreign origin to a foreign destination by any mode.

- The value of the shipments increases with shipment volume. The value of shipments totaled $16.1 trillion in 2010 and is forecast to increase 145% by 2040 to $39.4 trillion.
    - The value of shipments will be highest by truck ($21.8 trillion), followed by intermodal ($10.3 trillion), air and truck ($4.4 trillion), pipeline and unknown ($1.8 trillion), rail ($740 billion) and water ($448 billion) as shown in Table 7.

Table 7: Value of Shipments by Mode, 2010 and 2040 (Billions of 2007 Dollars)

	2010				2040			
Mode	Total	Domestic	Exports	Imports	Total	Domestic	Exports	Imports
Total	**16,065**	**13,032**	**1,217**	**1,816**	**39,441**	**29,578**	**4,195**	**5,668**
Truck	10,515	10,000	263	252	21,762	20,234	728	799
Rail	427	306	41	79	740	480	118	142
Water	343	146	15	182	448	171	32	245
Air, air & truck	999	123	409	466	4,350	732	1,683	1,936
Intermodal	2,739	1,562	434	743	10,322	6,538	1,473	2,310
Pipeline & Unknown	1,042	895	54	93	1,819	1,423	160	236

Sources: USDOT-FHWA.
Notes: Same as Table 6.

- Informa developed a baseline transportation forecast from 2010 through 2022 based on its own economic data and outlook. The Informa forecast suggests that air will have the largest compound annual growth rate (4.3%) followed by truck (2.8%), rail (3.1%), and water (0.7%).

- Informa forecasted ton-miles by transportation mode.
    - Growth rates in truck and railroad are similar. Truck trailers and intermodal containers move by truck and on railroads to take advantage of the fuel efficiency rail offers. As a result, the rail and truck industries are partners as well as competitors.

- Domestic water transportation increased slightly as inland waterways movements offset declines in coastwise shipments.
- Crude oil production from shale plays is driving increases in pipeline growth as shown in Table 8.

Table 8: Informa Baseline Transportation Projection by Mode (million ton-miles)

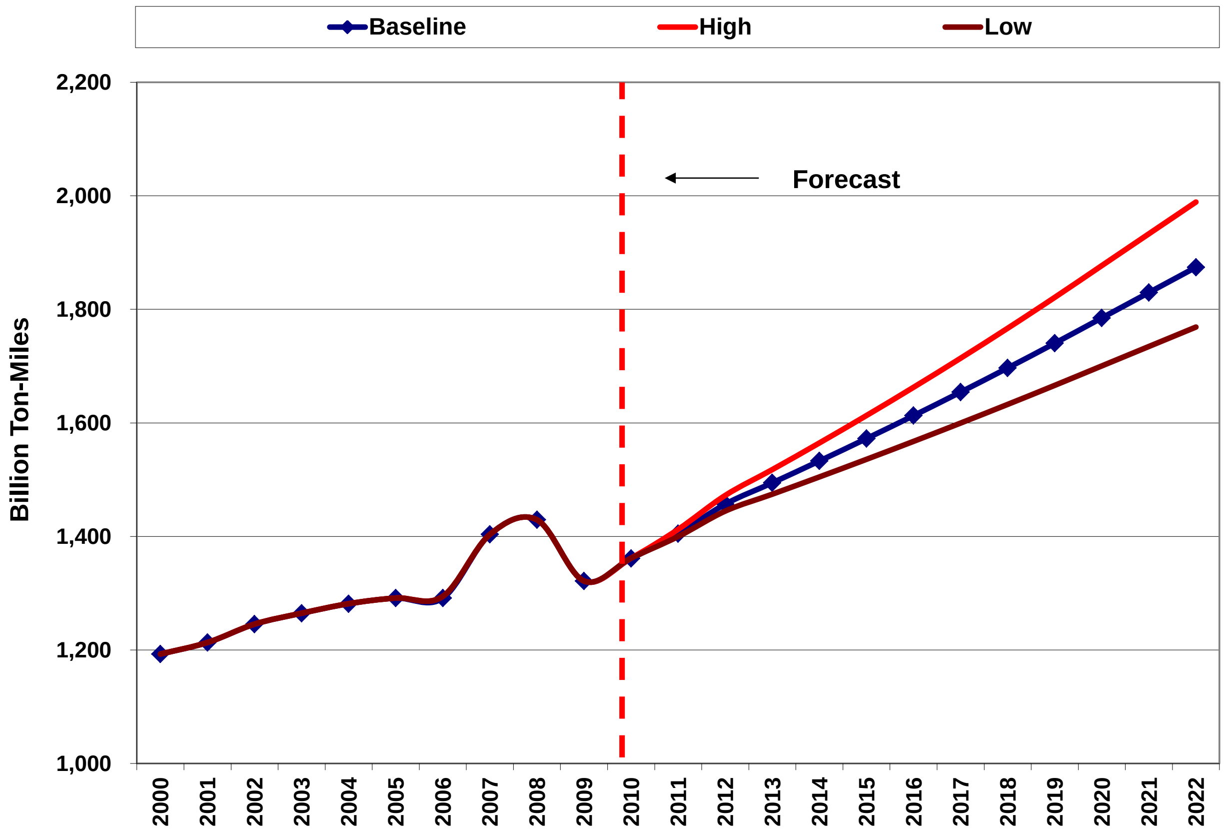
	Billion 2000 $	Million Tonmiles					
Year	US GDP	Total US Freight	Air	Truck	Railroad	Domestic Water Transportation	Pipeline
2000	9,817	4,328,750	15,810	1,192,633	1,546,319	645,799	928,189
2005	11,003	4,570,316	15,745	1,291,308	1,733,329	591,276	938,659
2010	**11,672**	**4,422,851**	**12,642**	**1,361,034**	**1,636,006**	**480,461**	**932,708**
2011	**12,034**	**4,555,122**	**13,319**	**1,404,633**	**1,695,309**	**483,825**	**958,036**
2012	**12,467**	**4,712,848**	**14,129**	**1,456,835**	**1,766,312**	**487,211**	**988,360**
2017	**14,105**	**5,313,795**	**17,192**	**1,654,242**	**2,034,819**	**504,504**	**1,103,037**
2022	**15,931**	**5,982,071**	**20,606**	**1,874,215**	**2,334,018**	**522,411**	**1,230,821**

Source: BTS and Informa Forecast

Domestic trucking is the major mode of transportation from a volume standpoint as shown in Table 4 but from a ton-mile standpoint the rail sector is over 45% greater than truck as seen in Table 8.

- Overall truck shipments represent two-thirds of the total freight tons moved and 30% ton-miles.
- The compound annual growth rate for truck ton-miles was forecast to stay in a range of 2.2% and 3.3% using GDP growth rates of 2.0% for a low case scenario and a high growth annual rate of 3.0%. The baseline growth rate assumed the U.S. economy would expand at a 2.5% growth rate starting in 2011.
    - Although this range appears narrow, by 2022 the difference between the high and low forecast is 210 billion ton-miles as shown in Figure 8.
    - Even the low ton-mile forecast is going to require more equipment, labor, and increases in highway mileage.
    - Allowing higher truck weights on the federal highway system will reduce the demand for new trucks and drivers, which will help contain transportation costs, reduce congestion, and lower environmental impacts.

Figure 8: U.S. Truck Ton-Mile Forecast (billion ton-miles)



Source: BTS and Informa

- The impact of increasing the federal limit on truck weights is small relative to the total transportation market.
    - Based on discussions with industry representatives and review of recent studies, approximately 80% of truck traffic is semi-tractor trailer traffic configured as a truck and trailer while the remaining traffic is straight truck or box truck.
    - Moreover, industry representatives indicated that approximately 20% of the semi-tractor trailer traffic is constrained by weight limits, meaning that goods and commodities loaded into a semi-tractor trailer configuration weigh out at the federal weight limit of 80,000 lbs. before cubing out the trailer or using all the available volume metric space of the trailer.

- For industries impacted by the weight limits, those that weigh out before they cube out, the benefits from increasing the federal truck weight limit from 80,000 pounds to 97,000 pounds for example is significant. If the federal truck weight limit were increased, and given that truck demand is large and will continue to grow, even a small percentage decrease in the number of trips could annually save approximately 39.2 million trips, reduce miles driven by 5.9 billion, and save 1.1 billion gallons of diesel by 2022, as summarized in Table 9.

Table 9: Impact of Truck Weight Limit Increased to 97,000 Pounds

Year	Truck Volume (billion tons)	Total Semi Volume Weight Constrained (billion tons)	Number of Trips (millions)			Mileage Saved (billion miles)	Fuel Saved (million gallons)
			80,000 lbs	97,000 lbs	Saved Trips		
2008	19,057	3,049	135,518	108,899	26,620	3,993	777
2012	**19,424**	**3,143**	**139,699**	**112,258**	**27,441**	4,116	801
2017	**22,057**	**3,770**	**167,541**	**134,631**	**32,910**	4,936	960
2022	**24,990**	**4,498**	**199,916**	**160,647**	**39,269**	5,890	1,146

* Assumes an average trip distance of 75 miles for all trucks. Semis are 150 miles.
* Does not include dead head miles
* Assumes 80% of trucks moves in 2008 are Semis, 90% by 2022
* Assumes 20% of Semi truck volume is limited by weight
* 80,000 lb. truck = 5.8 mpg, 97,000 lb. truck = 5.14 mpg
Source: BTS and Informa

- The key benefits to a state from an increase in federal truck weight limits includes the reduction in the number of trucks used to move the same volume and a shift of truck traffic from state highways to federal highways, which would lead to state savings on maintenance cost for roads and bridges on state highways, many of which already permit heavier-weight trucks in some instances.

C. Cost of New Equipment

To determine how a change in weight limits could affect shipment patterns and truck density, Informa considered a range of economic variables that could impact adoption, including the cost of new trailers, whether or not shipments in excess of 80,000 lbs. would be subject to additional fees/permits, and the type of freight most likely to benefit from higher weight standards.

- Industry experts say that the Class 8 semi-tractor trailers would be able to handle the increase in weight from 80,000 lbs. to 97,000 lbs. A typical truck configuration with a gross weight of 80,000 lbs. is assumed to be a Class 8 semi-tractor trailer with three axles hauling a two-axle trailer. To haul 97,000 lbs., a three-axle trailer will be required. The cost of a new truck is about $90,000. A trailer with two axles is about $20,000, and a trailer with three axles is about $23,000.

- Operationally, an operator's cost will increase for each trip hauling heavier weights and with the gross weight expected to increase 20% to 97,000 pounds; the additional weight will reduce the miles per gallon (mpg).
    - Industry representatives suggest heavier weights will cause an 11% mpg reduction from an estimated average of 5.80 mpg to around 5.14 mpg.
    - Actual[4] mile per gallon estimates that include traffic congestion, load, and unload times suggest the actual mile per gallon is 5.55 miles per gallon.

[4] Assumes the truck is fully loaded

This would suggest the fuel drag would be approximately 7% or less than originally believed.

D. Observations

The U.S. economy requires an effective and efficient freight transportation system to operate at minimal cost and respond quickly to demand for goods. As the economy grows, the demand for goods and related freight transportation activity will increase. Current volumes of freight are straining the capacity of the transportation system to deliver goods quickly, reliably, and cheaply. Anticipated long-term growth of freight could overwhelm the system's ability to meet the needs of the American economy. Increasing truck weight limits will have an unambiguous effect on the efficiency of the nation's freight transportation system by reducing the number of trucks needed to haul the equivalent volume of freight in the U.S. However, relative to the current volume of freight shipments and its anticipated growth, the effect on traffic congestion and overall transportation costs are small. Nevertheless, the cost savings and reduced fuel usage are not insignificant and could provide substantial savings to certain industries. And, given the fact that the capacity of the transportation system is increasing at a much slower rate than the demand for freight services, increasing truck weight limits could represent the quickest, most effective way to increase the capacity of the transportation network, however small that capacity increase might be relative to total demand. Even a modest reduction in truck volume on the highway system would be welcome to businesses, consumers and automobiles that share the road with trucks.

However, while the efficiency gains are clear, they must be balanced against the potential for heavier trucks to compromise the safety of public roads or to lead to greater wear-and-tear on roads and bridges that result in higher costs of highway maintenance which are ultimately paid by taxpayers. The following sections explore the relationship between truck weights and public safety and the integrity of roadways and bridges.

V. Motorist Safety

A. Summary

There is a significant body of research by official federal and state agencies that concludes that increasing truck weight maximums, e.g., from 80,000 to 97,000 lbs. and adding axles could improve braking performance and highway safety. One key reason is the fact that an additional axle with additional corresponding brakes increases excess braking capacity. Also adding an extra axle increases the number of tires from 18 to 22 and reduces the load weight per tire.

- The general safety impact of policies that change maximum truck sizes and weights is complex. Larger trucks are more difficult to handle, and can be more dangerous to operate in some situations, but that factor can be offset readily by using better equipment and better trained drivers. In addition, a bevy of new regulations are enacted that will improve safety, such as shorter work hours.
    - National Highway Traffic Safety Administration (NHTSA) is constantly studying new technology and increasing standards both in terms of equipment and drivers. New technologies range from enhanced brakes to tire pressure monitoring systems. Human concerns are warning systems and visibility studies.

- Available research also indicate that there is very little difference among truck configurations in terms of key characteristics of crash dynamics, such as static roll stability, load transfer ratio and rearward amplification.

- Still, proposals to increase truck size and weight maximums likely face opposition because automobile drivers feel threatened by large trucks.
    - In reality, fatalities and injuries in accidents involving trucks have been declining steadily for several decades in spite of much greater traffic congestion and much higher highway speeds for all vehicles.
    - With a whole government agency focused on safety, an enhanced safety regime should not be surprising.

- Available research also indicates that increasing maximum truck weights would make U.S. highways safer and reduce the number of highway truck crashes by reducing the number of truck miles needed to move any given amount of freight.

B. Truck Safety

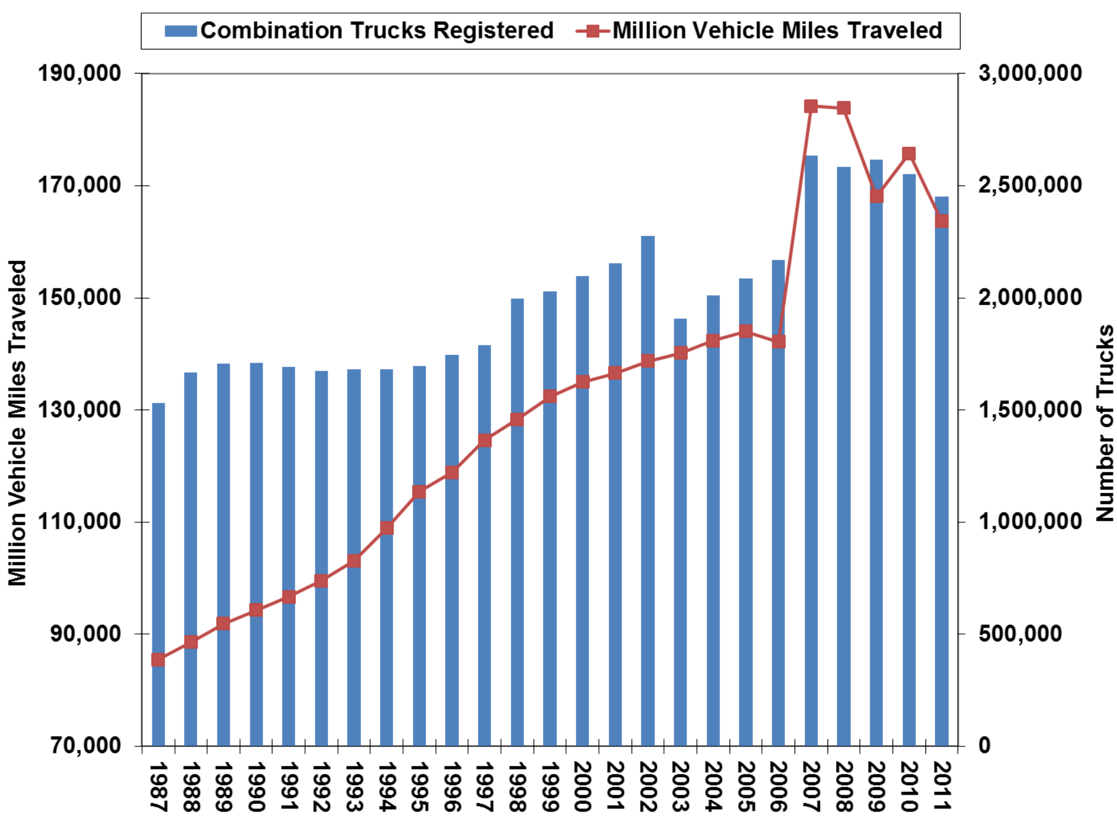
- Increasing freight movement requirements has increased the number of commercial vehicles on roadways and thus the need for more productive and potentially larger commercial trucks.

The DOT reports there were approximately 2.5 million combination trucks[5] in 2011 compared to 1.7 million twenty years earlier as shown in Figure 9.

- During this same time period the number of vehicle miles traveled by combination trucks increased nearly 70% to 163 billion miles in 2011.
- The growing number of large trucks has heightened public awareness of the need to improve commercial vehicle safety and preserve highway infrastructure.

- A combination truck is defined as a truck tractor pulling any number of trailers (including a "bobtail" truck tractor not pulling any trailers) or a straight truck pulling at least one trailer. The FHWA implemented an enhanced methodology for estimating registered vehicles and vehicle miles traveled by vehicle type beginning with data from 2007. As a result, involvement rates may differ, and in some cases significantly, from earlier years.

Figure 9: Trends in the Number of Combination Trucks Registered and Million Vehicle Miles Traveled

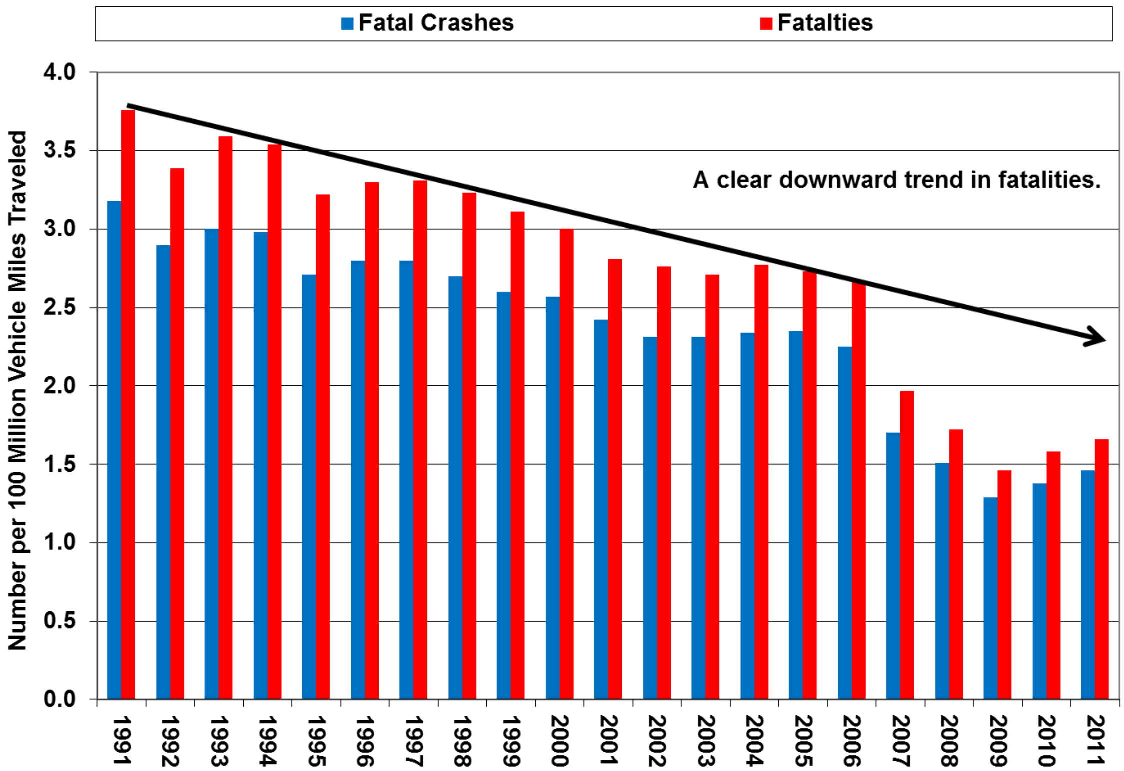


Source: *Large Truck and Bus Crash Facts 2011*, Analysis Division Federal Motor Carrier Safety Administration, Department of Transportation

5 Defined as a truck tractor pulling any number of trailers (including none) or a straight truck pulling at least one trailer.

- During the same period, the number of fatalities and injuries from combination truck crashes has decreased sharply as shown in Figure 10 and Figure 11. The number of fatalities from large truck crashes is down 54%, from 3.76 per 100 million vehicle miles traveled in 1991 to 1.66 in 2011. The number of injuries involved in large truck crashes decreased by 57%, from 65.2 per 100 million vehicle miles traveled in 1991 to 27.8 in 2011.
    - Although the number of fatal crashes and fatalities increased the last two years, it should be noted that is consistent with previous post-recession recoveries. Current levels are well below the pre-recession levels.

Figure 10: Number of Combination Truck Fatal Crashes and Fatalities per 100 Million Vehicle Miles Traveled



Source: *Large Truck and Bus Crash Facts 2011*, Analysis Division Federal Motor Carrier Safety Administration, Department of Transportation

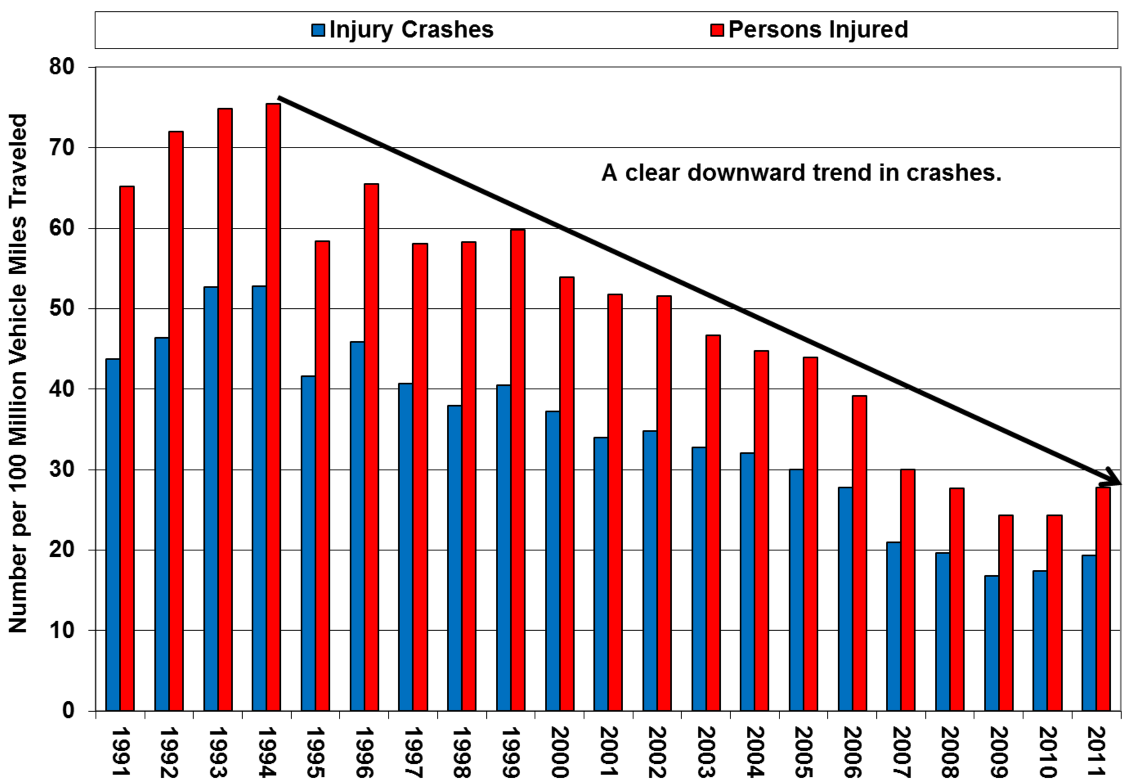
- In 2011, 3,608 large trucks were involved in fatal crashes, a 3% increase from 2010. However, from 2008 through 2011 the number of large trucks involved in fatal crashes declined by 12% and the number of passenger vehicles involved in fatal crashes declined by 13%.

- Over the past 10 years (2001 through 2011):
    - The number of large trucks involved in fatal crashes decreased from 4,823 to 3,608, a 25% decrease.

    - The number of large trucks involved in injury crashes decreased from 90,000 to 63,000, a decline of 30%.
    - The number of large trucks involved in property damage only crashes decreased from 335,000 to 221,000, a drop of 34%.

- Over the past 3 years (2008 through 2011):
    - The number of large trucks involved in fatal crashes declined by 12%, from 4,089 to 3,608, and the vehicle involvement rate for large trucks in fatal crashes (vehicles involved in fatal crashes per 100 million miles traveled by large trucks) increased by 2%.
    - The number of large trucks involved in injury crashes decreased by 5%, from 66,000 to 63,000, and the vehicle involvement rate for large trucks in injury crashes increased by 10%.
    - The number of large trucks involved in property damage decreased by 28%, from 309,000 to 221,000, and the vehicle involvement rate for large trucks in property damage only crashes declined by 17%.

Figure 11: Number of Combination Truck Injuries per 100 Million Vehicle Miles Traveled



Source: *Large Truck and Bus Crash Facts 2011*, Analysis Division Federal Motor Carrier Safety Administration, Department of Transportation

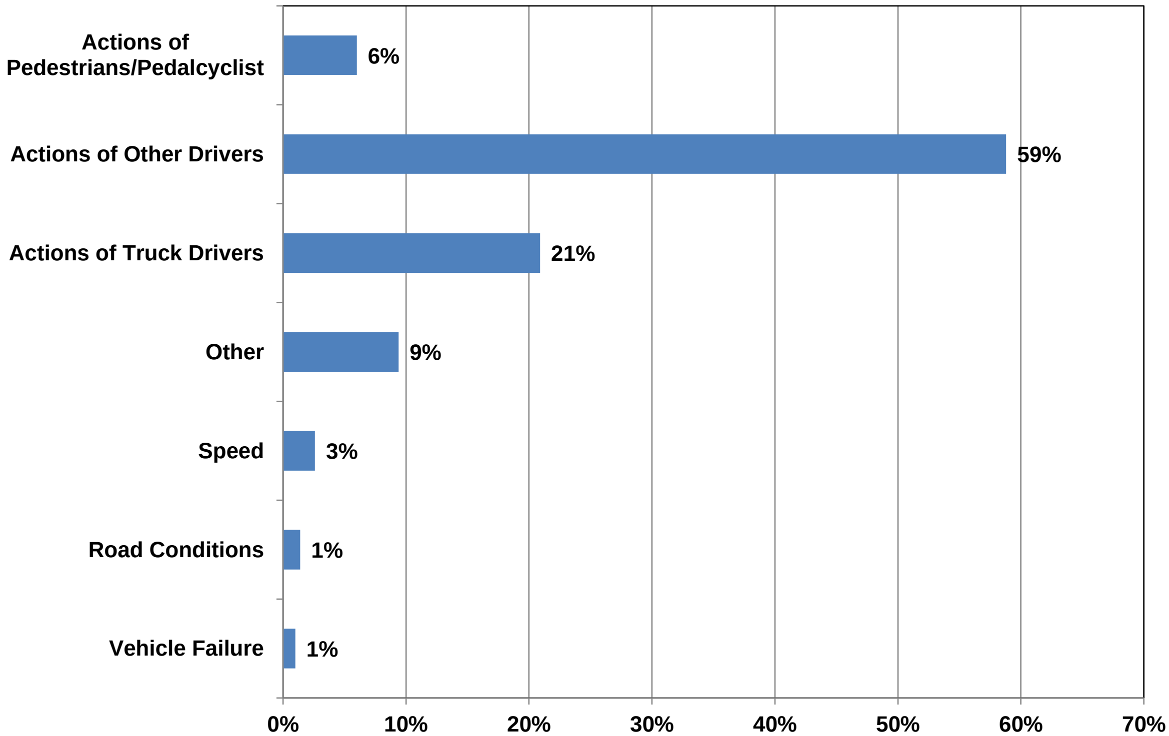
- Crash rates are perhaps the most important safety consideration, but other factors also must be factored into assessments of the safety of trucks. One intangible factor is the public reaction to larger and heavier trucks. While such perceptions may have little factual basis, they affect attitudes and decisions concerning whether to allow such vehicles. The DOT's "Comprehensive Truck Size and Weight Study" (2000) conducted focus group meetings to delve more deeply into driver perceptions of the safety of various truck configurations in different operating environments. The vast majority of automobile drivers participating in the focus group indicated they prefer the status quo and that if changes are made they should be in the direction of greater restrictions on truck size and weight limits. Some indicated they could accept a role for longer combination vehicles (LCV), but only under strict limits and conditions. While opinions expressed in the focus groups are not necessarily representative of all drivers, they provide insights into factors underlying opinions about truck safety.

- Despite the statistics, there is widespread perception that increasing truck weights would lead to a greater danger of injury or death on highways and interstates and outweigh potential trucking efficiency benefits. Efforts to reasonably predict accident rates associated with this policy change are complicated and often controversial, reflecting limited data for analysis and modeling. The fact that larger trucks generally operate on rural roads and turnpikes provides little basis to predict how they would operate on high-speed interstates and in more urbanized settings.

- Despite the common driver concerns about trucks, passenger cars are the most often the cause of crashes with large trucks.
    - The American Automobile Association (AAA) found in July 2002 that 80% of crashes were caused by car drivers.
    - In 2006, Virginia Tech analysis of two studies conducted for the DOT found that 78% of car-truck crashes were caused by passenger car drivers.
        - In 2006, rear-end collisions where passenger cars strike large trucks were 2.7 times more likely than large trucks rear-ending passenger cars.
        - Head-on collisions where passenger cars enter into the truck's lane are more than 16 times more likely to occur than vice-versa.

- Federal Motor Carrier Safety Administration (FMCSA) and the National Highway Traffic Safety Administration (NHTSA) found in 2001 that vehicle failures were only responsible for 1% of fatal crashes. As mentioned earlier in the report, equipment is constantly improving.

Figure 12: Critical Events in Large Truck Fatal Crashes



Source: Federal Motor Carrier Safety Administration (FMCSA) and the National Highway Traffic Safety Administration (NHTSA)

- Research also suggests that increasing maximum truck weights could make U.S. highways safer and reduce the number of highway truck crashes by reducing the number of VMT required to move any given amount of freight.
  - It follows that fewer trips and reduced truck mileage will also translate to fewer accidents involving trucks. In 2011, for every 100 million VMT by combination trucks, traffic accidents resulted in 1.7 fatalities.[6]
    - A combination truck is defined as a truck tractor pulling any number of trailers (including a "bobtail" truck tractor not pulling any trailers) or a straight truck pulling at least one trailer.
  - Applying these same accident rates to the estimated 4.1 billion mile reduction calculated by Informa in 2012 suggests a net reduction of 68 fatalities and 98 fatalities by 2022.

- FMCSA reported in 2011 combination trucks were involved in accidents that killed 2,724 people as shown in Table 10.
  - The government estimate for VMT was 164 billion miles.
  - Total fatalities divided by VMT equals 1.66 fatalities per 100 million VMT.

[6] Source: *Large Truck and Bus Crash Facts 2011*, January 2009, Analysis Division Federal Motor Carrier Safety Division.

  - Assuming 80% of combination trucks are semi-tractor trailer moves, total fatalities are 2,179.
    - A 97,000 pound GVW truck will require 20% less trips than an 80,000 pound GVW on loads that are constrained by weight.
    - According to industry sources, approximately 20% of freight moved by truck is constrained by weight, which results in a 4% decline in all semi-tractor trailer vehicle miles, which in turn results in a 4% decline in fatalities or 87 saved lives.

- The 87 saved lives assumes if a truck does not leave the parking lot, it will not be involved in an accident. It is argued that a heavier vehicle is inherently more dangerous. So, how much more would fatalities per 100 million VMT have to be for a 97,000 pound truck to have the same number of fatalities as an 80,000 pound truck?
  - Based on the data, a 97,000 pound truck's fatalities per 100 million VMT rate would have to be 25% greater than an 80,000 pound truck to prevent lives from being saved. In other words, if a 97,000 pound truck configuration is as safe as an 80,000 pound truck configuration, fatalities will be reduced by 20%.
  - A 97,000 pound truck with an extra axle should have comparable handling characteristics as an 80,000 pound truck, as regulated by law.
  - Safety reports indicating a very small percentage of wrecks are the result of equipment failure.

Table 10: Safety Comparison of an 80,000 pound versus 97,000 pound Truck Configurations in 2011

	All Combination Trucks	Semi-Tractor Trailers	80,000 Pounds or Less	97,000 Pounds
Cubes Out Versus Weights Out	100%	80%	64%	16%
Total Fatalities	2,724	2,179	1,743	436
Million Vehicle Miles Traveled	163,692	130,954	104,763	26,191
Fatalities per 100 Million VMT	1.66	1.66	1.66	1.66
Million Vehicle Miles Saved	3%	0%	0%	20%
Adjusted Vehicle Miles Traveled	158,454	125,715	104,763	20,953
Fatalities per 100 Million VMT	1.66	1.66	1.66	1.66
Adjusted Fatalities	2,637	2,092	1,743	349
Fatalities Lowered	87	87	-	87
Break Even Rate	1.72	1.73	1.66	2.08
Break Even Percent Increase	**3%**	**4%**	**0%**	**25%**

Source: Large Truck and Bus Crash Facts 2011, Analysis Division Federal Motor Carrier Safety Administration, Department of Transportation, and Informa

- For a truck driver, the increase in efficiency is viewed as either unemployment or driving a truck with a greater chance of harm. The options are not very attractive.
  - Truck drivers are paid to move freight and if they move more freight, they want more money.

- All stakeholders are waiting for the FHWA MAP-21 "Comprehensive Truck Size and Weight Limits Study" release in April 2014. The public release is slated for November 2014. This report will focus on safety, pavement, bridge, compliance, and modal shifts. Informa interviewed FHWA staff and indicated that the safety data concerning combination trucks is not ideal. The first responders are focused on saving lives and returning traffic to normal flows.

a) Braking Performance

- Braking performance is a factor in a variety of crash types, predominantly those in which the front of a large truck strikes a passenger vehicle. The NHTSA estimates that specific crash types affected by truck stopping distance account for 26% of passenger vehicle deaths in large truck crashes. To reduce the number of brake related issues, NHTSA issued new stopping requirements that will reduce the distance required to come to a complete stop by approximately 30%. Other crash types affected include some types of large truck-to-large truck crashes, large truck and pedestrian crashes, and single-vehicle crashes in which large trucks run off the road.

- The DOT's "Comprehensive Truck Size and Weight Study" (2000) concluded that braking performance is a general concern that applies to all trucks but is not particularly influenced by changes in truck size and weights, as long as the requisite number of axles and brakes are added as the vehicle's weight increases and all the vehicle's brakes are well-maintained. Some incremental diminution can be expected as truck weights increase, but the greater concern in braking ability relates to longer combination vehicles. More recent studies including the "Minnesota Truck Size and Weight Project" (June 2006) and "Wisconsin Truck Size and Weight Study" (January 2009) support the 2000 DOT study conclusion that braking performance is not a general concern if the requisite number of axles and brakes are added if the vehicle's weight is increased.

- The "Wisconsin Truck Size and Weight Study" concluded that adding axles to a truck tractor combination increases its braking ability, which in turn reduces crash rates. To account for this effect the study assumed that increasing the number of axles on a truck by 20%, e.g. from five to six axles reduces its crash rate by 5%. Although crash probability generally increases with weight of a truck, fewer truck trips because of larger loads combined with increased braking power from additional axles results in fewer accidents involving heavy trucks. The net safety benefits from larger truck weights will also include lower costs associated with fatalities, injuries, and property damage. The study analyzed seven truck configurations including the six-axle tractor-trailer with 98,000-pound gross vehicle weight.

- The Minnesota study concluded that crash rates per vehicle-mile increased slightly with gross weight primarily because loading a truck heavier raises its center of gravity and thereby increases the possibility of rollover. However, crash rates per payload ton-mile also can decrease with a gross weight increase because fewer truck trips are required to haul a given amount of freight.

- The Minnesota study did show there is more surplus brake capacity for all the proposed vehicle configurations than for the standard five-axle semi-tractor trailer when categorized on the basis of normal and winter weights. Since multiple axle groups are assembled using standard axles, the braking capacity increases proportionately to the sum of Gross Axle Weight Rating (GAWR) for the axle group. For example, a tandem axle group comprised of two 20,000-pound axles will have braking capacity sufficient to manage 40,000 lbs. However, size and weight regulations limit the tandem axle group to 34,000 lbs., which means the tandem axle group has more braking capacity than required.

- The maximum gross vehicle weight (GVW) for each truck configuration studied, the corresponding brake capacity expressed in terms of the vehicle axle load and percent brake surplus available for the vehicle configuration is shown in Table 11. This table shows that there is a surplus brake capacity for all the proposed truck configurations in the study. In all cases the proposed vehicles have more brake capacity than the current commonly used five-axle semi-tractor trailer when categorized on the basis of normal and winter weights.
    - For example, the 6-axle semi-tractor trailer has a 24.4% surplus brake capacity compared with a 5-axle semi-tractor trailer which has a 15% excess capacity. For winter, the 6-axle semi-tractor trailer (99,000 lbs.) has a 13.1% surplus brake capacity while the 5-axle semi-tractor trailer has only a 4.5% surplus capacity. It thus can be concluded that under loaded conditions, the other vehicle configurations in the study will have better stopping distance performance than the existing five-axle semi-tractor trailers.

Table 11: Surplus Brake Capacity by Truck Configuration

Vehicle Configuration	Regulated GVW	GAWR Brake Capacity	GAW Brake Requirement (Pounds)	Percent Surplus Brake Capacity
5-axle semi	80,000	92,000	80,000	15%
5-axle semi winter	88,000	92,000	88,000	5%
6-axle semi	90,000	112,000	90,000	24%
6-axle semi winter	99,000	112,000	99,000	13%
7-axle semi	97,000	132,000	97,000	36%
7-axle semi winter	99,000	132,000	99,000	33%
8-axle B-train	108,000	152,000	108,000	41%
7-axle single-unit truck	80,000	132,000	80,000	65%

Note: Gross axle weight rating assumptions: steer axle 12,000 pound, driver axle 20,000 pound, trailer axle 20,000 pound.
Source: "Minnesota Truck Size and Weight Project"

- According to "Increased Truck Weights Coalition for Transportation Productivity[7]," increasing truck weights from 80,000 lbs. on a five-axle truck tractor combination to 97,000 lbs. on a six-axle truck combination reduces the load weight per tire by approximately 35 lbs.
    - For example, the weight per tire of a five-axle truck combination with 18 wheels carrying 80,000 lbs. is 4,444 lbs. In comparison, the weight per tire of a six-axle truck combination with 22 tires carrying 97,000 lbs. is 4,409 lbs.

- The "Effects of Truck Size and Weights on Highway Infrastructure and Operations: A Synthesis Report" conducted for the Texas Department of Transportation concluded that a switch to heavier or larger trucks does not necessarily increase the rate of accidents per vehicle mile of travel. Improvements in the performance and selection of drivers as well as changes in vehicle and roadway design can offset the safety drawbacks of using some heavier or larger vehicles. Improvements in the selection and training of drivers contributed to the decline in the rate of fatal accidents involving medium-to-heavy trucks that occurred between 1985 and 1995. That study referred to the introduction of nationally uniform licensing of truck drivers, tracking of truck drivers' traffic violations and accident experiences, and improved industry programs for driver training.
    - The Texas study also indicated that there is some evidence that people tend to drive more cautiously in dangerous situations, "risk compensation."
    - So even when a heavier or larger truck has features that, other things equal, would increase the rate of accidents, the driver response to this situation may offset much of the added risk.

- As long as vehicle brakes are adequately sized, and virtually all are as a result of Federal regulatory requirements, they are capable of generating enough force to lock most wheels on a vehicle when it is fully loaded[8].

[7] Coalition for Transportation Productivity (CTP) - is a group of more than 100 companies and associations dedicated to safely and responsibly increasing the vehicle weight limit on federal interstate highways—but only for trucks equipped with an additional (sixth) axle. The CTP is asking Congress to responsibly reform truck weight limits in order to secure a safer, cleaner, more productive future for America's transportation network. Companies included in the group are listed in Appendix C.

[8] However, inadequately maintained or maladjusted brakes can fail to generate needed braking power, which leads to longer stopping distances. Improper brake balance can cause downhill runaways and braking instability. Furthermore, adding more load to a given vehicle without adding axles and brakes degrades stopping performance.

b) The National Highway Traffic Safety Administration (NHTSA) Rule Proposes to Reduce Truck Stopping Distances

Truck stopping distance is a factor in a variety of crash types, including those in which the front of a large truck strikes a passenger vehicle. The National Highway Traffic Safety Administration (NHTSA) estimates that specific crash types affected by truck stopping distance account for 26% of passenger vehicle deaths in large truck crashes. The NHTSA instituted new braking standards for commercial semi-tractor tractors, mandating that a semi-tractor trailer traveling at 60 miles per hour must come to a complete stop in 250 feet, versus the old standard of 355 feet or a reduction of truck stopping distance of roughly 30%.

The ability to stop in short distances mostly depends on:

- Size and number of brakes on the vehicle,
- Brake adjustment and state of maintenance, and
- Tire properties.

For a small number of very heavy severe service tractors, the stopping distance requirement will be 310 feet under these same conditions.

- In addition, this final rule requires that all heavy truck tractors must stop within 235 feet when loaded to their "lightly loaded vehicle weight" (LLVW).

- Though this new regulation is going to be phased in over four years beginning with 2012 models, NHTSA said three-axle tractors with a gross vehicle weight rating (GVWR) of 59,600 pounds or less had to meet the reduced stopping distance requirements specified in this final rule by August 1, 2011.

- Two-axle tractors and tractors with a GVWR above 59,600 pounds had to meet the reduced stopping distance requirements specified in this final rule by August 1, 2013, the agency noted, adding that voluntary early compliance is permitted before those dates.

- NHTSA also stressed that this new rule applies only to combination truck and does not impact single-unit trucks, trailers and buses.

- The NHTSA estimates that the new braking requirement will save 227 lives and prevent 300 serious injuries annually, while reducing property damage costs by over $169 million on a yearly basis, an amount which alone is expected to exceed the total cost of the rule.

c) Antilock Brakes

- Antilock brakes have improved safety on the highways. In 1995, NHTSA required antilock brakes for heavy trucks, tractors, trailers, and buses. All new truck tractors were required to have antilock brakes after March 1, 1997, and they were mandatory on new air-braked trailers and single-unit trucks and buses after March 1, 1998. Today antilock braking systems are required on all trucks and greatly enhance braking performance.

- Antilocks are important for big trucks because of the poor braking capabilities of these vehicles compared with passenger cars. On dry roads, big trucks take much farther to stop, 47% farther in institute tests. On wet and slippery roads, the stopping distance disparity is even worse. Tractor-trailer combinations also have the potential for loss of control and jackknifing on both dry and, especially, slippery roads. (Jackknifing occurs when the rear wheels of a tractor lock up, allowing the tractor to skid and spin so that it folds into the trailer. This also can happen when trailer wheels lock and cause the trailer to swing around the tractor.) Antilock brakes not only reduce stopping distances on wet and slippery roads but also help drivers maintain control.

- The standard for tractors requires antilock control on the front axle and at least one rear axle. On at least one of the tractor axles, each wheel must be independently controlled by an antilock modulator. This ensures that a wheel provides shorter stopping distances and optimal braking force on all surfaces, especially on roads where one side is slipperier than the other. For semi-tractor trailers, at least one axle must have antilocks. Full trailers must have antilock brakes for at least one front and one rear axle.

d) Vehicle Stability and Control

- Differences in large truck stability and control are perhaps the most important safety-related factors directly related to differences in vehicle weights and dimensions. Where crash rates and other direct evidence of the relative safety of certain large trucks are not available, the stability and control characteristics of different large trucks provide an indication of the relative safety of these vehicles compared to large trucks currently in widespread use such as the five-axle truck tractor trailer.

- The most important vehicle stability property is the susceptibility to rollover, which occurs in approximately 60% of crashes fatal to heavy truck occupants. In general rollovers result from two basic maneuvers—a steady-state turn at too high a speed or high speed evasive maneuvers[9]. All vehicles are susceptible to

[9] A measure of a vehicle's propensity to rollover during a steady-state turn is its static roll stability (SRS). The SRS is measured in terms of the lateral acceleration (g forces) required to lift a wheel off the ground. The higher the SRS, the less susceptible the vehicle is to rollover. A typical 80,000 pound semi-tractor trailer has an SRS of about 0.3 gs compared to 0.8 gs or higher for automobiles.

There are also two measures that characterize a vehicle's susceptibility to rollover during evasive maneuvers:

- The **rearward amplification factor** is the ratio of the lateral acceleration of the rearmost trailer to the lateral acceleration of the tractor when making rapid steering movements. Tractor-semirolling over, but heavy trucks are particularly susceptible. The principal attributes that affect a vehicle's rollover tendencies are the height of the center of gravity of the cargo, and the vehicle's track width, suspension and tire properties.

- The DOT study[10] compared different large truck configurations with the conventional five-axle semi-tractor trailer combination. The study found that the six-axle semi-tractor trailer with 97,000 lbs. had a slightly worse static roll stability and load transfer ratio than the five-axle semi-tractor trailer but had a better rearward amplification. Figure 13 shows the percentage difference between the scenario vehicle and reference vehicle for each of these three measures.

- Only the two Surface Transportation Assistance Act (STAA) doubles[11] in Figure 13 have better static roll stability than the five-axle semi-tractor trailer. The most susceptible vehicles were the three single unit trucks because of their high center of gravity. But each of the other vehicles, including the six-axle semi-tractor trailer was within 10% of the five-axle semi-tractor trailer.

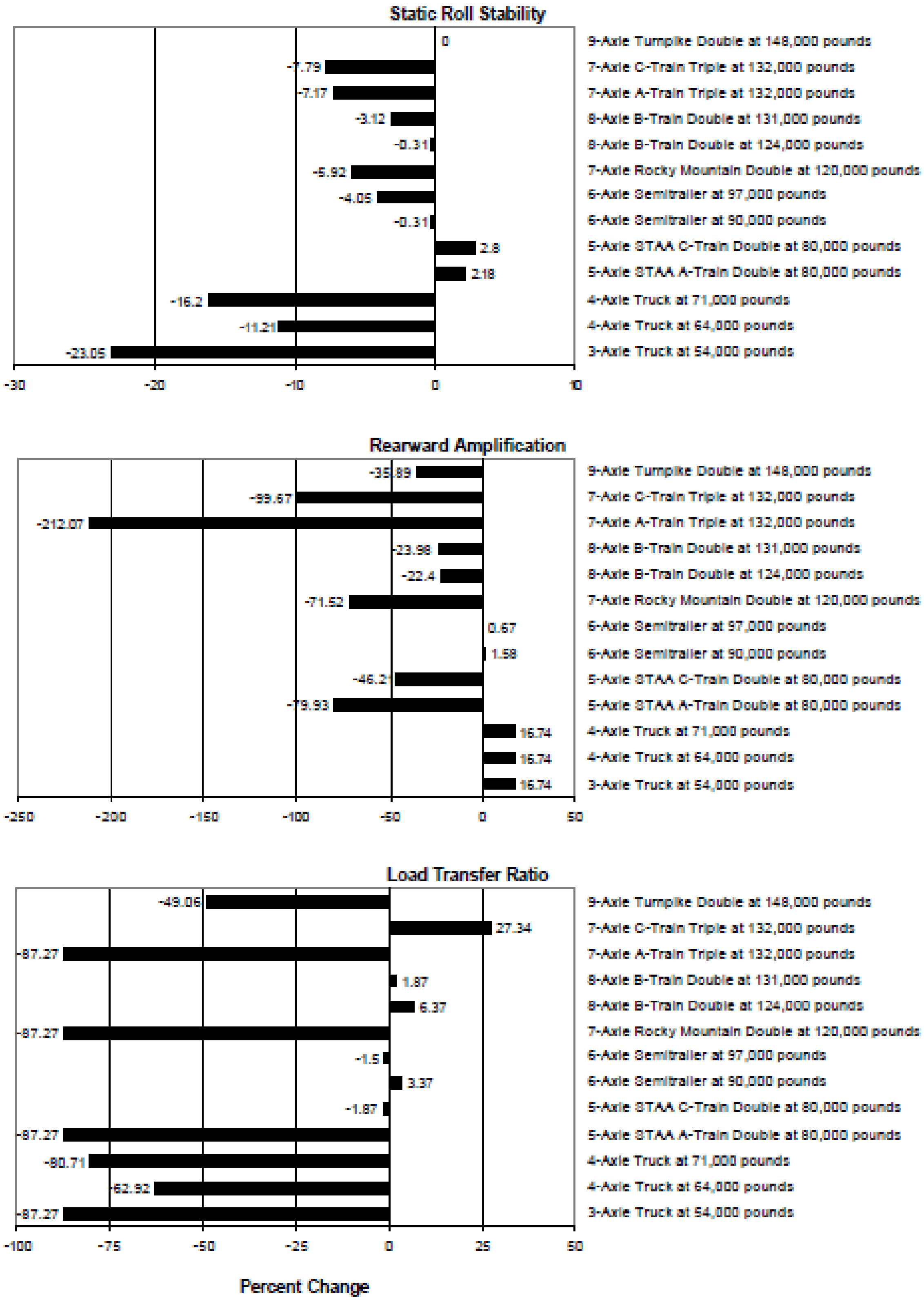
tractor trailer combinations have a factor of 1 and Surface Transportation Assistance Act of 1982 (see Appendix Figure 1) doubles a factor of 1.7. In general a rearward amplification factor of 2 or less is considered acceptable.

- The **load transfer ratio** is a measure of the dynamic roll stability of a truck. It measures the proportion of a vehicle's total axle load that is carried on one side of the vehicle relative to the other. A perfectly balanced vehicle would have a load transfer ratio of 0.5, while a vehicle with all its weight on one side of the vehicle (and the other side in the air) would have a transfer ratio of 1.0. The Society of Automotive Engineers has developed a standard evasive maneuver for evaluating dynamic stability. Load transfer ratios for each scenario vehicle can be calculated based on this standard evasive maneuver to determine which vehicles are most likely to roll over under that maneuver.

[10] US Department of Transportation's "Comprehensive Truck Size and Weight Study", 2000

[11] The federal Surface Transportation Assistance Act of 1982 (STAA) made it legal for large trucks, referred to as STAA trucks, to operate on routes that are part of the national network. A STAA truck is a truck with a 48-foot semi-tractor trailer, an unlimited overall length, and an unlimited kingpin-to-rear-axle (KPRA) distance.

Figure 13: Comparison of Stability and Control Measures for Scenario Vehicles Relative to Five-Axle Tractor Semi-Tractor Trailer



Source: DOT's "Comprehensive Truck Size and Weight Study," 2000

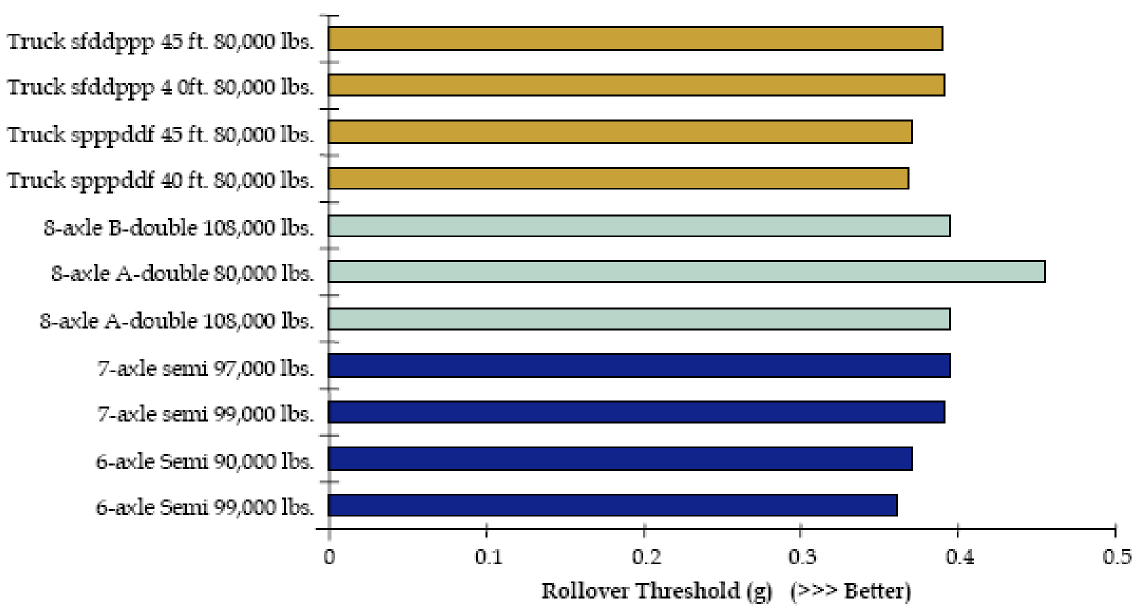
- Rearward amplification shows different relationships between the scenario vehicles. The three single unit trucks (with three and four axles) and the two six-axle semi-tractor trailers all have less rearward amplification than the five axle semi-tractor trailer reference vehicle. All other truck combinations have much worse rearward amplification than the five-axle semi-tractor trailer.

- Differences in load transfer ratios between the reference five-axle semi-tractor trailer and the scenario vehicles show that many of the scenario vehicles would likely roll over under Society of Automotive Engineers (SAE) standard evasive maneuver, including the conventional STAA double and the three-axle single unit truck. Multi-trailer combinations with B and C-train connections and the six-axle semi-tractor trailer was the most stable of the scenario vehicles.

- The "Minnesota Truck Size and Weight Project" found similar results to the DOT 2000 study in comparing the static rollover threshold, load transfer ratio, and rearward amplification for different truck configurations.

- All vehicles examined in the Minnesota study had acceptable rollover threshold performance as shown in Figure 14.
    - For example the static rollover threshold for five-axle semi-tractor trailers was only slightly better than for six-axle semi-tractor trailers. However the static rollover threshold among truck configurations was best for the eight-axle A-double with 80,000 lbs. weight.

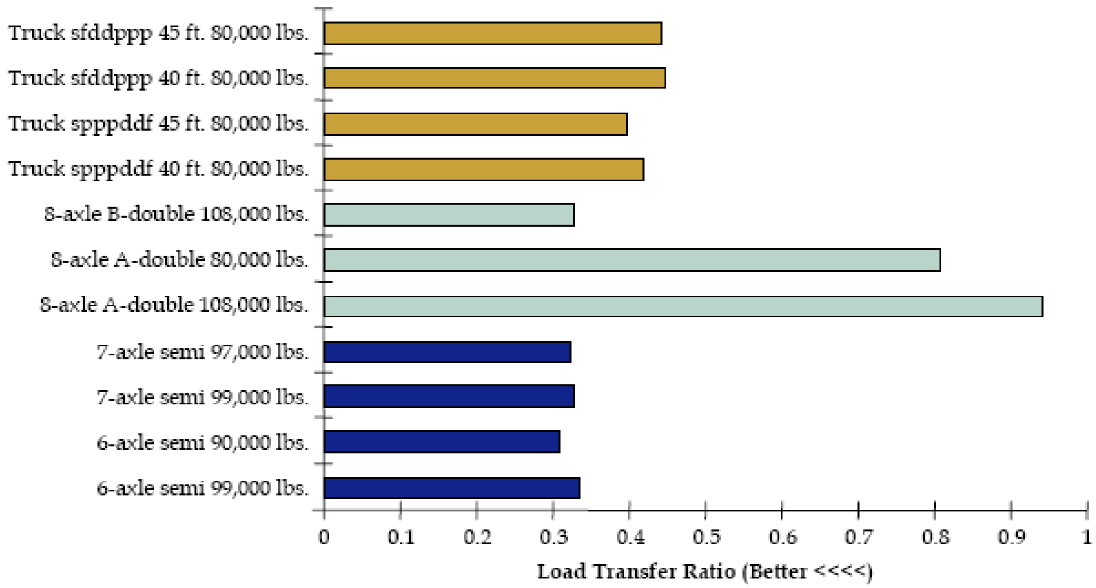
Figure 14: Comparison of Static Rollover Threshold for All Vehicles



Source: "Minnesota Truck Size and Weight Project"

- The Minnesota study found that the load transfer ratios, arguably the most powerful performance measure since it combines the influence of rearward amplification and static rollover threshold, were all below 0.5 or a perfectly balanced vehicle. Only the eight-axle A-double at 80,000 lbs. and the eight-axle A-double at 108,000 lbs. significantly exceeded 0.5 and were close to 1.0.

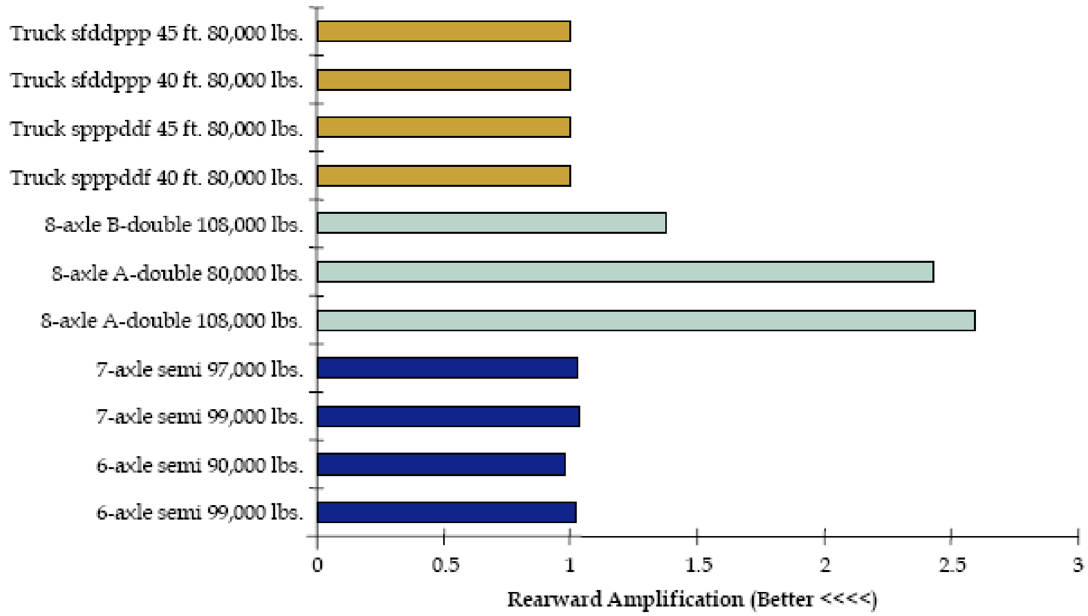
Figure 15: Comparison of Load Transfer Ratio for All Vehicles



Source: "Minnesota Truck Size and Weight Project"

- As indicated earlier rearward amplification is a measure specifically developed to assess the dynamic qualities of articulated vehicles. Generally the measure becomes more active as the number of articulation joints increases. Based on Minnesota study data, the rearward amplification is acceptable (under 2.0) for all vehicle configurations except the eight-axle A-double with 80,000 pounds and the eight-axle A-double with 108,000 pounds as shown in Figure 16.

Figure 16: Comparison of Rearward Amplification for All Vehicles



Source: "Minnesota Truck Size and Weight Project"

- Technological advancements are occurring in many different truck systems and tests for various trucks, although not specifically heavier combination vehicles. The NHTSA has conducted reports on stability systems, braking systems, and tire pressure monitoring system. Taken in aggregate, the continued development of these systems and technologies can further improve combination trucks' maneuverability and safety.

VI. Various Perspectives on Safety of Heavier Trucks

A. Federal Highway Administration, Department of Transportation

Informa interviewed the lead official with the FHWA on the MAP-21 "Comprehensive Truck Size and Weight Limits Study." The report will focus on safety, pavement, bridge, compliance, and modal shifts.

There currently are no studies that address the issue empirically in a comprehensive way. Most studies are based on geometries and simulations, rather than empirical evidence. This makes analysis of a policy change very difficult. The FHWA study is schedule to be released in November 2014.

The FHWA official noted that it is difficult to obtain quality data to analyze crashes. There are several reasons for this.

- First, there is not a standardized process for reporting and documenting accidents. Information differs by geography and the law enforcement agency that is in charge of documenting the crash.

- Additionally, capturing information that is important for crashes is not a high priority for a crash scene. Responders' first priority is to address any injuries or human-health concerns. The second priority is typically clearing the roadways to resume traffic.

- As a result, information involving a truck's weight and details of how the crash occurred are typically not very well suited to creating a comprehensive dataset.

The report instead will have to focus on alternative sources such as, state-by-state analysis, crash rate analysis, and fleet information. The team will then have to integrate the information to develop findings that will influence the final policy decisions. They are still determining what the best approach to utilizing a diverse set of data into a single study. There are experiences from other countries that can be drawn to provide insight for the U.S. In particular, Canada and Australia have programs for trucks with weight limits that exceed current U.S. restrictions. These are data that the FHWA will also take into account.

The FHWA also does not have the authority to initiate pilot studies, which would be an effective way of creating a dataset for analysis. Only Congress can set aside funding to develop a pilot study. That is what was done for the Maine and Vermont pilot programs. This further limits the agency's ability to collect the type of data that would be best suited to help make an informed decision on raising the weight limits.

B. Commercial Vehicle Safety Alliance

Informa interviewed the Executive Director of the Commercial Vehicle Safety Alliance (CVSA) to gain more insight into the CVSA's view regarding safety issues of raising weight limits. The CVSA is a not-for-profit organization comprised of local, state, and federal motor carrier officials and industry representatives in North America. Their mission is to promote safety and security to commercial motor vehicles and to provide leadership to the industry, policy makers, and enforcement officials.

First and foremost, the CVSA believes that the issue is complex and answers are not always as straight forward as they seem. There is not necessarily a one-size-fits all approach that will solve all the issues that are involved. Many states have programs that allow for permitted trucks to carry heavier loads. They identify four key factors that are the most important to consider when looking at truck weights.

- Having drivers that are trained and qualified to handle the heavier trucks

- Having designated routes for the heavier trucks to follow as a way of segregating trucks with higher loads.

- Try to force heavier trucks away from areas that have higher traffic density. There are much different implications for having an oversized truck in a metropolitan area compared with less dense commercial lanes in the Midwest or Mountains, for example.

- Standardizing and requiring advanced safety systems on all trucks that have heavier weights.

The CVSA is currently conducting a study inspecting the condition of heavier trucks that are on the road. The group cites that there is a lack of information and no comprehensive studies that analyze the issue.

- The CVSA study has 27 states participating and inspects trucks at weigh stations. The results have not been published yet, but the data indicate that heavier trucks have higher incidents of brake-related violations. These incidents include both trucks that are permitted to carry heavier loads and trucks that are illegally over the limit.

- Data such as these indicate to the CVSA that safety standards are an essential area of regulation that needs to be addressed before the limits should be increased.

- There have been significant improvements in truck design and safety systems that can help safely accommodate heavier weights. Their concern is that there are older fleets or trucks that are not properly maintained for the heavier loads. In order to increase the weight limits, truck owners should reinvest in their vehicles to ensure that they have the safety systems in place to safely carry heavier loads.

- In addition to increased safety regulations, there also needs to be increased enforcement capabilities. There are cases of unpermitted trucks carrying loads that exceed the current weight limits. One solution would be to create a national enforcement system that discourages people from skirting the system.

The CVSA commented that the issue of traffic density is complex. Increased capacity of trucks would definitely result in fewer trucks on the road. That would likely be offset, however, by lower costs structures that may increase the demand for truck carriers. The decrease in trucks due to capacity would likely occur immediately, while the increase from lower costs would likely be more gradual over time. Therefore, it is important to have the right time horizon when evaluating the comprehensive effects.

The growing demand for freight, overall, requires that solutions be found to overcome the challenges of delivering freight on an infrastructure that needs to be revamped. CVSA believes that a system increasing the weight limit on trucks can be developed and the capabilities are available from the standpoint of the technical advances for trucks. It is important that proper systems are in place to support such changes.

C. American Trucking Association

The ATA represents the trucking industry. The organization supports the increased trucking size and weight limits.

- The ATA notes that large truck crash, injury, and fatality rates have fallen considerably since data has been recorded in 1975. Additionally, there are double and triple-trailer combination configurations that studies have found have better crash statistics.

- The organization notes that most states have exemptions that allow heavier trucks to use state roads. Because these trucks cannot use interstate highways and are instead diverted to state roads, this has negative safety and maintenance effects.

- The organization supports implementing standards that are consistent with engineering and safety standards.

- The organization also notes that U.S. limits are lower than other countries, which U.S. businesses compete with in international markets.

- The ATA believes that regulations should not be done at a national level so that the best carrier solutions can be applied relative to the appropriate needs of the specific state.

- The organization point to research that concludes that higher weight limits would slow the growth of truck traffic and lower accident exposure.

D. Owner-Operator Independent Drivers Association

The OOIDA represents small-business trucking professionals and truck drivers. The organization does not support any efforts to increase truck weight limits. The organization cites both the safety and infrastructure effects that such a change would have. They formally opposed Safe and Efficient Transportation Act (SETA) language that was introduced in the current congress that would increase the interstate system's truck weight limit to 97.000 pounds for six-axle vehicles. They have endorsed legislation in previous Congresses that would preserve the current size and weight limits. With regards to safety and efficiency issues, the organization has made the following statements.

- The organization claims that stability and maneuverability of heavier vehicles is more difficult and, therefore, interaction with other vehicles on the road is problematic.

- The organization refutes claims of increased efficiency due to the increased time of loading and unloading trucks. They cite that truckers spend between 30 to 40 hours per week waiting at docks for load movements.

- They claim that traffic congestion would become worse, as the increased dimensions of trucks will impede motorists and potentially increase speed differentials that would also create more dangerous driving conditions.

- Increase costs of small businesses due to the requirement of retrofitting or purchasing new equipment. They also claim that small-business drivers would spend more on fuel, insurance, and repairs.

E. American Association of State Highway and Transportation Officials

The AASHTO is still developing its position on truck size and weight limits. The organization acknowledges various perspectives that argue for or against increasing limits. Since 2008, the organization has committed to investigating the feasibility of adjustments to the restrictions, particularly in corridors that demonstrate important economic benefits, meet safety requirements, and meet infrastructure and financing criteria.

- The group notes the importance of highway geometrics and the role they play for longer and heavier trailers and configuration possibilities. Route selection should be an important consideration.

- An infrastructure assessment to determine if increases in size and weight can be done without serious adverse impacts on infrastructure.

- A cost estimate carried to determine the total cost and timing of investments necessary.

- Vehicles operating under higher limits should be required to be of the highest available quality, drivers are required to have outstanding safety records, and companies also demonstrate strong safety histories.

- A rigorous monitoring and reporting system should be developed to ensure that evaluation criteria are consistent.

- Sufficient funding mechanisms put in place for infrastructure and implementation.

- AASHTO officials confirmed that the organization has not yet developed a position on the size and weight issue. They have assembled a working group that is evaluating the different sides of the issue. The official noted that the organization rarely takes a stance on very specific issues, given that 52 separate state transportation organizations comprise its membership.

- The official also did not think that the prospect of a change to trucks size and weights regulations was likely in the immediate future. It was noted that while there are certain vested interests that have strong positions on the issue, it does not have the type of profile to garner the attention of officials to initiate a change. The DOT study that is currently being conducted, in some ways, was a mechanism to push the discussion of the issue into the future rather than make a difficult policy decision.

- AASHTO is working to harmonize standards for trucking. This is challenging, however, given the number of differences that exist across state borders. Issues such as funding levels, pavement and maintenance practices, bridge and highway infrastructures, and political importance of different industries makes having large scale harmonization very challenging. Due to this, the official believed that making changes to the Interstate system would be a much easier task, although with its own set of challenges.

- AASHTO works alongside much law enforcement associations. Their perspective is that the law enforcement community's perspective comes down to two main points. First, they are the first responders for crashes that involve trucks. Second, law enforcement will shoulder additional burdens of enforcement with regards to size and weight issues. Having clear and enforceable policies are a major priority for law enforcement officials. These need to be considered in order to gain the support of the law enforcement community.

- The AASHTO official also noted that some provisions regarding truck size and weight may be attached to legislative vehicles that are outside of the transportation bill. As an example, he noted that there is a possibility that provisions regarding the use of LCVs could be included in a defense authorization bill. While this has not been officially done, it was noted that there are possibilities for transportation policies to advance through means outside of MAP-21 or other transportation legislation.

- Modal shift is also seen as important factor that will affect truck size and weight politics. AASHTO notes that freight transportation policies are gaining a higher profile in recent years. In particular, the rail industry has gained political strength as a result. With trucks potentially competing with some rail freight, the rail industry is unlikely to be a major supporter of changing the policies. Alternatively, however, the focus on inland waterway infrastructure could support the need to increase the regulations, as a major disruption in the Mississippi River system could create a logistical challenge that current truck freight systems might not be able to handle.

F. The American Automobile Association

The AAA has been publicly opposed to increasing the truck size and weight restrictions. Among the reasons for their opposition are safety concerns. The justification is primarily focused on statistics that cite the number of truck-related fatalities. Additionally, the AAA opposes the state exemptions for heavy trucks.

VII. Infrastructure Integrity

A. Summary

- Freight volumes are expected to increase 50% over the next 30 years, pressuring all freight modes to improve productivity to handle the movements. According to the DOT, the volume of freight demand by all modes will increase from 18.3 billion tons in 2010 to 27.5 billion in 2040, an increase of 9.2 billion tons or 50%.
  - Truck volumes are forecast to increase the most, from 12.5 billion tons in 2010 to 18.5 billion in 2040, an increase of 6 billion tons or 48% over that time. This burden will be a significant issue for both highway and bridge capacity and conditions.

- Pavement and bridges have limited engineer spans, depending on their design, the local environment and the repeated loadings to which they are subjected. Average pavement life depends on the design employed. Many pavements and bridges constructed in the 1960s and 1970s are reaching the end of their useful lives and will soon require significant rehabilitation or replacement. Use by heavy trucks and overweight trucks is a major determinant of pavement and bridge design and a major factor in costs of roadways and bridge maintenance[12].

- These factors are also increasing pressure to increase truck size and weights (TS&W). Virtually all TS&W studies show large reductions in shipping costs associated with an increase in TS&W limits, with the magnitude of the reductions depending on specific assumptions concerning allowable vehicle weights and dimensions.

- Such studies also show potential adverse impacts of increasing TS&W limits on infrastructure costs. Pavement and bridge impacts are major concerns associated with changing TS&W limits because of the magnitude of federal and state investments in pavement on the nation's highways and in repairing or replacing bridges. Wear-and-tear on paved surfaces (including on bridges) depends on both the volume of traffic and the number of axles over which the weight of the traffic is distributed. The structural integrity of bridges depends not only on the weight of the vehicles that pass over it, but also the number of axles that carry the weight and the distance between those axles, a relationship used to establish the "bridge formula" that guides current weight restrictions.

- Most TS&W studies show that switching to heavier trucks with additional axles can leave pavement damage about the same or slightly lower.

[12] "Factors Affecting the State of Our Transportation Infrastructure," Sponsored by Center for Transportation Studies University of Minnesota, 2007.

  - First, allowing heavier trucks increases the payload per truck, so fewer trips are required to move the same freight and resulting in fewer vehicle miles and less pavement damage.
  - Second, heavier trucks distribute their weight over a larger number of axles, as compared with the trucks they replace. Because pavement damage increases sharply with axle weight, the reduced weight per axle of the heavier trucks means less pavement damage.
    - On the other hand, adding more payload to a current truck configuration (such as increasing the weight on a five-axle truck semi-tractor trailer from 80,000 to 100,000 lbs.) will increase pavement damage sharply. Thus an increase in truck weight limits that does not encourage a switch to more axle-trucks can have substantial pavement costs.

- For example, the DOT “Comprehensive Truck Size and Weight Study” concludes that the six-axle 90,000 and 97,000 pound semi-tractor trailers cause less road damage than the five-axle semi-tractor trailer. This study also shows that unit pavement costs and pavement costs per unit of payload-mile are the same or lower for six-axle semi-tractor trailers than for five-axle semi-trailers. The “Wisconsin Truck Size and Weight Study” found the six-axle 98,000 pound semi-tractor trailer generated the most total net benefits of the truck configurations studied. Although the six-axle 98,000 pound semi-tractor trailer ranked third out of seven vehicles in terms of pavement net benefits, such vehicles showed substantial savings in transport, safety and congestion costs. “The Minnesota Truck Size and Weight Project” found that the seven-axle 97,000 pound semi-tractor trailer had the smallest impact on roads of the studied vehicles. The six-axle 90,000 pound semi-tractor trailer also had a smaller impact than the 80,000 pound five-axle semi-tractor trailer.

- Some TS&W studies found that the stress to bridges depends more on trucks total load than on the number of axles, suggesting that increases to truck weight limits can create large costs for bridges, even when additional axles are added. For bridges the principal cost associated with heavier trucks lies in ensuring that the bridge can safely accommodate the trucks. This involves replacing or strengthening bridges. In addition bridge replacement or repair disrupts traffic and increases motorist time requirements as traffic patterns change.

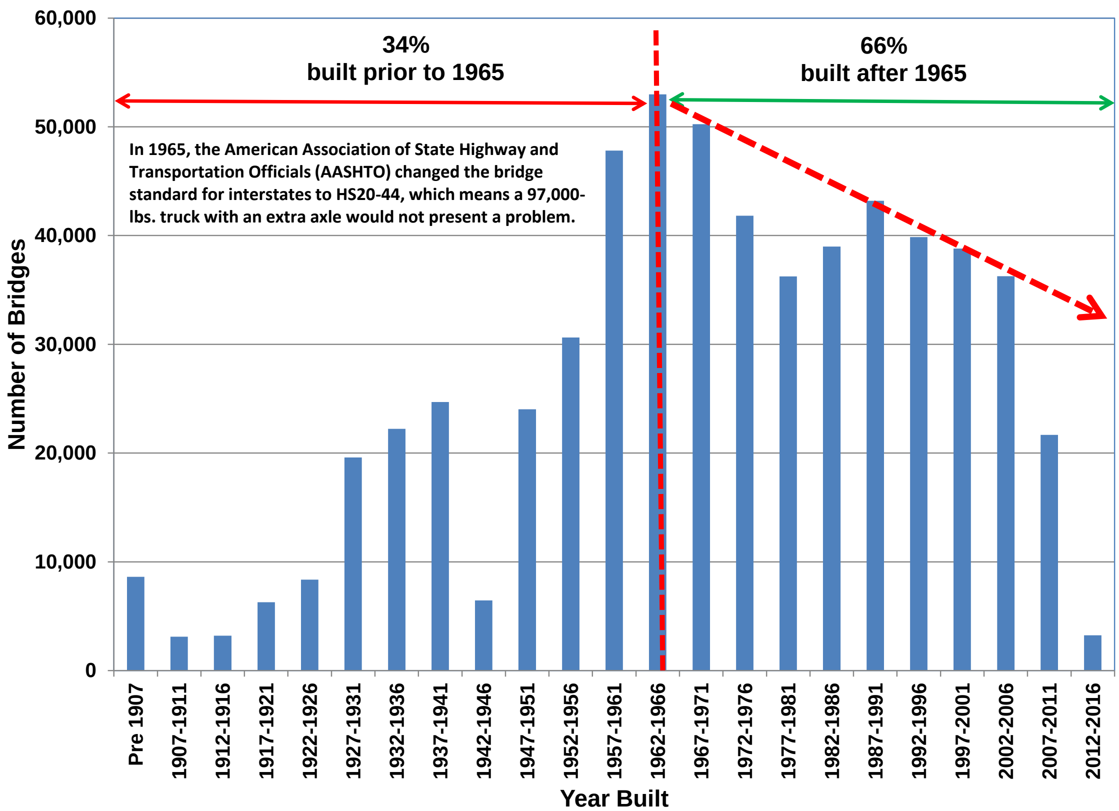
- The TS&W studies reviewed found that the use of six-axle 90,000 pound semi-tractor trailers would not increase stress on bridges at maximum weight compared with five-axle semi-tractor trailers. However, the DOT and Wisconsin studies found that the heavier six-axle 97,000/98,000 pound semi-tractor trailers would exceed current bridge formula limits and would cause stresses exceeding bridge design stresses if fully loaded. In addition, the Wisconsin study found that bridge replacement costs were the highest for the six-axle 98,000 pound semi-tractor trailer of the vehicles studied. The removal of the current bridge formula cap of 80,000 lbs. on gross vehicle weight would allow minimal or no increase in gross weight of a five-axle semi-tractor trailer, but could allow vehicles with additional axles to operate substantially above 80,000 pounds. However, none of the studies reviewed tried to develop a new bridge formula.

  - The bridge formula was developed in 1975 and according to some sources bridges built since the late 1970s should accommodate higher truck weight limits. But, about 37% of the total bridges in the U.S. in 2008 were built since the late 1970s.

B. Number of Bridges Built to the 97,000 Pound Truck Standards

- In 1965, the American Association of State Highway and Transportation Officials (AASHTO) changed the bridge building standard for interstates to HS20-44, to accommodate military vehicles. The Federal Highway Administration released the number of bridges built by year for each state.
  - Most bridges built after 1965 were to higher standards that can handle a 97,000-pound truck with an extra axle, but approximately one third of U.S. bridges (205 thousand) were built before 1965 as shown in Figure 17.
  - The recent recession reduced bridge construction.
    - Part of the reduction is reflecting a slower growing economy, but budget cuts are the primary reason for the slowdown.

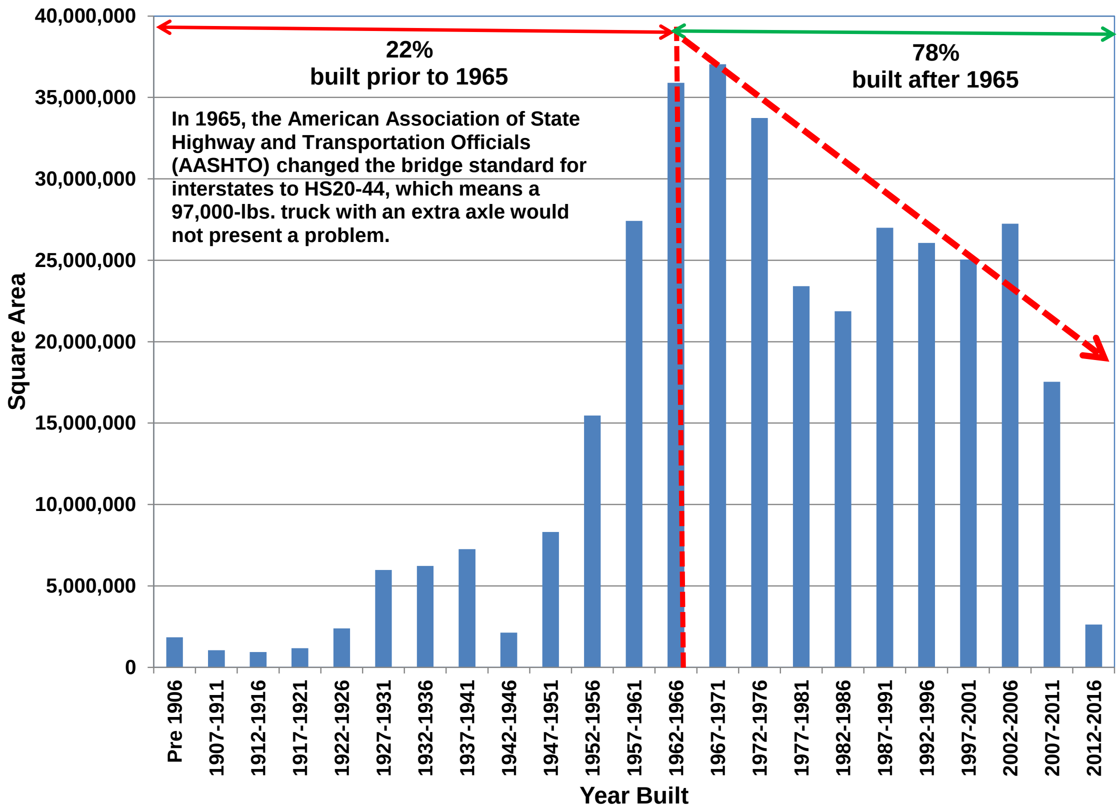
Figure 17: Number U.S. Bridges Built by Year



Source: U.S. Department of Transportation Federal Highway Administration

- On an area measurement, almost 80% of the bridges can accommodate heavier vehicles as shown in Figure 18.
    - The average size of the bridges being built is increasing, suggesting the 20% of the bridges built before 1965 are smaller less critical bridges.

Figure 18: Square Miles of U.S. Bridges Built by Year



Source: U.S. Department of Transportation Federal Highway Administration

C. Status of Bridge Infrastructure

Bridges are key components of the highway system. In 2012 there were 607,378 bridges (over 20 feet long) on the nation's highways (federal, state and local) that are tracked by the federal bridge inventory system, and the average age is over 40 years. Most were built at a time when vehicular traffic and weights were much less than they are today, when bridge material standards were lower, and when a lower level of non-redundancy was acceptable. As these structures age, there is inevitable deterioration, often accelerated by increasing traffic. As of 2012 more than 66,749 bridges or 11% of all bridges were classified as deficient and the number of functionally obsolete bridges is 84,748 or 14%.

- A structurally deficient bridge is not necessarily unsafe, but they require significant maintenance attention, rehabilitation, or replacement. Depending on the rating it receives in inspection and evaluation the bridge may be identified for certain types of maintenance or rehabilitation, for weight limit posting or closed altogether.

- A "functionally obsolete" bridge has older design features (inadequate lane widths, shoulder widths, vertical clearances) or may be unable to handle occasional roadway flooding. While not unsafe, it cannot accommodate all the traffic or vehicle types[13].

- As structural deficiencies may imply safety problems, they are considered more critical; thus a bridge that is both structurally deficient and functionally obsolete is identified only as structurally deficient. Approximately 50% of structurally deficient bridges also have functional problems that need correction. Bridges indicated as functionally obsolete do not have structural deficiencies.

- The selected states noted in Table 12 have more bridges that are structurally deficient (12%) than the rest of the country (11%). The states of South Dakota, North Dakota and Nebraska currently allow trucks weights on non-interstate highways at respectively 129,000 lbs., 105,500 lbs., and 95,000 lbs., significantly above the 80,000 lbs. allowed on interstate highways. The maximum weight allowed on all highways in other selected states is 80,000 lbs.

- As a general rule, most bridges constructed after 1965, when the American Association of State Highway and Transportation Officials (AASHTO) changed the bridge building standard for interstates to HS20-44, were built to accommodate military vehicles. Load Factor Design (LFD) standards were implemented, can support heavier trucks than are allowed under current rules.
    - More recent standards, including the new (2007) AASHTO Load and Resistance Factor Design Bridge Design Specification allow heavier vehicle loads.
    - However, significant numbers of older bridges and other structures not designed for a heavier vehicle loading present the greatest challenge to carrying heavier vehicle loads.
    - Interstate bridges should not have an issue with increased road weights. The bridges that feed into an interstate are the issue.

[13] Structural deficiencies and functional obsolescence are not mutually exclusive, and a bridge may have both types of deficiencies. Factors considered in determining whether bridges are deficient include load-carrying capacity, clearances, waterway adequacy and approach alignment. Structural assessments along with condition ratings determine whether a bridge should be classified as structurally deficient. Functional adequacy is assessed by comparing the geometric configurations to current standards and demands. Disparities between the actual and desired configurations used to determine whether a bridge should be classified as functionally obsolete. When deficiency percentages are presented, however, bridges are indicated as being one of three categories—structurally deficient, functionally obsolete, or non-deficient.

Table 12: U.S. Road Bridge Conditions, 2012

Selected States	Total Number Bridges	Number Structurally Deficient	Number Functionally Obsolete	Total Number Deficient	Percent Structurally Deficient	Percent Functionally Obsolete	Percent Total Deficient
Illinois	26,514	2,311	1,976	4,287	9%	7%	16%
Indiana	18,789	2,036	2,188	4,224	11%	12%	22%
Iowa	24,496	5,193	1,282	6,475	21%	5%	26%
Kansas	25,176	2,658	1,959	4,617	11%	8%	18%
Kentucky	14,031	1,244	3,219	4,463	9%	23%	32%
Minnisota	13,121	1,190	423	1,613	9%	3%	12%
Missouri	24,334	3,528	3,365	6,893	14%	14%	28%
Nebraska	15,393	2,779	1,058	3,837	18%	7%	25%
North Dakota	4,453	746	247	993	17%	6%	22%
Ohio	27,045	2,462	4,311	6,773	9%	16%	25%
South Dakota	5,870	1,208	237	1,445	21%	4%	25%
Tennessee	19,985	1,195	2,669	3,864	6%	13%	19%
Selected States	219,207	26,550	22,934	49,484	12%	10%	23%
US Total	607,380	66,749	84,748	151,497	11%	14%	25%

selected state totals
Source: US DOT, Federal Highway Administration

D. Impact of Increasing Truck Weight Limits on Bridges

- Currently the Federal Bridge Formula[14] (FBF) controls weights to protect the nation's bridges. In particular it limits the weight on groups of axles depending on their configuration and is intended to assure that stresses placed on bridges do not exceed the design stress[15].
    - Although design stresses are well below stresses at which a bridge will fail, prolonged repetitions of high stresses can accelerate bridge deterioration.
    - Bridges found deficient from being overstressed may need to be replaced.

[14] The US federal bridge formula was developed in 1975 to protect the Interstate bridge inventory from damage from excessive truck weights. Bridge formula establishes the maximum weight any set of axles on a motor vehicle may carry on the interstate highway system. Compliance with Bridge Formula weight limits is determined by using the following formula: W=500[LN/N-1 +12N +36]
Where:
W = the overall gross weight on any group of two or more consecutive axles to the nearest 500 pounds.
L = the distance in feet between the outer axles of any group of two or more consecutive axles.
N = the number of axles in the group under consideration
In addition to Bridge Formula weight limits, federal law states that single axles are limited to 20,000 pounds and axles closer than 96 inches apart (tandem axles) are limited to 34,000 pounds. Gross vehicle weight is limited to 80,000 pounds.

[15] The two most typical bridge designs in the United States are H-20 which is common on higher class highways and H-15 which is typical of bridges on lower class highways. The FBF is intended to assure that stresses placed on H-20 bridges do not exceed the design stress by more than five percent and stresses on H-15 bridges are no more than 30% greater than the design stress.

  - However some bridges could be improved by strengthening them rather than replacing them and bridges with low volumes of damaging vehicles may not have to be improved.

- If the legally allowable truck weight limits change, in cases where limits exceed design criteria, the bridge must be posted (signed for restricted use) to prevent heavier vehicles from using it, and heavy trucks will face longer routes as additional bridges are posted.
  - Noncompliance to bridge postings (a safety risk and significant infrastructure costs) will also be a major enforcement issue.
  - Another impact of changing allowable bridge weight limits is increased costs for inspecting and rating bridges and structures for posting signs.

- The impact of increasing truck weights on bridges depends on several factors including the gross weight of the vehicle (GVW); the weight on various groups of axles; the distance between axle groups; truck length, width and height; and the type and length of bridge as shown in Table 13. The effect of axle weight is more important on short bridges, but GVW is an important factor for long-span bridges; that is, bridge spans longer than the wheelbase of the truck. Bridge bending stress is more sensitive to the spread of axles than to the number of axles.

- Although additional axles on a truck can substantially reduce pavement damage, most studies have found that the stress to bridges depends more on the truck's total load than the number of axles. This is the major reason that increases in truck weight limits can create large costs for bridges even when additional axles are added. The main cost associated with using heavier trucks on bridges lies in ensuring that the bridge can safely accommodate the trucks. This is a major concern since 25% of all bridges are classified deficient, with about half of those considered "structurally" deficient implying those bridges may have to be strengthened, replaced or posted restricting use of heavier trucks. Although studies indicate that bridges built since the late 1970s should be able to accommodate heavier trucks, only 37% of current U.S. bridges were built after 1979.

Table 13: Bridge Infrastructure Elements Affected by Truck, Size and Weight Limits

Bridge Feature	Axle Weight	GVW	Axle Spacing	Truck Length	Truck Width	Truck Height
Short-Span	E		E	E		
Long-Span		E	e	E		
Clearance					e	E

Key: E-significant impact and e-some effect
Source: DOT's "Comprehensive Truck Size and Weight Study," 2000

- The DOT's "Comprehensive Truck Size and Weight Study" found that bridge impacts are mixed depending on the gross weights allowed but vehicles heavier than the commonly used 5-axle 80,000 pound trucks would require substantial bridge improvements.
    - The study concluded that the impact of trucks on bridges varies primarily by the weight on each group of axles on a truck and the distances between axle groups.
    - The number of axles in each group was found to be less important than the distance between adjacent groups. Generally, except for some continuous bridges with long spans, the longer the spacing between the two axle groups, the less the impact.

- The DOT study based its analysis on using different truck configurations and weight loads on the Federal Bridge Formula rather than developing an alternative formula. The results showed that all the heavier vehicles increased stress on bridges as shown in Table 14. Only the three-axle truck, four-axle truck, five-axle semi-tractor trailer and the six-axle 90,000 pound semi-tractor trailer had no increased stress on bridges if loaded to their maximum weight. All other trucks, including the heavier six-axle 97,000 pound semi-tractor trailer would increase stress on bridges if loaded to their maximum weights.

Table 14: Truck Configuration Parameters for Analysis of Bridge Impacts

Configuration	Scenarios	Gross Vehicle Weight (Pounds)	Trailer Lengths (Feet)	Outside Axle Spread (Feet)	Highways Assumed Available	Maximum Weight No Impact (Pounds)
Three-Axle Truck	Uniformity	54,000	**C**	24.0	All	54,000
Four Axle Truck	North American Trade	64,000	**C**	24.5	All	63,500
		71,000	**C**		All	63,500
Five-Axle Semitrailer	Uniformity	80,000	40	54.3	All	80,000
Six-Axle Semitrailer	North American Trade	90,000	40	54.8	All	90,300
		97,000	40	54.8	All	90,300
Five-Axle STAA double	Uniformity	80,000	28, 28	64.3	All	92,000
Seven-Axle Rocky Mt. Double	LCV's Nationwide	120,000	53, 28	94.3	42,500-mile System	115,300
Eight-Axle B-Train Double	North American Trade	124,000	33, 33	79.3	All	111,600
	and LCV's Nationwide	131,000	33, 33	79.3	All	111,600
Nine-Axle Turnpike Double	LCV's Nationwide	148,000	40, 40	119.3	42,500-mile System	122,200
Seven-Axle C-Train Triple	LCV's Nationwide and Triples	132,000	28, 28, 28	97.2	65,000-mile System	116,100

Source: DOT's "Comprehensive Truck Size and Weight Study," 2000

- The study analyzed the use of tridem axles for the six-axle semi-tractor trailers based on spacing of nine feet between the outer two axles of the tridem group[16] (Table 13) and found that at the 44,000 pound limit (six-axle 90,000 pound semi-tractor trailer) there would be no increase in bridge stress but at the 51,000 pound limit (97,000 pound semi-tractor trailer) there would be a considerable increase in bridge stress and that vehicle did not meet the bridge formula based on its axle weights.

[16] Adding nine feet, places the distance in feet between the extremes of any group of 2 or more consecutive axles at 60 feet, with a weight of 90,000 lbs. on a six-axle vehicle.

- The DOT study also estimated costs for replacing bridges that would be overstressed as shown in Table 15. The study's Uniformity scenario vehicles[17] would reduce current bridge investment requirements by $20 billion[18] and user costs by $42 billion. The bridge impacts of the North American Trade scenario vehicles[19], dominated by the six-axle 90,000 and 97,000 pound semi-tractor trailers would increase capital costs by $51 billion for the 90,000 pound semi-tractor trailer and $65 billion for the 97,000 pound semi-tractor trailer. However the study admits these costs are somewhat overstated because not all overstressed bridges would have to be replaced. Some could be strengthened and others could be posted to prevent use by heavier trucks.

Table 15: Scenario Bridge Impacts

Analytical Case		Costs ($Billion)			Change from Base Case ($Billion)		
		Capital	User	Total	Capital	User	Total
1994 Base Case		154	175	329	0	0	0
2000 Base Case		154	175	329	0	0	0
SCENARIO							
Uniformity		134	133	267	-20	-42	-62
North American Trade	**44,000-pound tridem axle**	205	378	583	51	203	254
	51,000-pound tridem axle	219	439	658	65	264	329
LCV's Nationwide		207	441	648	53	266	319
H.R. 551		154	175	329	0	0	0
Triples Nationwide		170	276	446	16	101	117

Source: DOT's "Comprehensive Truck Size and Weight Study," 2000
Notes: See Appendix B, Figures 2 and 3, for description of LCV Nationwide and H.R. 551

- The 2009 "Wisconsin Truck Size and Weight Study" reached similar conclusions as the 2000 DOT study regarding six-axle semi-tractor trailers. It concluded that the six-axle 90,000 pound semi-tractor trailer did not increase stress on bridges but the six-axle 98,000 pound semi-tractor trailer did increase stress on bridges and did not meet the Federal Bridge Formula. The study did not try to develop a new bridge formula.

[17] Includes three-axle single unit truck at a maximum weight of 51,000 lbs., five-axle semi-tractor trailer at a maximum weight of 80,000 lbs., and the five-axle STAA double at a maximum weight of 80,000 lbs.
[18] In 1994 dollars.
[19] Includes the four-axle single unit truck at 64,000 lbs. or 71,000 lbs. maximum weight, the six-axle semi-tractor trailer at 90,000 lbs. or 97,000 lbs., and the eight-axle B-train double at 124,000 lbs. or 131,000 lbs. maximum weight.

- The Wisconsin study evaluated six truck configurations to determine the vehicle impact on various types of bridge structure configurations. Four of the six truck configurations met the Federal Bridge Formula including:
  - Configurations meeting Federal Bridge Formula:
    - Six-Axle Tractor-Trailer with 90,000-Pound Gross Vehicle Weight. The axle spacing is 12 feet, 4 feet, 33.5 feet, and two spaces at 5.25 feet. The axle load is 12,000 lbs., two at 17,500 lbs. each and three at 14,667 lbs. each.
    - Seven-Axle Tractor-Trailer with 97,000-Pound Gross Vehicle Weight. The axle spacing is 10 feet, two spaces at 4.25 feet, 34 feet, and three spaces at 5.25 feet. The axle load is 12,000 lbs., three at 14,000 lbs., and three at 14,333 lbs. each.
    - Seven-Axle Tractor-Trailer with 80,000-Pound Gross Vehicle Weight. The axle spacing is 11 feet, two spaces at 5.5 feet, 9 feet, and two at 5.5 feet. The axle load is 11,000 lbs., three at 11,500 lbs., and three at 11,500 lbs. each.
    - Eight-Axle Tractor-Trailer with 108,000-Pound Gross Vehicle Weight. The axle spacing is 12 feet, 4 feet, 21.5 feet, two at 5.5 feet, 21.5 feet, and 4 feet. The axle load is 12,000 lbs., two at 13,500 lbs., three at 14,000 lbs., and two at 13,500 lbs.
  - Configurations not meeting Federal Bridge Formula:
    - Six-Axle Tractor-Trailer with 98,000-Pound Gross Vehicle Weight. This vehicle did not meet the Bridge Formula because the rear tridem exceeds allowable weight. The axle spacing is 12 feet, 4 feet, 37 feet, and two spaces at 5 feet. The axle load is 12,000 lbs., two at 17,500 lbs. each and three at 17,000 lbs. each.
    - Six-Axle Tractor-Trailer and Pup with 98,000-Pound Gross Vehicle Weight. The axle spacing is 11 feet, 9 feet, 4.5 feet, 11 feet, and 16 feet. The axle load is 18,000 lbs., 15,320 lbs., two at 15,330 lbs., 17,000 lbs., and 17,000 lbs.

- The study team fine-tuned the axle spacing and axle weight to meet the restrictions and guidelines of the Federal Bridge Formula where possible. But even with this fine tuning it was not possible for the 98,000 pound vehicles to satisfy the formula.

- The Wisconsin study also annualized costs for replacing bridges on state routes and local routes for each of the studied vehicle configurations as shown in Figure 17. The six-axle tractor-trailer with 98,000 lbs. GVW has the highest annual costs of the six vehicle configurations studied.

Table 16: Estimated Annual Bridge Replacement Costs ($ million) per Year[20]

Special Vehicle Configuration	State Route Bridge Replacement Costs	Local Route Bridge Replacement Costs
6-Axle Tractor-Trailer, 90,000 Pound GVW	$0.04	$2.14
6-Axle Tractor-Trailer, 98,000 Pound GVW	$1.54	$6.94
6-Axle Tractor-Trailer and Pup, 98,000 Pound GVW	$0.72	$3.50
7-Axle Tractor-Trailer, 97,000 Pound GVW	$0.28	$2.80
7-Axle Tractor-Trailer, 80,000 Pound GVW	$0.78	$5.24
8-Axle Tractor-Trailer, 108,000 Pound GVW	$0.04	$2.22

Source: Wisconsin Truck Size and Weight Study, January 2009

- The "Minnesota Truck Size and Weight Project" found that increases in truck weight limits can affect bridges and bridge related costs in several ways:
  - If the vehicles made legal by changes in limits exceeds the overstress criteria for a bridge, the bridge must be posted to prevent those vehicles from using it.
  - The possibility that a bridge might need to be posted will increase agency costs for inspecting and rating bridges and also for placing bridge posting signs.
  - Agencies may be pressured to replace posted bridges so that bridges can be used by all trucks.
  - Illegal overloads can overstress bridges, resulting in permanent damage, and, in extreme cases, catastrophic bridge failure.
  - Concrete decks and other bridge elements can wear out with repetitive loadings by heavy vehicles.
  - If legal loadings are increased, it may be necessary to increase the loadings used in designing new and replacement bridges, which, in turn will increase costs for these structures.

- The Minnesota study also concluded that the six-axle 90,000 pound semi-tractor trailer met the Federal Bridge Formula and did not increase bridge stress.

E. Impact of Heavier Vehicles on Road Pavement

Potential impacts associated with changes in truck weight limits are of intense concern because of the magnitude of Federal and State investments in pavement on the U.S. highway systems. Factors contributing to pavement impacts expected following truck weight policy changes include:

- Allowable axle load limits,
- Changes in vehicle miles traveled (VMT) by different vehicle classes, and
- Changes in VMT and axle loads on different highway classes.

[20] Costs are annualized over a 10-year period using a 5% interest rate.

- In terms of vehicle-specific characteristics, pavement wear increases with axle weight, the number of axle loadings, and the spacing between axle groups, such as for tandem- or tridem-axle groups. Vehicle suspensions, tire pressure and tire type also have an impact on pavement.

- Most studies show that switching to heavier trucks with additional axles can leave pavement damage about the same or slightly reduced.
  - Allowing heavier trucks increases the payload per truck, so fewer trips are required to move the same freight. The resulting reduction in vehicle miles of travel means less pavement damage.
  - Heavier trucks distribute their weight over a larger number of axles, as compared with the trucks they replace. Because pavement damage increases sharply with axle weight, the reduced weight per axle of the heavier trucks means less pavement damage.

- On the other hand, adding more payloads to a current truck configuration (increasing the weight on a five-axle truck semi-tractor trailer from 80,000 to 100,000 lbs.) will increase pavement damage sharply.
  - Thus an increase in truck weight limits that does not encourage a switch to more axle-trucks can have substantial pavement costs.
  - On the other hand significant savings in transportation costs by increasing truck weight limits more than offset higher pavement costs as well as higher bridge costs for the heavier trucks.

- The DOT's "Comprehensive Truck Size and Weight Study" (2000) focused on axle weight and pavement type characteristics as having the most impact on pavement. The study found that adding one or two axles to a single axle to make a tandem- or tridem-axle group allows higher gross weights without increasing pavement damage. These axle groups reduce pavement damage by spreading the load across more pavement area. Also the spread between two consecutive axles in a tandem- or tridem-axle group affects pavement life or performance. The greater the spread the more each axle in a group acts as a single axle. The study focused on two types of pavement: flexible[21] and rigid[22]. About 50% of the Interstate System mileage has rigid or composite pavement.

[21] Flexible pavements are surfaced with asphalt materials. The total pavement structure bends or deflects in response to a load. In addition, a flexible pavement structure is usually composed of several layers that absorb most of the deflection. Flexible pavements are expected to last from 10 to 15 years while rigid pavements can last for 30 years or more. But when flexible pavement needs repair, the work is generally less expensive and quicker to perform than for rigid pavements.

[22] Rigid pavements are made from Portland cement concrete and are substantially stiffer than flexible pavements. Some rigid pavements have reinforcing steel to help resist cracking due to temperature changes and repeated loading. Only 11% of all hard surfaced highways have rigid or composite pavements (rigid pavements with flexible overlays).

- The study used load equivalency factors (LEFs)[23] to evaluate the relative pavement impact of various axle groups and truck configurations at their maximum allowable weights. Table 17 shows total LEFs for various scenario vehicles at their maximum allowable weights.

- Switching to heavier trucks with additional axles can have the same or lower pavement damage as shown in Table 17.
    - For example the six-axle 90,000 pound semi-tractor trailer has lower LEFs than the conventional five-axle 80,000 pound semi-tractor trailer for rigid and flexible pavement fatigue while it has a slightly higher flexible pavement rutting. The six-axle 97,000 pound semi-tractor trailer has a lower rigid pavement fatigue than the five axle semi-tractor trailer but higher flexible pavement fatigue and rutting.

Table 17: Theoretical Load Equivalency Factors for Truck Scenario Vehicles

Configuration	Gross Vehicle Weight (Pounds)	Number of Axles in Each Group (S=Streering Axle)	Load Equivalency Factors ***		
			Rigid Pavement Fatigue (10-inch thickness)	Flexible Pavement (5-inch Wearing	
				Fatigue	Rutting
Three-Axle Single Unit Truck	54,000	S,2	4.2	5.6	4.1
Four-Axle Single Unit Truck	64,000	S,3	3.6	5.4	4.6
	71,000	S,3	4.1	6.5	5.0
Five-Axle Semitrailer	80,000	S,2,2	2.8	4.6	5.1
Five-Axle Semitrailer (10-foot Spread)	80,000	S,2,2,(spread)	3.1	6.0	5.4
Six-Axle Semitrailer	90,000	S,2,3	2.2	4.4	5.6
	97,000	S,2,3	2.7	5.5	6.0
STAA Double (five-axle)	80,000	S,1,1,1,1	4.2	5.0	4.9
B-Train Double (eight-axle)	124,000	S,2,3,2	3.3	6.0	6.5
	131,000	S,2,3,2	3.8	7.1	6.9
Rocky Mt. Double (seven axle)	120,000	S,2,2,1,1	6.0	7.6	7.3
Turnpike Double (nine-axle)	148,000	S,2,2,2,2	5.0	7.8	7.3
Triple (seven axle)	114000 (LTL operation)	S,1,1,1,1,1,1	6.0	6.8	6.7
	132000 (TL operation)	S,1,1,1,1,1,1	10.2	10.4	7.9

*LTL=Less-than-truckload
**TL=Truckload
***(based on 18,000-pound single axle with dual tires)
The lower the LEF the less road damage done
Source: DOT's "Comprehensive Truck Size and Weight Study", 2000

- Table 18 presents pavement impacts of different vehicle configurations from a different perspective. It shows total LEFs that would be accumulated by different vehicle configurations in hauling 100,000 lbs. of freight. This measure reflects both absolute pavement damage caused by each vehicle at the maximum weight at which it can operate, as well as the benefits of moving the same volume of cargo in fewer trips. It also shows that pavement impacts vary by type of pavement.

[23] Comparisons were based on the effects of axle groups and their load relative to a 18,000 pound single axle load. These relative effects were expressed in LEFs that are defined as the number of repetitions of a reference load and axle combination (such as the 18,000 pound single axle) that is equivalent in pavement life consumption to one application of the load and axle configuration in question.

- Both the six-axle 90,000 pound semi-tractor trailer and 97,000 pound semi-tractor trailer have lower LEFs than the conventional five-axle 80,000 pound semi-tractor trailer for both rigid and flexible pavement as shown in Figure 19. At the same time the six-axle 90,000 pound semi-tractor trailer has lower LEFs than the six-axle 97,000 pound semi-tractor trailer. Among the combination vehicles, many can haul the same quantity of cargo as the conventional five-axle semi-tractor trailer with less pavement damage, but relative damage depends on the types of axles on each vehicle (single, tandem, or tridem) and the type of pavement upon which the vehicle is operating.

Table 18: Theoretical Load Equivalency Factors per 100,000 Pounds of Payload Carried by Study Vehicle Configurations

Configuration	Gross Vehicle Weight (Pounds)	Empty Weight (Pounds)	Payload Weight (Pounds)	Number Vehicles per 100,000 Pounds of Payload	Load Equivalency Factors ***		
					Rigid Pavement Fatigue (10-inch thickness)	Flexible Pavement (5-inch wearing surface)	
						Fatigue	Rutting
Three-Axle Single Unit Truck	54,000	22,600	31,400	3.18	13.4	17.8	13.0
Four-Axle Single Unit Truck	64,000	26,400	376,000	2.66	9.6	14.4	12.2
	71,000	26,400	44,600	2.24	9.2	14.6	11.2
Five-Axle Semitrailer	80,000	30,500	49,500	2.02	5.7	9.3	10.3
Five-Axle Semitrailer (10 foot Spread)	80,000	30,500	49,500	2.02	6.3	12.2	10.9
Six-Axle Semitrailer	90,000	31,500	58,500	1.71	3.8	7.5	9.6
	97,000	31,500	65,500	1.53	4.1	8.4	9.2
STAA Double (five-axle)	80,000	29,300	50,700	1.97	8.3	9.9	9.7
B-Train Double (eight-axle)	124,000	38,700	85,300	1.17	3.9	7.0	7.6
	131,000	38,700	92,300	1.08	4.1	7.7	7.5
Rocky Mt.Double (seven-axle)	120,000	43,000	77,000	1.30	7.8	9.9	9.5
Turnpike Double (nine axle)	148,000	46,700	101,300	0.99	5.0	7.7	7.2
Triple (seven-axle)	114,000 (LTL)*	44,500	69,500	1.44	8.6	9.8	9.6
	132,000 (TL)**	44,500	87,500	1.14	11.6	11.8	9.0

*LTL=Less-than-truckload
**TL=Truckload
***(based on 18,000-pound single axle with dual tires)
Source: DOT's "Comprehensive Truck Size and Weight Study

- The DOT study also compared unit pavement costs and pavement costs per unit of payload-mile by truck configuration, which shows that the addition of axles allows for increased payloads, and at the same time reduces pavement deterioration. The most significant comparisons were between the 3- and 4-axle single unit trucks, the 5- and 6-axle semi-tractor trailer combinations, and the 5- and 8-axle doubles. In comparing the 5-axle and 6-axle semi-tractor trailers, the unit pavement costs and unit costs per payload mile were similar or slightly lower for the 6-axle 90,000 pounds semi-tractor trailers as shown in Table 19 and Table 20.

Table 19: Unit Cost per Payload-Mile for Various Truck Types, $1,000 Ton Miles

		Truck Type								
		Single-Unit		Semitrailer		Double-Trailer			Triple	
	Weights (Pounds)	3-Axles	4-Axles	5-Axles	6-Axles	5-Axles	7-Axles	8-Axles	7-Axles	
	GVW	54,000	64,000	80,000	90,000	80,000	100,000	105,000	100,000	115,000
	Tare	22,600	26,400	30,490	31,530	29,320	38,600	33,470	41,700	41,700
	Payload	31,400	37,600	49,510	58,470	50,680	61,400	71,530	58,300	73,300
Area Type	**Functional Class**									
Rural	Interstate	0.006	0.004	0.002	0.002	0.001	0.003	0.001	0.001	0.002
	Prim. Art.	0.011	0.009	0.005	0.004	0.003	0.005	0.003	0.006	0.008
	Min. Art.	0.024	0.018	0.012	0.008	0.013	0.013	0.006	0.013	0.020
	Maj. Col.	0.088	0.072	0.036	0.027	0.046	0.034	0.018	0.050	0.080
	Min. Col.	0.145	0.111	0.060	0.042	0.076	0.055	0.030	0.083	0.133
	Locals	0.376	0.299	0.156	0.110	0.197	0.143	0.078	0.215	0.344
Urban	Interstate	0.004	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.001
	Freeway & Expressway	0.006	0.003	0.002	0.002	0.002	0.002	0.001	0.003	0.005
	Prim. Art.	0.008	0.006	0.004	0.003	0.004	0.003	0.002	0.004	0.007
	Min. Art.	0.019	0.013	0.009	0.006	0.007	0.006	0.003	0.011	0.019
	Collectors	0.042	0.037	0.022	0.017	0.018	0.011	0.007	0.030	0.050
	Locals	0.149	0.136	0.077	0.060	0.065	0.039	0.024	0.105	0.176

Source: DOT's "Comprehensive Truck Size and Weight Study

Table 20: Unit Pavement Cost for Various Truck Types, Dollars per 1,000 Miles

		Truck Type								
		Single-Unit		Semitrailer		Double-Trailer			Triple	
		3-Axles	4-Axles	5-Axles	6-Axles	5-Axles	7-Axles	8-Axles	7-Axles	
	GVW (pounds)	54,000	64,000	80,000	90,000	80,000	100,000	105,000	100,000	115,000
Area Type	Functional Class									
Rural	Interstate	0.09	0.07	0.05	0.05	0.03	0.10	0.05	0.04	0.08
	Prim. Art.	0.17	0.16	0.12	0.11	0.07	0.15	0.10	0.17	0.31
	Min. Art.	0.37	0.33	0.29	0.22	0.32	0.41	0.21	0.39	0.75
	Maj. Col.	1.38	1.35	0.90	0.80	1.17	1.03	0.65	1.46	2.95
	Min. Col.	2.27	2.08	1.49	1.24	1.92	1.69	1.07	2.42	4.87
	Locals	5.90	5.63	3.87	3.23	4.99	4.40	2.79	6.27	12.60
Urban	Interstate	0.06	0.04	0.04	0.04	0.03	0.04	0.02	0.03	0.05
	Freeway & Expressway	0.09	0.06	0.06	0.05	0.04	0.07	0.04	0.09	0.18
	Prim. Art.	0.13	0.12	0.10	0.09	0.11	0.09	0.06	0.13	0.26
	Min. Art.	0.30	0.24	0.22	0.17	0.19	0.18	0.12	0.34	0.70
	Collectors	0.66	0.70	0.54	0.49	0.46	0.34	0.25	0.86	1.82
	Locals	2.34	2.53	1.91	1.75	1.64	1.19	0.88	3.06	6.45

Source: DOT's "Comprehensive Truck Size and Weight Study

- The Wisconsin Truck Size and Weight Study (2009) evaluated six truck configurations including two six-axle 98,000 pound configurations which did not meet the Federal Bridge Formula but are both currently in use on non-interstate highways through exceptions in Wisconsin law[24]. The study analyzed the vehicle configurations both in terms of their use only on non-interstate highways and on interstate highways. In both analyses the six-axle semi-tractor trailer generated the most net statewide benefits.

[24] The Federal Bridge Formula would have to be changed to allow the operation of the six-axle 98,000 pound trucks on interstate highways.

- In analyzing costs and benefits for trucks operating only on non-interstate highways, five of the six truck configurations generated net statewide benefits if the impacts on bridges are limited to the direct impacts of the new truck configurations as shown in Table 21. In terms of pavement costs and benefits the 97,000 pound seven-axle semi-tractor trailer generates the most net benefits followed by the 108,000 pound eight-axle double and the 90,000 pound six-axle semi-tractor trailer. However, 98,000 pound six-axle semi-tractor trailer was the most successful configuration with the most savings in transport costs, safety, and congestion. The next most successful configurations were the 97,000 pound seven-axle semi-tractor trailer and the 90,000 pound six-axle semi-tractor trailer. However, because the state of Wisconsin faces baseline maintenance needs to support existing truck traffic on its structures, the backlog of total state bridge costs overwhelms the benefits for all trucks in this evaluation, unless they are also allowed to operate on the Interstate system. Under this scenario (with all bridge costs), all vehicle configurations had negative net benefits.

Table 21: Wisconsin Annual Costs and Benefits for Truck Configurations Operating on Non-Interstate Highways Only, All Values in Millions

Meets Federal Bridge Formula	Configuration	System User Benefits			Public Agency Benefits & Impacts			Net Benefits	
		Transport Savings	Safety	Congestion	Pavement	Bridge Costs for TSW Config	Baseline Bridge Costs	With TSW Bridge Costs	With all Bridge Costs
Yes	5-axle 80,000 lb. tractor semitrailer	0.00	0.00	0.00	0.00	0.00	-55.50	0.00	-55.50
Yes	6-axle 90,000 lb. tractor semitrailer	36.64	3.48	3.44	14.65	-2.18	-55.50	56.03	0.53
Yes	7-axle 97,000 lb. tractor semitrailer	41.83	4.43	4.08	19.91	-3.08	-55.50	67.18	11.68
Yes	7-axle 80,000 lb. single unit truck	9.83	0.53	0.09	1.53	-2.26	-55.50	9.73	-45.77
Yes	8-axle 108,000 lb. double	22.77	2.90	1.65	16.76	-6.02	-55.50	38.06	-17.44
No	**6 axle 98,000 lb. tractor semitrailer**	**127.94**	**9.40**	**11.03**	**10.19**	**-8.48**	**-55.50**	**150.09**	**94.59**
No	6-axle 98,000 lb. straight truck trailer	14.61	0.68	0.26	0.32	-4.22	-55.50	11.65	-43.85

Source: Wisconsin Truck Size and Weight Study

- The Wisconsin study found that allowing heavier trucks on Interstate highways would decrease the impact on state and local roads. Net benefits for this scenario were greater because Interstate highways are frequently better designed to handle heavy trucks because Interstate pavements tend to be thicker than non-Interstates and truck crash costs per vehicle mile are lower on interstates.

- Taking into account the total bridge costs and the ability to operate on the interstate, the most successful truck configuration, in terms of total benefits again was the six-axle 98,000 pound semi-tractor trailer which again generated the highest savings in transport costs, safety and congestion as shown in Table 22. The next most beneficial truck configuration was the seven-axle 97,000 pound semi-tractor trailer followed by the marginally beneficial six-axle 90,000 pound semi-tractor trailer The other four truck configurations in the study had negative benefits. In terms of pavement costs and benefits the 97,000 pound seven-axle semi-tractor trailer generates the most net benefits followed by the 108,000 pound eight-axle double and the 90,000 pound six-axle semi-tractor trailer

Table 22: Wisconsin Annual Costs and Benefits for Truck Configurations Assuming Interstate Operation is Allowable, All Values in Millions

Meets Federal Bridge Formula	Configuration	System User Benefits			Public Agency Benefits & Impacts			Net benefits	
		Transport Savings	Safety	Congestion	Pavement	Bridge Costs for TSW Config	Baseline Bridge Costs	With TSW Bridge Costs	With all Bridge Costs
Yes	5-axle 80,000 lb. tractor semitrailer	0.00	0.00	0.00	0.00	0.00	-55.50	0.00	-55.50
Yes	6-axle 90,000 lb. tractor semitrailer	5.50	0.46	0.92	2.57	-2.18	-55.50	7.26	-48.24
Yes	7-axle 97,000 lb. tractor semitrailer	6.27	0.70	0.85	3.87	-3.08	-55.50	8.62	-46.88
Yes	7-axle 80,000 lb. single unit truck	2.46	0.11	0.08	0.40	-2.26	-55.50	0.78	-54.72
Yes	8-axle 108,000 lb. double	3.42	0.46	0.49	3.34	-6.02	-55.50	1.69	-53.81
No	**6 axle 98,000 lb. tractor semitrailer**	**19.19**	**1.52**	**1.89**	**1.10**	**-8.48**	**-55.50**	**15.23**	**-40.27**
No	6-axle 98,000 lb. straight truck trailer	2.19	0.09	0.06	0.03	-4.22	-55.50	-1.85	-57.35

Source: Wisconsin Truck Size and Weight Study

- “The Minnesota Truck Size and Weight Project” also found that adding axles to a truck can greatly reduce its effect on pavement.
  - For example, a conventional five-axle semi-tractor trailer operating at 80,000 lbs. is about 2.4 equivalent single axle loads (ESALs)[25]. If the weight on this vehicle was increased to 90,000 lbs. (12.5% increase), its

[25] Although it is not too difficult to determine a wheel or an axle load for an individual vehicle, it becomes quite complicated to determine the number and types of wheel/axle loads that a particular pavement will be subject to over its design life. Furthermore, it is not the wheel load but rather the damage to the pavement caused by the wheel load that is of primary concern. The most common historical approach is to convert damage from wheel loads of various magnitudes and repetitions (“mixed traffic”) to damage from an equivalent number of “standard” or “equivalent” loads. The most commonly used equivalent load in the US is the 18,000 pound (80 kN) equivalent single axle load (normally designated ESAL).

ESAL value would increase to 4.1 (up 70.8%), because pavement damage increases at a geometric rate with weight increases. In comparison, a six-axle semi-tractor trailer at 90,000 lbs. has an ESAL value of only 2.0 because its weight is distributed over six axles instead of five as shown in Table 23. An added pavement benefit of using a six-axle semi-tractor trailer is that fewer trips would be needed to carry the same amount of payload. As a result, the six-axle truck at 90,000 lbs. produces almost 30% fewer ESAL miles per payload ton-mile than the five-axle truck at 80,000 lbs. Based on ESAL factors, all truck configurations in the Minnesota study are better for pavements than the current five-axle semi-tractor trailer at 80,000 lbs.

- The Minnesota study recommended that in the winter months the weight limit for the six-axle semi-tractor trailer be increased to 99,000 lbs. because pavements are less vulnerable to damage. During the spring, pavement layers are generally in a saturated, weakened state due to partial thaw conditions and trapped water. A given traffic loading during spring thaw results in five to eight times more damage to pavements than that same loading at other times of the year.

Table 23: Equivalent Single-Axle Load (EASL) Values of Flexible Pavements

Configuration	Total ESALs
Current 5-Axle Tractor-Semitrailer at 80,000 pounds	2.4
6-Axle Tractor-Semitrailer at 90,000 pounds	2.0
7-Axle Tractor-Semitrailer at 97,000 pounds	1.5
8-Axle Double at 108,000 pounds	1.8
Single Unit 6-and7-Axle respectively	0.7 to 0.9

Source: "Minnesota Truck Size and Weight Project"

- Based on the analysis conducted in the Minnesota study regarding the impact of increasing truck weight limits:
  - Increased payloads and fewer truck trips will lower transport costs significantly.
  - Additional axles and fewer truck trips will result in less pavement wear.
  - The increase in bridge postings and future design costs necessary will be modest.
  - Proposed trucks have slightly higher crash rates but, given fewer overall truck miles (due to increased payloads) than would be experienced otherwise under existing weight limits, safety would improve slightly.

- The Transportation Research Board's 1990 Report, "Truck Weight Limits: Issues and Options, Special Report 225, also affirms that pavement damage from heavy vehicles depends mainly on axle weights. Study results showed that heavier trucks can be pavement-friendlier than some lighter trucks with fewer axles as shown in Table 24. For example, ESALs for a six-axle semi-tractor trailer GVW of 88,000 pounds is less than a five-axle semi-tractor trailer GVW of 80,000 pounds. Thus trucks can be configured to carry heavier loads and at the same time cause less pavement damage.

Table 24: Relative Pavement Impacts of Different Trucks as Measured by Number of Equivalent Single-Axle Loads (EASL)

Truck Type	GVW (pounds)	ESALs for Flexible Pavements	ESALs for Rigid Pavements
3-Axle Single-Unit Truck	48,000	1.48	2.1
4-Axle Single-Unit Truck	56,000	1.11	1.78
5-Axle Tractor Semitrailer	80,000	2.37	4.07
5-Axle Double	80,000	4.05	4.09
6-Axle Tractor Semi-Trailer	88,000	1.88	3.57
7-Axle Double	101,000	2.57	3.56
8-Axle B-Train Double	122,000	2.97	5.52
9-Axle Double	129,000	2.66	4.43

Source: Transportation Research Board, 1990

- Table 25 shows a typical ranges for ESAL's per truck based on assumed gross vehicle weight and assumed distributions of loading to the various axles or axle groups. The six-axle 80,000 pound semi-tractor trailer has significantly lower ESALs than the five-axle 80,000 pound semi-tractor trailer. If the six-axle semi-tractor trailer weight is increased to 100,000 pounds, it has higher ESALs than the five-axle vehicle, although its lower range ESAL of 2.2 is close to the higher range ESAL of the five-axle vehicle at 2.1. Even more significant if both the five-axle and six-axle semi-tractor trailer weights are increased to 100,000 pounds, the six-axle semi-tractor trailer has significantly lower ESALs.

Table 25: Equivalent Single-Axle Loads (EASL) Ranges by Select Vehicles

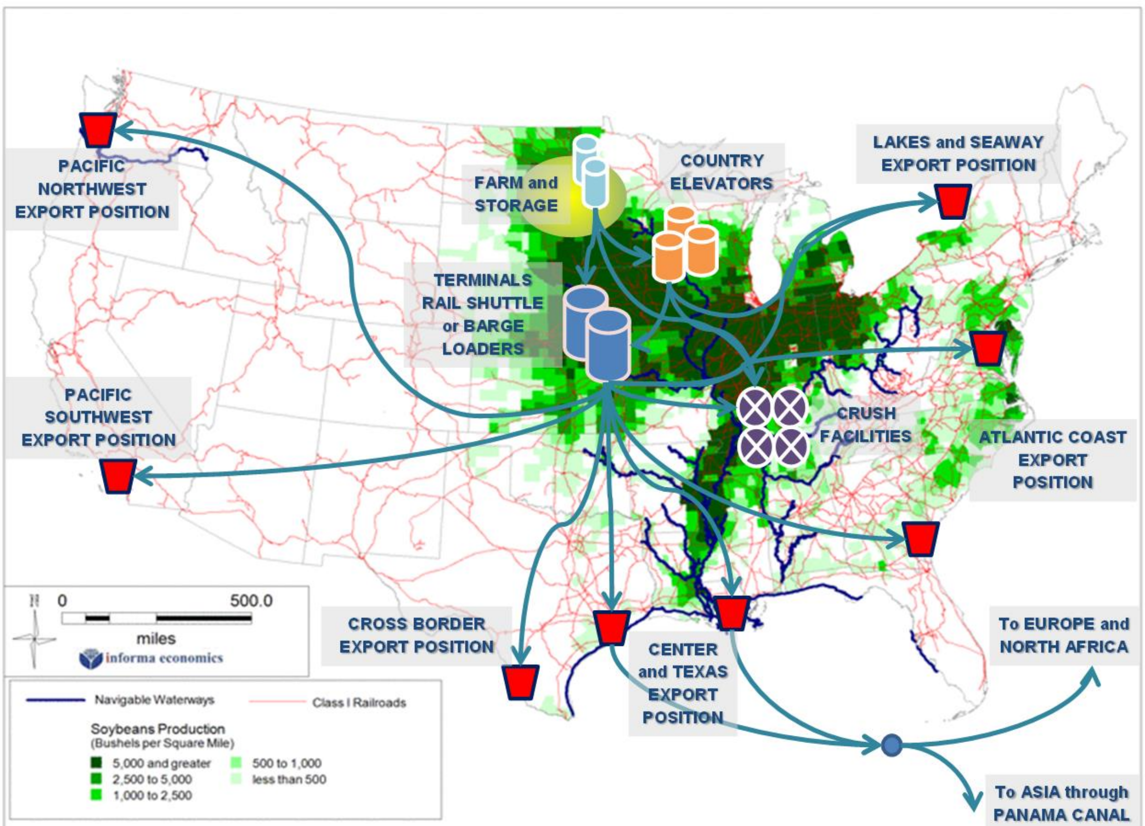
Vehicle Type	Number of Axles	Gross Vehicle Weight (pounds)	ESAL's per Truck
Single Unit Truck	Two Axles	13,000	0.1 to 0.2
		26,000	1.1 to 1.3
		40,000	1.7 to 1.9
	Three Axles	42,000	0.8 to 1.0
		46,000	1.2 to 1.4
		50,000	2.2 to 2.4
		90,000	28.0 to 52.0
	Four Axles	66,000	1.3 to 1.5
		70,000	2.3 to 2.5
		74,000	2.7 to 2.9
		100,000	9.0 to 11.0
Semi-Trailer Combination Truck	Three Axles	48,000	2.5 to 2.7
		56,000	2.8 to 3.0
	Four Axles	60,000	1.7 to 1.9
		64,000	2.2 to 2.4
		70,000	3.0 to 3.2
	Five Axles	80,000	1.9 to 2.1
		100,000	4.8 to 5.2
		120,000	11.0 to 13.0
	Six Axles	80,000	1.4 to 1.6
		100,000	2.2 to 2.6
		120,000	6.4 to 8.4
Automobiles		4,000	0.01

Source: Pavement Design Guide, September 1997, Division of Highway Design Pavement Branch

VIII.   Efficiency of Transporting Soybeans and Soybean Products

The U.S. soybean farm to market value chain and logistics flow is presented visually and is accompanied by a brief description of each component of the marketing chain. The value chain provides a framework to analyze the journey of a soybean from its initial production region to end consumer as shown in Figure 19. The information in this section is based on a “typical” journey, encompassing the prominent flow patterns. The goal is to provide a foundation how the vast majority of soybeans and soybean products are transported from farm to market.

Figure 19: U.S. Soybean Logistics Flow



A. U.S Soybean Marketing Chain Impacts

This information provides the starting point to determine the amount of fuel and volume of emissions transporting soybeans and soybean products from origin to destination can be saved using higher truck weights. Not all savings will be accomplished in one year, but will emerge over a number of years. The greater efficiencies of a greater payload will offset the increase cost of diesel. Moreover, as soybean yields (bushels per acre) increase, the trips required to move the crop will increase and in turn increase fuel and carbon emissions. Higher truck weights will reduce trips and reduce the environmental footprint of higher yields.

- Higher truck weights will reduce the fuel cost, fuel consumption and carbon emissions from transporting farm inputs. Inputs consist of machinery (combines, tractors, drills, etc.), chemicals/fertilizers, and certified seed.
  - The distance transporting inputs from manufacturer to dealership varies.
    - If a combine is manufactured in Moline, IL for example, it will be trucked to a local dealer in the Midwest.
    - However, combines can and are transported by train to equipment dealers' located long distances from Moline.
  - Fertilizers and chemicals produced in the U.S. are usually transported by barge or rail to local distribution facilities then trucked to individual dealerships for delivery to farm operations.
    - In the case of fertilizer imported through East Coast ports, it will be railed from those ports to fertilizer distribution centers in the Corn Belt and then transferred to storage.
    - That stored fertilizer will then be delivered by truck to farms and fields for application.
  - Certified seed follows a similar transportation path as fertilizer and chemicals.

- The end-products that use soybean meal and soybean oil would benefit from higher truck weights.
  - The key to growth in the U.S. meat industry is increasing exports, which is dependent on longer multistate refrigerated truck and rail moves. Lower freight costs will result in a lower landed cost that in turn supports higher levels of exports.
    - Railroads base freight rates on competing transportation modes.
    - Exporting meat instead of soybeans results in a stronger domestic soybean market and more jobs in the U.S.
  - Many food products are dense, weighing out a truck trailer before cubing it out.
    - Reducing the food cost through lower freight rates leads to a corresponding savings at the check-out counter for consumers, allowing spending on other goods, which in turn spurs economic growth.

a) Soybean Value Chain

- The U.S. annually produces approximately 3.3 billion bushels or 89.8 million metric tons of soybeans. Soybean production occurs primarily in the Midwest, Northern Plains, and along the Mississippi River.

- The first move is from the farm to market pipelines. During harvest farmers have as many as seven primary options, depending upon where they are located, transporting soybeans, to:
  - On-farm storage,
  - Country elevator,

    - Direct use,
    - Container yard or transloader,
    - Barge terminal,
    - Shuttle elevator, or
    - Crushing plant.

- The first move is by truck with virtually no back-haul. During the first move the wait time can be up to several hours, but the trucks typically are running for approximately 15 minutes in line and 15 minutes unloading.

  - Approximately three out of four bushels of the soybeans either remains on-farm initially or is delivered to a country elevator during harvest.
    - On-farm storage is an important asset in terms of managing harvest pressure and making marketing decisions.
      - The combination of higher yields and larger harvesting equipment results in large quantities of soybeans needing to be handled in a short period of time. A farmer's response to increased harvest pressure has been to add more trucks delivering soybeans to the next step in the value chain, increasing the size of the trucks, and building more on-farm storage.
      - After harvest, approximately one-quarter of the soybean production remains on-farm and is then delivered to market position from April through September.
    - Harvest pressure makes the nearby availability of storage valuable. For farmers that are not located within 50 miles of a container yard, barge terminal, shuttle elevator, and or crush facility, the country elevator is essential during harvest.
      - Interviews of country elevator operators indicated that the main draw area is 20 miles to 50 miles. Farmers west of the Mississippi River typically drive farther distances than farms east of the Mississippi River.
      - Farm to country elevators account for an estimated 55% of first moves.

  - Approximately one-fifth of the soybean harvest is shipped directly from the farm to direct use, export position or crusher.
    - To consistently utilize containers requires a farmer to be located within close proximity of a transloader or container yard. Currently, container movements represent less than 1% of soybean production and about one-tenth of soybean exports, with prospects of expanding more so.
    - It is assumed that during the two months of harvest the farmer delivers directly to the barge terminal, shuttle elevator, and crushing plant.
      - Farm to barge terminal represents an estimated 5% of soybean production.

- Farm to shuttle elevator is approximately 5% of soybean production.
- Approximately 7% of soybean production moves directly from farm to crushing plant. According to crush plant managers located in the Corn Belt the average reach of their facilities is 40 miles and nearly all soybeans arrive by truck.

Table 26: U.S. Soybean Farm to Market Pipeline Distribution at Harvest

	Thousand Bushels	Average Distance (Miles)	Total Ton-Miles (Thousands)	Truck Ton-Miles (Thousands)	Rail Ton-Miles (Thousands)	Barge Ton-Miles (Thousands)
Crop Size	3,300,000	26	2,534,771	2,534,771	-	-
On-Farm Storage	825,000	-	-	-	-	-
Country Elevator	1,815,000	35	1,905,750	1,905,750	-	-
Direct Use	99,000	35	103,950	103,950	-	-
Container	495	50	743	743	-	-
Barge Terminal	165,000	25	123,750	123,750	-	-
Shuttle Elevator	164,505	25	123,379	123,379	-	-
Crushing Plant	231,000	40	277,200	277,200	-	-

Source: USDA, USACOE, USITC, Informa

- During harvest, higher truck weights could reduce the number of truck trips by approximately 465 thousand.
  - Labor and time are precious commodities during harvest that would be aided by a more efficient transportation system of higher truck weights.

Table 27: U.S. Soybean Farm to Market Pipeline Reduced Trips at Harvest using Higher Truck Weights

	Average Distance (Miles)	Truck Ton-Miles (Thousands)	Truck Trips (80,000 LB GW)	Truck Trips (97,000 LB GW)	Reduced Trips (Thousands)
Crop Size	26	2,534,771	2,750	2,285	465
On-Farm Storage*	-	-	-	-	-
Country Elevator	35	1,905,750	2,017	1,675	341
Direct Use	35	103,950	110	91	19
Container	50	743	1	0	0
Barge Terminal	25	123,750	183	152	31
Shuttle Elevator	25	123,379	183	152	31
Crushing Plant	40	277,200	257	213	43

* On-Farm Storage is moved after harvest. It accounts for an additional 917 truck trips.

Source: USDA, USACOE, USITC, Informa

- Higher truck weights will reduce fuel consumption and carbon emissions moving soybeans through the farm to market pipeline by 1.4 million gallons and 14 thousand tons, respectively.

Table 28: U.S. Soybean Farm to Market Pipeline Reduced Fuel and Carbon Emissions at Harvest using Higher Truck Weights

	Truck Ton-Miles (Thousands)	Truck (80,000 LB) (Gallons)	Truck (97,000 LB) (Gallons)	Reduced Fuel (Gallons)	Reduced Emissions (Tons)
Crop Size	2,534,771	16,898,475	15,503,188	1,395,287	14,098
On-Farm Storage	-	-	-	-	-
Country Elevator	1,905,750	12,705,000	11,655,963	1,049,037	10,600
Direct Use	103,950	693,000	635,780	57,220	578
Container	743	4,950	4,541	409	4
Barge Terminal	123,750	825,000	756,881	68,119	688
Shuttle Elevator	123,379	822,525	754,610	67,915	686
Crushing Plant	277,200	1,848,000	1,695,413	152,587	1,542

Source: USDA, USACOE, USITC, Informa

- For first soybean move, the farmer will save $3 million to $7 million, depending on the price of fuel.

Table 29: U.S. Soybean Farm to Market Pipeline Reduced Fuel Expense at Harvest using Higher Truck Weight to 97,000 Pounds

	Reduced Fuel (Gallons)	Reduced Fuel Savings ($2 per Gallon)	Reduced Fuel Savings ($3 per Gallon)	Reduced Fuel Savings ($4 per Gallon)	Reduced Fuel Savings ($5 per Gallon)
Crop Size	1,395,287	$2,790,574	$4,185,861	$5,581,148	$6,976,435
On-Farm Storage	-	$0	$0	$0	$0
Country Elevator	1,049,037	$2,098,073	$3,147,110	$4,196,147	$5,245,183
Direct Use	57,220	$114,440	$171,661	$228,881	$286,101
Container	409	$817	$1,226	$1,635	$2,044
Barge Terminal	68,119	$136,239	$204,358	$272,477	$340,596
Shuttle Elevator	67,915	$135,830	$203,745	$271,660	$339,575
Crushing Plant	152,587	$305,174	$457,761	$610,349	$762,936

Source: USDA, USACOE, USITC, Informa

- By definition on-farm stored soybeans are not transported off-farm during harvest, which increases the time available to market directly to an export position or crusher. The availability of time allows the farmer to ship the soybeans a greater distance than during harvest.
  - The on-farm move to export position or crusher is typically 20 miles to 150 miles and 100% is delivered by truck.
  - The moves are programmed, meaning the deliveries are scheduled with the destination location, which reduces the wait time to unload and allows soybeans to be transported as a backhaul. The backhaul moves are less expensive than deadhead moves, but are also longer distances, which offsets the emission savings from avoiding deadhead moves, but increases the benefits of higher truck weights.
  - Farmers in the western U.S. tend to drive farther distances than farmers in the eastern U.S.
  - Of the estimated 825 million bushels remaining on-farm after March, approximately 40% are shipped to a crushing plant, 25% to a shuttle elevator, 15% to a barge terminal, and 20% to a country elevator as shown in Table 30.
  - The on-farm storage shipments are soybeans stored at the farm to the marketing pipeline. The moves are considered to be by truck.

Table 30: U.S. Distribution of Soybeans from On-Farm Storage

	Thousand Bushels	Average Distance (Miles)	Total Ton-Miles (Thousands)	Truck Ton-Miles (Thousands)	Rail Ton-Miles (Thousands)	Barge Ton-Miles (Thousands)
On-Farm Storage	825,000	59	1,460,250	1,460,250	-	-
Country Elevator	165,000	35	173,250	173,250	-	-
Barge Terminal	123,750	50	185,625	185,625	-	-
Shuttle Elevator	206,250	50	309,375	309,375	-	-
Crushing Plant	330,000	80	792,000	792,000	-	-

Source: USDA, USACOE, USITC, Informa

- From on-farm storage into the marketing chain, higher truck weights could reduce the number of truck trips by approximately 155 thousand.

Table 31: U.S. Soybean Shipments from On-Farm Storage, Reduced Trips using Higher Truck Weights

	Average Distance (Miles)	Truck Ton-Miles (Thousands)	Truck Trips (80,000 LB GW)	Truck Trips (97,000 LB GW)	Reduced Trips (Thousands)
Crop Size	59	1,460,250	917	762	155
Country Elevator	35	173,250	183	152	31
Barge Terminal	50	185,625	138	114	23
Shuttle Elevator	50	309,375	229	190	39
Crushing Plant	80	792,000	367	305	62

Source: USDA, USACOE, USITC, Informa

- Higher truck weights could reduce fuel consumption and carbon dioxide emissions moving soybeans from on-farm to market pipeline by 804 thousand gallons and 8 thousand tons, respectively.

Table 32: U.S. Soybean Shipments from On-Farm Storage, Reduced Fuel and Carbon Dioxide Emissions using Higher Truck Weights

	Truck Ton-Miles (Thousands)	Truck (80,000 LB) (Gallons)	Truck (97,000 LB) (Gallons)	Reduced Fuel (Gallons)	Reduced Emissions (Tons)
Crop Size	1,460,250	9,735,000	8,931,193	803,807	8,122
Country Elevator	173,250	1,155,000	1,059,633	95,367	964
Barge Terminal	185,625	1,237,500	1,135,321	102,179	1,032
Shuttle Elevator	309,375	2,062,500	1,892,202	170,298	1,721
Crushing Plant	792,000	5,280,000	4,844,037	435,963	4,405

Source: USDA, USACOE, USITC, Informa

- Higher truck weights would reduce the farmers' on-farm storage transportation expense by $2 million to $4 million, depending on the price of fuel.

Table 33: U.S. Soybean Shipments from On-Farm Storage, Reduced Fuel Expense using Higher Truck Weight to 97,000 Pounds

	Reduced Fuel (Gallons)	Reduced Fuel Savings ($2 per Gallon)	Reduced Fuel Savings ($3 per Gallon)	Reduced Fuel Savings ($4 per Gallon)	Reduced Fuel Savings ($5 per Gallon)
Crop Size	803,807	$1,607,615	$2,411,422	$3,215,229	$4,019,037
Country Elevator	95,367	$190,734	$286,101	$381,468	$476,835
Barge Terminal	102,179	$204,358	$306,537	$408,716	$510,894
Shuttle Elevator	170,298	$340,596	$510,894	$681,193	$851,491
Crushing Plant	435,963	$871,927	$1,307,890	$1,743,853	$2,179,817

Source: USDA, USACOE, USITC, Informa

- The country elevator provides marketing options for the farmer, nearby crushers, feeding operations, barge terminals and shuttle elevators.
  - Elevator operators indicate that approximately 85% of country elevator shipments are shipped out by truck with the remaining 15% by rail as shown in Table 34.
  - The moves are executed when the customer wants the soybeans, which reduces the wait time to unload and allows soybeans to be transported as a backhaul. The backhaul moves are less expensive than deadhead moves, but are also longer distances, which offsets the emission savings from avoiding deadhead moves. The report assumes no backhaul moves for the purpose of emissions.
  - Country elevators are in essence feeder elevators to barge terminals and shuttle elevators.
  - Crushers typically either own country elevators and or have marketing agreements with country elevators.

Table 34: U.S. Distribution of Soybeans from Country Elevators

	Thousand Bushels	Average Distance (Miles)	Total Ton-Miles (Thousands)	Truck Ton-Miles (Thousands)	Rail Ton-Miles (Thousands)	Barge Ton-Miles (Thousands)
Country Elevator	1,980,000	66	3,896,640	3,312,144	584,496	-
Barge Terminal	396,000	50	594,000	504,900	89,100	-
Shuttle Elevator	554,400	50	831,600	706,860	124,740	-
Crushing Plant	990,000	80	2,376,000	2,019,600	356,400	-
Export	39,600	80	95,040	80,784	14,256	-

Source: USDA, USACOE, USITC, Informa

- Higher truck weights could reduce the number of truck trips by approximately 316 thousand for country elevators.

Table 35: U.S. Soybeans Country Elevators Reduced Trips using Higher Truck Weights

	Average Distance (Miles)	Truck Ton-Miles (Thousands)	Truck Trips (80,000 LB GW)	Truck Trips (97,000 LB GW)	Reduced Trips (Thousands)
Country Elevator	66	3,312,144	1,870	1,554	316
Barge Terminal	50	504,900	374	311	63
Shuttle Elevator	50	706,860	524	435	89
Crushing Plant	80	2,019,600	935	777	158
Export	80	80,784	37	31	6

Source: USDA, USACOE, USITC, Informa

- Higher truck weights could reduce fuel consumption and carbon emissions moving soybeans from country elevators by 1.8 million gallons and 18 thousand tons, respectively.

Table 36: U.S. Soybean Country Elevators Reduced Fuel and Carbon Emissions using Higher Truck Weights

	Truck Ton-Miles (Thousands)	Truck (80,000 LB) (Gallons)	Truck (97,000 LB) (Gallons)	Reduced Fuel (Gallons)	Reduced Emissions (Tons)
Country Elevator	3,312,144	22,080,960	20,257,761	1,823,199	18,422
Barge Terminal	504,900	3,366,000	3,088,073	277,927	2,808
Shuttle Elevator	706,860	4,712,400	4,323,303	389,097	3,931
Crushing Plant	2,019,600	13,464,000	12,352,294	1,111,706	11,233
Export	80,784	538,560	494,092	44,468	449

Source: USDA, USACOE, USITC, Informa

- Higher truck weights would save the country elevators $4 million to $9 million, depending on the price of fuel.

Table 37: U.S. Soybean Country Elevators Reduced Fuel Expense with Higher Truck Weights to 97,000 Pounds

	Reduced Fuel (Gallons)	Reduced Fuel Savings ($2 per Gallon)	Reduced Fuel Savings ($3 per Gallon)	Reduced Fuel Savings ($4 per Gallon)	Reduced Fuel Savings ($5 per Gallon)
Country Elevator	1,823,199	$3,646,397	$5,469,596	$7,292,794	$9,115,993
Barge Terminal	277,927	$555,853	$833,780	$1,111,706	$1,389,633
Shuttle Elevator	389,097	$778,194	$1,167,292	$1,556,389	$1,945,486
Crushing Plant	1,111,706	$2,223,413	$3,335,119	$4,446,826	$5,558,532
Export	44,468	$88,937	$133,405	$177,873	$222,341

Source: USDA, USACOE, USITC, Informa

- The shuttle elevator primary utilizes railroads to transport soybeans. The accumulation of soybeans in a single location has increased railroad efficiency and offers incentives to shippers.
    - Railroads own their systems and attempt to operate at the highest possible level within safety limits.
    - The expansion of soybean production west of the Mississippi River combined with strong Asian demand has increased exports through the Pacific Northwest (PNW).
    - Increasingly, shuttle trains are delivering soybeans to East St. Louis to be transloaded onto barge. As the dependability of the locks continues to erode and as deeper hull barges become a greater percentage of the fleet, more soybeans will be loaded downriver from locks at deeper water terminals downriver from St. Louis.
    - Export elevators located at Texas and Louisiana ports do receive shuttle trains of soybeans for loading onto ocean going vessels.
    - Crushers typically have the ability to receive shuttle trains especially those located outside the Corn Belt and ship products out by unit train.
    - Approximately one-third of shuttle train moves have a backhaul. Fertilizer is cited as the primary backhaul. Crushing plants can ship out products.

- In addition, empty cars will be attached to the end of the train that is moving products. In effect only a-third of the train is coming back empty.

Table 38: U.S. Distribution of Soybeans from Rail Shuttle Elevators

	Thousand Bushels	Average Distance (Miles)	Total Ton-Miles (Thousands)	Truck Ton-Miles (Thousands)	Rail Ton-Miles (Thousands)	Barge Ton-Miles (Thousands)
Shuttle Elevator	925,155	1,323	36,706,218	-	36,706,218	-
Barge Terminal	64,761	400	777,130	-	777,130	-
Crushing Plant	74,012	600	1,332,223	-	1,332,223	-
Export	786,382	1,467	34,596,865	-	34,596,865	-
PNW	416,782	1,700	21,255,899	-	21,255,899	-
Mexico	196,595	1,600	9,436,581	-	9,436,581	-
Canada	23,591	400	283,097	-	283,097	-
Texas / Louisiana	94,366	900	2,547,877	-	2,547,877	-
East Coast	55,047	650	1,073,411	-	1,073,411	-

Source: USDA, USACOE, USITC, Informa

- Soybean barge movements to crushing plants and to export position in the Center Gulf are shown in Table 39. An estimated 90% of the soybean barge movements are to export position in the Center Gulf.

- Equipment flexibility allows greater backhaul opportunities for barge than rail. Informa assumed that one-third of the downbound soybean moves have corresponding upbound moves. The upbound moves include other commodities that depend on backhaul pricing, such as road salt, and other commodities that are considered high value, such as steel, iron ore, pig iron and fertilizer.

Table 39: U.S. Distribution of Soybeans from Barge Terminals

	Thousand Bushels	Average Distance (Miles)	Total Ton-Miles (Thousands)	Truck Ton-Miles (Thousands)	Rail Ton-Miles (Thousands)	Barge Ton-Miles (Thousands)
Barge Terminal	749,511	954	21,439,758	-	-	21,439,758
Crushing Plant	74,951	535	1,202,965	-	-	1,202,965
Export	674,560	1,000	20,236,793	-	-	20,236,793

Source: USDA, USACOE, USITC, Informa

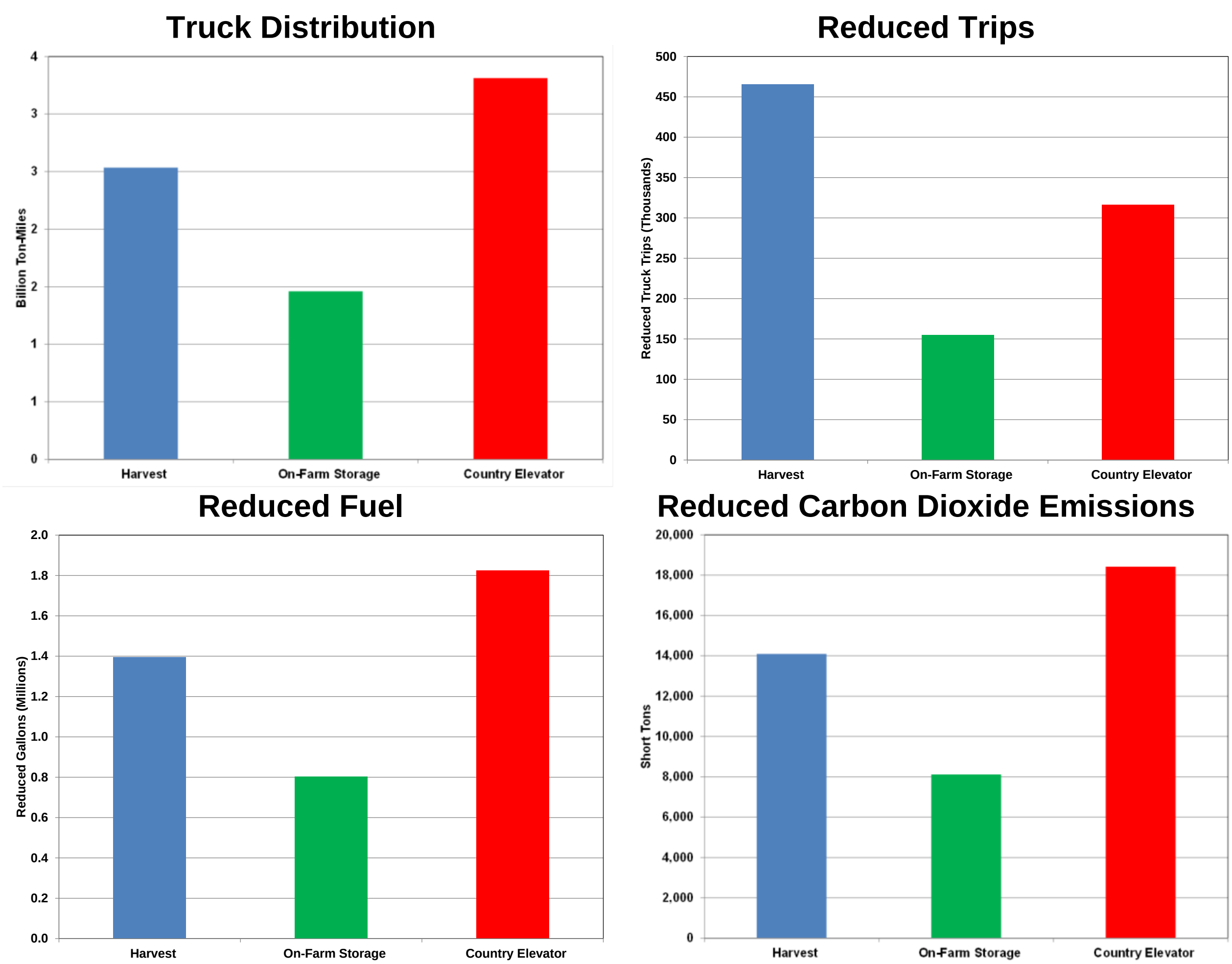
- The journey from farm to crushing plant or export position requires soybeans to be handled 2.4 times, travel an average distance of 667 miles which amounts to 66 billion ton-miles, as shown in Table 40.
    - So, by mode, the average move from farm to market requires 74 miles by truck, 377 miles by rail, and 217 miles by barge.

Table 40: U.S. Soybean Distribution Summary for Farm to Crushing Plant or Export Position

	Thousand Bushels	Average Distance (Miles)	Total Ton-Miles (Thousands)	Truck Ton-Miles (Thousands)	Rail Ton-Miles (Thousands)	Barge Ton-Miles (Thousands)
Total	3,300,000	667	66,037,638	7,307,165	37,290,714	21,439,758
Harvest	3,300,000	26	2,534,771	2,534,771	-	-
On-Farm Storage	825,000	59	1,460,250	1,460,250	-	-
Country Elevator	1,980,000	66	3,896,640	3,312,144	584,496	-
Barge Terminal	749,511	954	21,439,758	-	-	21,439,758
Shuttle Elevator	925,155	1,323	36,706,218	-	36,706,218	-

Source: USDA, USACOE, USITC, Informa

Figure 20: U.S. Soybean Summary for Farm to Crushing Plant or Export Position, and Reduced Trips, Fuel Consumption and Carbon Dioxide Emissions using Higher Truck Weights to 97,000 Pounds



Source: USDA, USACOE, USITC, Informa

- Higher truck weights could reduce the number of truck trips required to move soybeans from farm to crushing plant or export position by approximately 937 thousand.

Table 41: U.S. Soybeans Summary for Farm to Crushing Plant or Export Position Reduced Trips using Higher Truck Weights

	Average Distance (Miles)	Truck Ton-Miles (Thousands)	Truck Trips (80,000 LB GW)	Truck Trips (97,000 LB GW)	Reduced Trips (Thousands)
Total	667	7,307,165	5,537	4,600	937
Harvest	26	2,534,771	2,750	2,285	465
On-Farm Storage	59	1,460,250	917	762	155
Country Elevator	66	3,312,144	1,870	1,554	316
Barge Terminal	954	-	-	-	-
Shuttle Elevator	1,323	-	-	-	-

Source: USDA, USACOE, USITC, Informa

- Higher truck weights could reduce fuel consumption and carbon dioxide emissions required to move soybeans from farm to crushing plant or export position soybeans 4 million gallons and 41 thousand tons, respectively.

Table 42: U.S. Soybean Summary for Farm to Crushing Plant or Export Position, Reduced Fuel and Carbon Emissions using Higher Truck Weights

	Truck Ton-Miles (Thousands)	Truck (80,000 LB) (Gallons)	Truck (97,000 LB) (Gallons)	Reduced Fuel (Gallons)	Reduced Emissions (Tons)
Total	7,307,165	48,714,435	44,692,142	4,022,293	40,642
Harvest	2,534,771	16,898,475	15,503,188	1,395,287	14,098
On-Farm Storage	1,460,250	9,735,000	8,931,193	803,807	8,122
Country Elevator	3,312,144	22,080,960	20,257,761	1,823,199	18,422
Barge Terminal	-	-	-	-	-
Shuttle Elevator	-	-	-	-	-

Source: USDA, USACOE, USITC, Informa

- Higher truck weights would save the soybean stakeholders \$8 million to \$20 million, depending on the price of fuel or \$0.002 per bushel to \$0.006 per bushel.

Table 43: U.S. Soybean Summary for Farm to Crushing Plant or Export Position, Reduced Fuel Expense using Higher Truck Weights to 97,000 Pounds

	Reduced Fuel (Gallons)	Reduced Fuel Savings (\$2 per Gallon)	Reduced Fuel Savings (\$3 per Gallon)	Reduced Fuel Savings (\$4 per Gallon)	Reduced Fuel Savings (\$5 per Gallon)
Total	4,022,293	\$8,044,586	\$12,066,878	\$16,089,171	\$20,111,464
Harvest	1,395,287	\$2,790,574	\$4,185,861	\$5,581,148	\$6,976,435
On-Farm Storage	803,807	\$1,607,615	\$2,411,422	\$3,215,229	\$4,019,037
Country Elevator	1,823,199	\$3,646,397	\$5,469,596	\$7,292,794	\$9,115,993
Barge Terminal	-	\$0	\$0	\$0	\$0
Shuttle Elevator	-	\$0	\$0	\$0	\$0

Source: USDA, USACOE, USITC, Informa

b) Soybean Meal Value Chain

- Soybean meal is a dense product that would benefit from higher truck weights. For example, nearby animal operations could reduce their truck trips by 20%. In rural areas that often struggle to find qualified labor, labor savings are important.

- Soybean crushing plants in the United States produce approximately 41 million short tons of soybean meal annually.
  - Utilizing Army Corps of Engineers *Waterborne Commerce of the United States* and railroad *Public Use Waybill* data, 24 million short tons to 25 million are moved by barge and rail.
    - Barge moves 10%, rail moves 50% and the remaining 40% is moved by truck into the local markets.
    - Crushing plant capabilities to load out varies by facility, but most soybean meal that is exported by barge is either loaded directly into the barge or is a short drive.
      - The crushing industry is an oligopoly, which allows companies to pick the most efficient route.
      - Local moves are within 200 miles because animal units and crusher gravitate towards each other.
  - Crushing plants receive approximately 15% of feedstocks by rail and 5% by barge. This translates into a 40% and 50% backhaul for meal rail and barge shipments, respectively.
  - Crushing plants are primarily located in production regions to take advantage of abundant soybean supplies.

Table 44: U.S. Crushing Plant Soybean Meal Marketing Pipeline

	Thousand Short Tons	Average Distance (Miles)	Total Ton-Miles (Thousands)	Truck Ton-Miles (Thousands)	Rail Ton-Miles (Thousands)	Barge Ton-Miles (Thousands)
Soybean Meal Production	40,799	42	1,693,164	1,662,564	30,599	-
Local	16,320	100	1,631,965	1,631,965	-	-
River Terminal	4,080	15	61,199	30,599	30,599	-
Rail Terminal	20,400	-	-	-	-	-

Source: USDA, USACOE, USITC, AAR, Informa

- Higher truck weights could reduce the number of truck trips required for first move soybean meal by approximately 115 thousand.

Table 45: U.S. Crushing Plant Soybean Meal Reduced Trips using Higher Truck Weights

	Average Distance (Miles)	Truck Ton-Miles (Thousands)	Truck Trips (80,000 LB GW)	Truck Trips (97,000 LB GW)	Reduced Trips (Thousands)
Soybean Meal Production	42	1,662,564	680	565	115
Local	100	1,631,965	604	502	102
River Terminal	15	30,599	76	63	13
Rail Terminal	-	-	-	-	-

Source: USDA, USACOE, USITC, Informa

- Higher truck weights could reduce fuel consumption and carbon emissions for the first move of soybean meal by 916 thousand gallons and 9 thousand tons, respectively.

Table 46: U.S. Crushing Plant Soybean Meal Reduced Fuel and Carbon Dioxide Emissions using Higher Truck Weights

	Truck Ton-Miles (Thousands)	Truck (80,000 LB) (Gallons)	Truck (97,000 LB) (Gallons)	Reduced Fuel (Gallons)	Reduced Emissions (Tons)
Soybean Meal Production	1,662,564	11,083,762	10,168,589	915,173	9,247
Local	1,631,965	10,879,766	9,981,437	898,329	9,077
River Terminal	30,599	203,996	187,152	16,844	170
Rail Terminal	-	-	-	-	-

Source: USDA, USACOE, USITC, Informa

- Higher truck weights would save the crushing plant $2 million to $6 million annually, depending on the price of fuel.

Table 47: U.S. Crushing Plant Soybean Meal Reduced Fuel Expense using Higher Truck Weights to 97,000 Pounds

	Reduced Fuel (Gallons)	Reduced Fuel Savings ($2 per Gallon)	Reduced Fuel Savings ($3 per Gallon)	Reduced Fuel Savings ($4 per Gallon)	Reduced Fuel Savings ($5 per Gallon)
Soybean Meal Production	915,173	$1,830,346	$2,745,519	$3,660,692	$4,575,865
Local	898,329	$1,796,659	$2,694,988	$3,593,317	$4,491,647
River Terminal	16,844	$33,687	$50,531	$67,375	$84,218
Rail Terminal	-	$0	$0	$0	$0

Source: USDA, USACOE, USITC, Informa

- Rail movements of soybean meal are 25% to export and 75% to domestic locations.
  - About 40% of rail exports are delivered to the Mexican and Canadian animal markets.
  - Domestic soybean meal is prominently sent towards the poultry and swine markets.

Table 48: U.S. Distribution of Soybean Meal by Rail to Market Position

	Thousand Short Tons	Average Distance (Miles)	Total Ton-Miles (Thousands)	Truck Ton-Miles (Thousands)	Rail Ton-Miles (Thousands)	Barge Ton-Miles (Thousands)
Rail	20,400	858	17,498,234	-	17,498,234	-
Domestic	15,300	773	11,825,116	-	11,825,116	-
Delta	3,825	590	2,256,702	-	2,256,702	-
East Coast	1,530	890	1,361,671	-	1,361,671	-
Southeast	3,060	600	1,835,961	-	1,835,961	-
Midwest	1,836	135	247,855	-	247,855	-
Southwest	2,754	890	2,451,007	-	2,451,007	-
West Coast	1,836	2,000	3,671,921	-	3,671,921	-
Export	5,100	1,112	5,673,118	-	5,673,118	-
Container	204	1,405	286,614	-	286,614	-
East Coast	1,224	890	1,089,337	-	1,089,337	-
PNW	1,530	1,700	2,600,944	-	2,600,944	-
Canada	1,122	430	482,450	-	482,450	-
Mexico	1,020	1,190	1,213,774	-	1,213,774	-

Source: USDA, USACOE, USITC, AAR, Informa

- The rail terminal at destination to end user is typically 0 miles to 150 miles and 100% is delivered by truck. The moves are programmed, which reduces the wait time to unload and allows soybean meal to be a backhaul. The backhaul moves are less expensive than deadhead moves, but are also longer distances, which offsets the emission savings from avoiding deadhead moves. The report assumes no backhaul moves for the purpose of emissions.

Table 49: U.S. Domestic Moves of Soybean Meal to Animal Operations or Feed Manufacturer

	Thousand Short Tons	Average Distance (Miles)	Total Ton-Miles (Thousands)	Truck Ton-Miles (Thousands)	Rail Ton-Miles (Thousands)	Barge Ton-Miles (Thousands)
Domestic	15,300	55	833,832	833,832	-	-
Delta	3,825	50	191,246	191,246	-	-
East Coast	1,530	50	76,498	76,498	-	-
Southeast	3,519	50	175,946	175,946	-	-
Midwest	1,836	25	45,899	45,899	-	-
Southwest	2,754	75	206,546	206,546	-	-
West Coast	1,836	75	137,697	137,697	-	-

Source: USDA, USACOE, USITC, AAR, Informa

- Higher truck weights could reduce the number of truck trips required to move soybean meal to animal operations or feed manufacturer by approximately 96 thousand.

Table 50: U.S. Domestic Moves of Soybean Meal to Animal Operations or Feed Manufacturer Reduced Trips using Higher Truck Weights

	Average Distance (Miles)	Truck Ton-Miles (Thousands)	Truck Trips (80,000 LB GW)	Truck Trips (97,000 LB GW)	Reduced Trips (Thousands)
Domestic	55	833,832	567	471	96
Delta	50	191,246	142	118	24
East Coast	50	76,498	57	47	10
Southeast	50	175,946	130	108	22
Midwest	25	45,899	68	56	12
Southwest	75	206,546	102	85	17
West Coast	75	137,697	68	56	12

Source: USDA, USACOE, USITC, Informa

- Higher truck weights could reduce fuel consumption and carbon emissions required to move soybean meal to animal operations or feed manufacturer of soybean meal is 459 thousand gallons and 5 thousand tons, respectively.

Table 51: U.S. Domestic Moves of Soybean Meal to Animal Operations or Feed Manufacturer Reduced Fuel and Carbon Dioxide Emissions using Higher Truck Weights

	Truck Ton-Miles (Thousands)	Truck (80,000 LB) (Gallons)	Truck (97,000 LB) (Gallons)	Reduced Fuel (Gallons)	Reduced Emissions (Tons)
Domestic	833,832	5,558,881	5,099,890	458,990	4,638
Delta	191,246	1,274,973	1,169,700	105,273	1,064
East Coast	76,498	509,989	467,880	42,109	425
Southeast	175,946	1,172,975	1,076,124	96,851	979
Midwest	45,899	305,993	280,728	25,266	255
Southwest	206,546	1,376,970	1,263,276	113,695	1,149
West Coast	137,697	917,980	842,184	75,797	766

Source: USDA, USACOE, USITC, Informa

- Higher truck weights would save the feed market $1 million to $2 million, depending on the price of fuel.

Table 52: U.S. Domestic Moves of Soybean Meal to Animal Operations or Feed Manufacturer Reduced Fuel Expense using Higher Truck Weights to 97,000 Pounds

	Reduced Fuel (Gallons)	Reduced Fuel Savings ($2 per Gallon)	Reduced Fuel Savings ($3 per Gallon)	Reduced Fuel Savings ($4 per Gallon)	Reduced Fuel Savings ($5 per Gallon)
Domestic	458,990	$917,980	$1,376,970	$1,835,961	$2,294,951
Delta	105,273	$210,546	$315,819	$421,092	$526,365
East Coast	42,109	$84,218	$126,328	$168,437	$210,546
Southeast	96,851	$193,702	$290,553	$387,405	$484,256
Midwest	25,266	$50,531	$75,797	$101,062	$126,328
Southwest	113,695	$227,390	$341,084	$454,779	$568,474
West Coast	75,797	$151,593	$227,390	$303,186	$378,983

Source: USDA, USACOE, USITC, Informa

- River terminals were assumed to handle soybean meal for export. Equipment flexibility allows greater backhaul opportunities for barge than rail. Additionally, tow configurations for empty barges is 45 barges versus 30 barges when fully laden. This effectively reduces the backhaul by one-third. For the calculation for emissions, one-third has backhauls, one-third is moved by a larger tow configuration, and one-third is a deadhead move.

Table 53: U.S. Distribution of Soybean Meal from River Terminals

	Thousand Short Tons	Average Distance (Miles)	Total Ton-Miles (Thousands)	Truck Ton-Miles (Thousands)	Rail Ton-Miles (Thousands)	Barge Ton-Miles (Thousands)
River Terminal	4,080	1,000	4,079,912	-	-	4,079,912
Export	4,080	1,000	4,079,912	-	-	4,079,912

Source: USDA, USACOE, USITC, AAR, Informa

- The soybean meal journey from crushing plant to end user or export position requires it being handled twice; travel an average distance of 590 miles which amounts to 24 billion ton-miles as shown in Table 54.

- The average move from crushing plant to market requires 60 miles by truck, 430 miles by rail, and 100 miles by barge.

Table 54: U.S. Soybean Meal Distribution Summary to End User or Export Position

	Thousand Short Tons	Average Distance (Miles)	Total Ton-Miles (Thousands)	Truck Ton-Miles (Thousands)	Rail Ton-Miles (Thousands)	Barge Ton-Miles (Thousands)
Total	40,799	590	24,082,193	2,473,447	17,528,833	4,079,912
Crushing Plant	40,799	42	1,693,164	1,662,564	30,599	-
Barge Terminal	4,080	1,000	4,079,912	-	-	4,079,912
Rail	20,400	858	17,498,234	-	17,498,234	-
Domestic	15,300	53	810,883	810,883	-	-

Source: USDA, USACOE, USITC, AAR, Informa

- Higher truck weights could reduce the number of truck trips required to move soybean meal is approximately 211 thousand.

Table 55: U.S. Soybean Meal Summary Reduced Trips using Higher Truck Weights

	Average Distance (Miles)	Truck Ton-Miles (Thousands)	Truck Trips (80,000 LB GW)	Truck Trips (97,000 LB GW)	Reduced Trips (Thousands)
Total	591	2,496,396	1,247	1,036	211
Crushing Plant	42	1,662,564	680	565	115
Barge Terminal	1,000	-	-	-	-
Rail	858	-	-	-	-
Domestic	55	833,832	567	471	96

Source: USDA, USACOE, USITC, Informa

- Higher truck weights could reduce fuel consumption and carbon dioxide emissions required to move soybean meal by 1 million gallons and 14 thousand tons, respectively.

Table 56: U.S. Soybean Meal Summary Reduced Fuel and Carbon Dioxide Emissions using Higher Truck Weights

	Truck Ton-Miles (Thousands)	Truck (80,000 LB) (Gallons)	Truck (97,000 LB) (Gallons)	Reduced Fuel (Gallons)	Reduced Emissions (Tons)
Total	2,496,396	16,642,643	15,268,479	1,374,163	13,885
Crushing Plant	1,662,564	11,083,762	10,168,589	915,173	9,247
Barge Terminal	-	-	-	-	-
Rail	-	-	-	-	-
Domestic	833,832	5,558,881	5,099,890	458,990	4,638

Source: USDA, USACOE, USITC, Informa

- Higher truck weights would save the feed market $3 million to $7 million, depending on the price of fuel.

Table 57: U.S. Soybean Meal Summary Reduced Fuel Expense using Higher Truck Weights to 97,000 Pounds

	Reduced Fuel (Gallons)	Reduced Fuel Savings ($2 per Gallon)	Reduced Fuel Savings ($3 per Gallon)	Reduced Fuel Savings ($4 per Gallon)	Reduced Fuel Savings ($5 per Gallon)
Total	1,374,163	$2,748,326	$4,122,489	$5,496,653	$6,870,816
Crushing Plant	915,173	$1,830,346	$2,745,519	$3,660,692	$4,575,865
Barge Terminal	-	$0	$0	$0	$0
Rail	-	$0	$0	$0	$0
Domestic	458,990	$917,980	$1,376,970	$1,835,961	$2,294,951

Source: USDA, USACOE, USITC, Informa

c) Soybean Oil Value Chain

- About 10 million short tons of soybean oil is produced annually with 90% shipped to a refiner and 10% exported as crude oil.
  - Crude soybean oil is sometimes shipped to an adjacent building by pipeline, which is turned into an end product.
  - Refineries typically serve many functions, such as blending, hydrogenation, bottling, and of course refining. This requires vegetable oils to be shipped to a refinery, but because soybean oil is the largest, other vegetable oils make

to longer journey. For example, canola oil is shipped to the Midwest to be blended with soybean oil for foodservice operations.

- Approximately 85% to 90% of U.S. soybean oil exports are crude.

Table 58: U.S. Distribution of Soybean Oil from Crushing Plants

	Thousand Short Tons	Average Distance (Miles)	Total Ton-Miles (Thousands)	Truck Ton-Miles (Thousands)	Rail Ton-Miles (Thousands)	Barge Ton-Miles (Thousands)
Soybean Oil Production	9,605	110	1,054,606	86,443	199,780	768,383
Refinery	8,644	10	86,443	86,443	-	-
Export	960	1,008	968,163	-	199,780	768,383
Center Gulf	768	1,000	768,383	-	-	768,383
Mexico	96	1,190	114,297	-	114,297	-
East Coast	96	890	85,483	-	85,483	-

Source: USDA, USACOE, USITC, AAR, Informa

- Higher trucks weight reduces the number of truck trips required to move crude oil from the crushing plant to refinery or export position by 54 thousand.

Table 59: U.S. Crushing Plants Soybean Oil Reduced Trips using Higher Truck Weights

	Average Distance (Miles)	Truck Ton-Miles (Thousands)	Truck Trips (80,000 LB GW)	Truck Trips (97,000 LB GW)	Reduced Trips (Thousands)
Soybean Oil Production	110	86,443	320	266	54
Refinery	10	86,443	320	266	54
Export	1,008	-	-	-	-
Center Gulf	1,000	-	-	-	-
Mexico	1,190	-	-	-	-
East Coast	890	-	-	-	-

Source: USDA, USACOE, USITC, Informa

- Shipping crude oil by heavier trucks will save 48 thousand gallons and reduce carbon dioxide emissions by 881 tons.

Table 60: U.S. Crushing Plants Soybean Oil Reduced Fuel and Carbon Dioxide Emissions using Higher Truck Weights

	Truck Ton-Miles (Thousands)	Truck (80,000 LB) (Gallons)	Truck (97,000 LB) (Gallons)	Reduced Fuel (Gallons)	Reduced Emissions (Tons)
Soybean Oil Production	86,443	576,288	528,704	47,583	481
Refinery	86,443	576,288	528,704	47,583	481
Export	-	-	-	-	-
Center Gulf	-	-	-	-	-
Mexico	-	-	-	-	-
East Coast	-	-	-	-	-

Source: USDA, USACOE, USITC, Informa

- Shipping crude oil by heavier trucks would save crushing plants $95 thousand to $238 thousand, depending on the price of fuel. Crude oil is a small truck move.

Table 61: U.S. Crushing Plants Soybean Oil Reduced Fuel Expense using Higher Truck Weights to 97,000 Pounds

	Reduced Fuel (Gallons)	Reduced Fuel Savings ($2 per Gallon)	Reduced Fuel Savings ($3 per Gallon)	Reduced Fuel Savings ($4 per Gallon)	Reduced Fuel Savings ($5 per Gallon)
Soybean Oil Production	47,583	$95,167	$142,750	$190,334	$237,917
Refinery	47,583	$95,167	$142,750	$190,334	$237,917
Export	-	$0	$0	$0	$0
Center Gulf	-	$0	$0	$0	$0
Mexico	-	$0	$0	$0	$0
East Coast	-	$0	$0	$0	$0

Source: USDA, USACOE, USITC, Informa

- With manufacturing, the question always arises, "Is it less expensive to ship the product or the feedstocks?" In this case, should soybean oil be transported or have the manufacturing of finished goods near soybean oil source plants.
    - With biodiesel, the economics of transporting biodiesel favors centralized production and shipping the product to the end user.
    - Snack foods are in bags that are light and cube out before they weight out. So, the manufacturing tends to be located near the population centers.
    - Retail and foodservice operations are also located near the population centers.

- Refined vegetable oil exports are shipped to Mexico and Canada.

- Rail use is the primary shipping option for vegetable oil, but rapid expansion of crude oil production from the vast shale plays across North America is pressuring the tank market.

- It is assumed the local moves are 100% truck.

Table 62: U.S. Soybean Oil Distribution from Vegetable Oil Refinery to End User

	Thousand Short Tons	Average Distance (Miles)	Total Ton-Miles (Thousands)	Truck Ton-Miles (Thousands)	Rail Ton-Miles (Thousands)	Barge Ton-Miles (Thousands)
Refinery	8,644	392	3,389,915	161,325	3,159,471	65,697
Biodiesel	1,988	80	159,055	39,764	119,292	-
Local	1,591	25	39,764	39,764	-	-
Rail	398	300	119,292	-	119,292	-
Manufacturing	3,458	469	1,620,809	64,832	1,555,977	-
Local	864	75	64,832	64,832	-	-
Rail	2,593	600	1,555,977	-	1,555,977	-
Foodservice	1,729	469	810,404	32,416	777,988	-
Local	432	75	32,416	32,416	-	-
Rail	1,297	600	777,988	-	777,988	-
Retail	1,297	469	607,803	24,312	583,491	-
Local	324	75	24,312	24,312	-	-
Rail	972	600	583,491	-	583,491	-
Export	173	1,110	191,843	-	122,723	65,697
Center Gulf	69	1,000	69,155	-	35	65,697
Mexico	43	1,190	51,434	-	51,434	-
Canada	26	1,191	30,886	-	30,886	-
West Coast	9	2,000	17,289	-	17,289	-
East Coast	26	890	23,080	-	23,080	-

Source: USDA, USACOE, USITC, AAR, Informa

- Shipping refined oil by heavier trucks reduces the number of truck trips by 20 thousand.

- Due to refined oil average distance moved being almost 400 miles; truck is at a disadvantage to rail.

Table 63: U.S. Vegetable Oil Refinery Reduced Trips using Higher Truck Weights

	Average Distance (Miles)	Truck Ton-Miles (Thousands)	Truck Trips (80,000 LB GW)	Truck Trips (97,000 LB GW)	Reduced Trips (Thousands)
Refinery	392	161,325	119	99	20
Biodiesel	80	39,764	59	49	10
Local	25	39,764	59	49	10
Rail	300	-	-	-	-
Manufacturing	469	64,832	32	27	5
Local	75	64,832	32	27	5
Rail	600	-	-	-	-
Foodservice	469	32,416	16	13	3
Local	75	32,416	16	13	3
Rail	600	-	-	-	-
Retail	469	24,312	12	10	2
Local	75	24,312	12	10	2
Rail	600	-	-	-	-
Export	1,110	-	-	-	-
Center Gulf	1,000	-	-	-	-
Mexico	1,190	-	-	-	-
Canada	1,191	-	-	-	-
West Coast	2,000	-	-	-	-
East Coast	890	-	-	-	-

Source: USDA, USACOE, USITC, Informa

- Shipping refined oil by heavier trucks saves 89 thousand gallons and reduces carbon dioxide emissions by 897 tons.

Table 64: U.S. Vegetable Oil Refinery Reduced Fuel and Carbon Dioxide Emissions using Higher Weight Trucks

	Truck Ton-Miles (Thousands)	Truck (80,000 LB) (Gallons)	Truck (97,000 LB) (Gallons)	Reduced Fuel (Gallons)	Reduced Emissions (Tons)
Refinery	161,325	1,075,497	986,694	88,802	897
Biodiesel	39,764	265,092	243,204	21,888	221
Local	39,764	265,092	243,204	21,888	221
Rail	-	-	-	-	-
Manufacturing	64,832	432,216	396,528	35,688	361
Local	64,832	432,216	396,528	35,688	361
Rail	-	-	-	-	-
Foodservice	32,416	216,108	198,264	17,844	180
Local	32,416	216,108	198,264	17,844	180
Rail	-	-	-	-	-
Retail	24,312	162,081	148,698	13,383	135
Local	24,312	162,081	148,698	13,383	135
Rail	-	-	-	-	-
Export	-	-	-	-	-
Center Gulf	-	-	-	-	-
Mexico	-	-	-	-	-
Canada	-	-	-	-	-
West Coast	-	-	-	-	-
East Coast	-	-	-	-	-

Source: USDA, USACOE, USITC, Informa

- Higher truck weights would save refineries $178 thousand to $444 thousand, depending on the price of fuel.

Table 65: U.S. Vegetable Oil Refinery Reduced Fuel Expense using Higher Truck Weights to 97,000 Pounds

	Reduced Fuel (Gallons)	Reduced Fuel Savings ($2 per Gallon)	Reduced Fuel Savings ($3 per Gallon)	Reduced Fuel Savings ($4 per Gallon)	Reduced Fuel Savings ($5 per Gallon)
Refinery	88,802	$177,605	$266,407	$355,210	$444,012
Biodiesel	21,888	$43,777	$65,665	$87,553	$109,442
Local	21,888	$43,777	$65,665	$87,553	$109,442
Rail	-	$0	$0	$0	$0
Manufacturing	35,688	$71,375	$107,063	$142,750	$178,438
Local	35,688	$71,375	$107,063	$142,750	$178,438
Rail	-	$0	$0	$0	$0
Foodservice	17,844	$35,688	$53,531	$71,375	$89,219
Local	17,844	$35,688	$53,531	$71,375	$89,219
Rail	-	$0	$0	$0	$0
Retail	13,383	$26,766	$40,148	$53,531	$66,914
Local	13,383	$26,766	$40,148	$53,531	$66,914
Rail	-	$0	$0	$0	$0
Export	-	$0	$0	$0	$0
Center Gulf	-	$0	$0	$0	$0
Mexico	-	$0	$0	$0	$0
Canada	-	$0	$0	$0	$0
West Coast	-	$0	$0	$0	$0
East Coast	-	$0	$0	$0	$0

Source: USDA, USACOE, USITC, Informa

- The soybean oil journey from crushing plant to end user or export position requires it being handled 1.9 times; travel an average distance of 463 miles which amounts to 4.5 billion ton-miles as shown in Table 66.

- The average move from crushing plant to market requires 26 miles by truck, 350 miles by rail, and 87 miles by barge.

Table 66: U.S. Distribution of Soybean Oil from Crushing Plant to End User or Export Position

	Thousand Short Tons	Average Distance (Miles)	Total Ton-Miles (Thousands)	Truck Ton-Miles (Thousands)	Rail Ton-Miles (Thousands)	Barge Ton-Miles (Thousands)
Total	9,605	463	4,444,522	247,768	3,359,251	834,080
Crushing Plant	9,605	110	1,054,606	86,443	199,780	768,383
Refinery	8,644	392	3,389,915	161,325	3,159,471	65,697

Source: USDA, USACOE, USITC, AAR, Informa

- U.S. distribution of soybean oil from crushing plant to end user or export position requires 439 thousand truck trips. An increase in truck weights would save 74 thousand trips.

- Refineries have indicated a willingness to invest in larger tank trucks if the gross truck weight is increased to 97,000 pounds.

Table 67: U.S. Soybean Oil from Crushing Plant to End User or Export Position Reduced Trips using Higher Truck Weights

	Average Distance (Miles)	Truck Ton-Miles (Thousands)	Truck Trips (80,000 LB GW)	Truck Trips (97,000 LB GW)	Reduced Trips (Thousands)
Total	463	247,768	439	365	74
Crushing Plant	110	86,443	320	266	54
Refinery	392	161,325	119	99	20

Source: USDA, USACOE, USITC, Informa

- U.S. distribution of soybean oil from crushing plant to end user or export position requires 1.6 million gallons of fuel. An increase in truck weights would save 136 thousand gallons and reduce carbon dioxide emissions by 1,478 tons.

Table 68: U.S. Soybean Oil from Crushing Plant to End User or Export Position Reduced Fuel and Carbon Dioxide Emissions using Higher Truck Weights

	Truck Ton-Miles (Thousands)	Truck (80,000 LB) (Gallons)	Truck (97,000 LB) (Gallons)	Reduced Fuel (Gallons)	Reduced Emissions (Tons)
Total	247,768	1,651,784	1,515,399	136,386	1,378
Crushing Plant	86,443	576,288	528,704	47,583	481
Refinery	161,325	1,075,497	986,694	88,802	897

Source: USDA, USACOE, USITC, Informa

- Higher truck weights would save crushing plants and refineries $272 thousand to $682 thousand, depending on the price of fuel.

Table 69: U.S. Soybean Oil from Crushing Plant to End User or Export Position Reduced Fuel Expense using Higher Truck Weights to 97,000 Pounds

	Reduced Fuel (Gallons)	Reduced Fuel Savings ($2 per Gallon)	Reduced Fuel Savings ($3 per Gallon)	Reduced Fuel Savings ($4 per Gallon)	Reduced Fuel Savings ($5 per Gallon)
Total	136,386	$272,772	$409,158	$545,543	$681,929
Crushing Plant	47,583	$95,167	$142,750	$190,334	$237,917
Refinery	88,802	$177,605	$266,407	$355,210	$444,012

Source: USDA, USACOE, USITC, Informa

d) Soybean and Soybean Product Value Chain Summary

- Assuming soybean meal and soybean oil are a continuation of the soybean, the average distance traveled to an end user or export position is 955 miles. Truck accounts for 101 miles, rail 588 and barge 266.

- Transporting soybeans requires an average move of 667 miles, soybean meal requires 590 miles and soybean oil requires 463 miles.

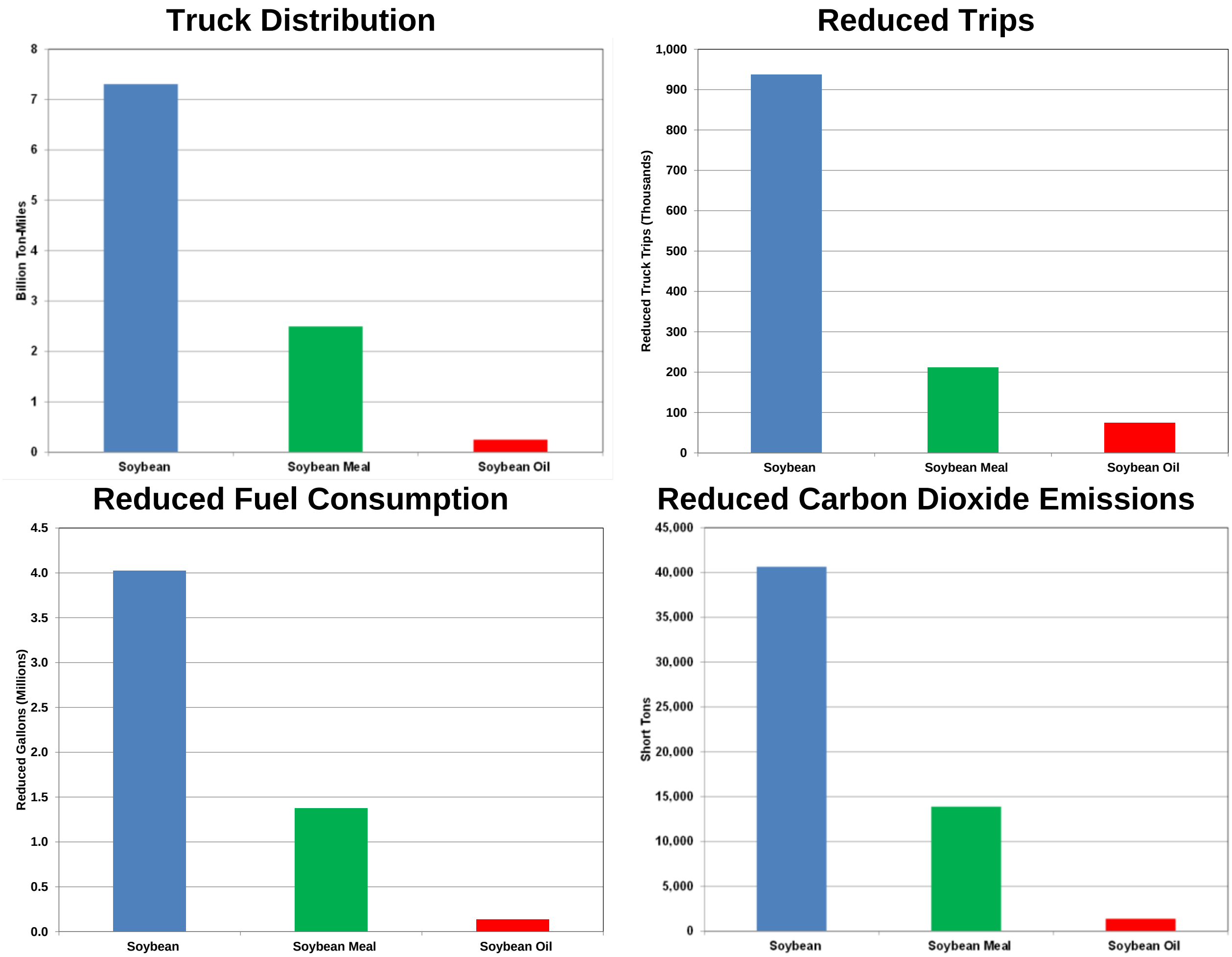
- Soybeans account for approximately 70% of the ton-miles while the soybean products account for remaining 30%.

Table 70: U.S. Distribution of Combined Soybean and Soybean Products by Mode

	Thousand Short Tons	Average Distance (Miles)	Total Ton-Miles (Thousands)	Truck Ton-Miles (Thousands)	Rail Ton-Miles (Thousands)	Barge Ton-Miles (Thousands)
Total	99,000	955	94,564,352	10,028,380	58,178,799	26,353,751
Soybean	99,000	667	66,037,638	7,307,165	37,290,714	21,439,758
Soybean Meal	40,799	590	24,082,193	2,473,447	17,528,833	4,079,912
Soybean Oil	9,605	463	4,444,522	247,768	3,359,251	834,080

Source: USDA, USACOE, USITC, AAR, Informa

Figure 21: U.S. Combined Soybean and Soybean Products Distribution by Truck, and Reduced Trips, Fuel Consumption and Carbon Dioxide Emissions using Higher Truck Weights to 97,000 Pounds



Source: USDA, USACOE, USITC, Informa

- U.S. distribution of soybean and soybean products with heavier trucks could reduce truck traffic by 1.2 million trips.
    - Moving soybeans requires the most truck handling.

Table 71: U.S. Combined Soybean and Soybean Products Reduced Trips using Higher Truck Weights

	Average Distance (Miles)	Truck Ton-Miles (Thousands)	Truck Trips (80,000 LB GW)	Truck Trips (97,000 LB GW)	Reduced Trips (Thousands)
Total	955	10,051,329	7,222	6,000	1,222
Soybean	667	7,307,165	5,537	4,600	937
Soybean Meal	591	2,496,396	1,247	1,036	211
Soybean Oil	463	247,768	439	365	74

Source: USDA, USACOE, USITC, Informa

- U.S. distribution of soybean and soybean products with heavier trucks could reduce fuel and carbon dioxide emissions by 6 million and 56 thousand tons, respectively.

Table 72: U.S. Combined Soybean and Soybean Products Reduced Fuel and Carbon Dioxide Emissions using Higher Truck Weights

	Truck Ton-Miles (Thousands)	Truck (80,000 LB) (Gallons)	Truck (97,000 LB) (Gallons)	Reduced Fuel (Gallons)	Reduced Emissions (Tons)
Total	10,051,329	67,008,862	61,476,020	5,532,842	55,904
Soybean	7,307,165	48,714,435	44,692,142	4,022,293	40,642
Soybean Meal	2,496,396	16,642,643	15,268,479	1,374,163	13,885
Soybean Oil	247,768	1,651,784	1,515,399	136,386	1,378

Source: USDA, USACOE, USITC, Informa

- Higher truck weights would save the soybean industry $11 million to $28 million, depending on the price of fuel.

Table 73: U.S. Combined Soybean and Soybean Products Reduced Fuel Expense using Higher Truck Weights to 97,000 Pounds

	Reduced Fuel (Gallons)	Reduced Fuel Savings ($2 per Gallon)	Reduced Fuel Savings ($3 per Gallon)	Reduced Fuel Savings ($4 per Gallon)	Reduced Fuel Savings ($5 per Gallon)
Total	5,532,842	$11,065,684	$16,598,525	$22,131,367	$27,664,209
Soybean	4,022,293	$8,044,586	$12,066,878	$16,089,171	$20,111,464
Soybean Meal	1,374,163	$2,748,326	$4,122,489	$5,496,653	$6,870,816
Soybean Oil	136,386	$272,772	$409,158	$545,543	$681,929

Source: USDA, USACOE, USITC, Informa

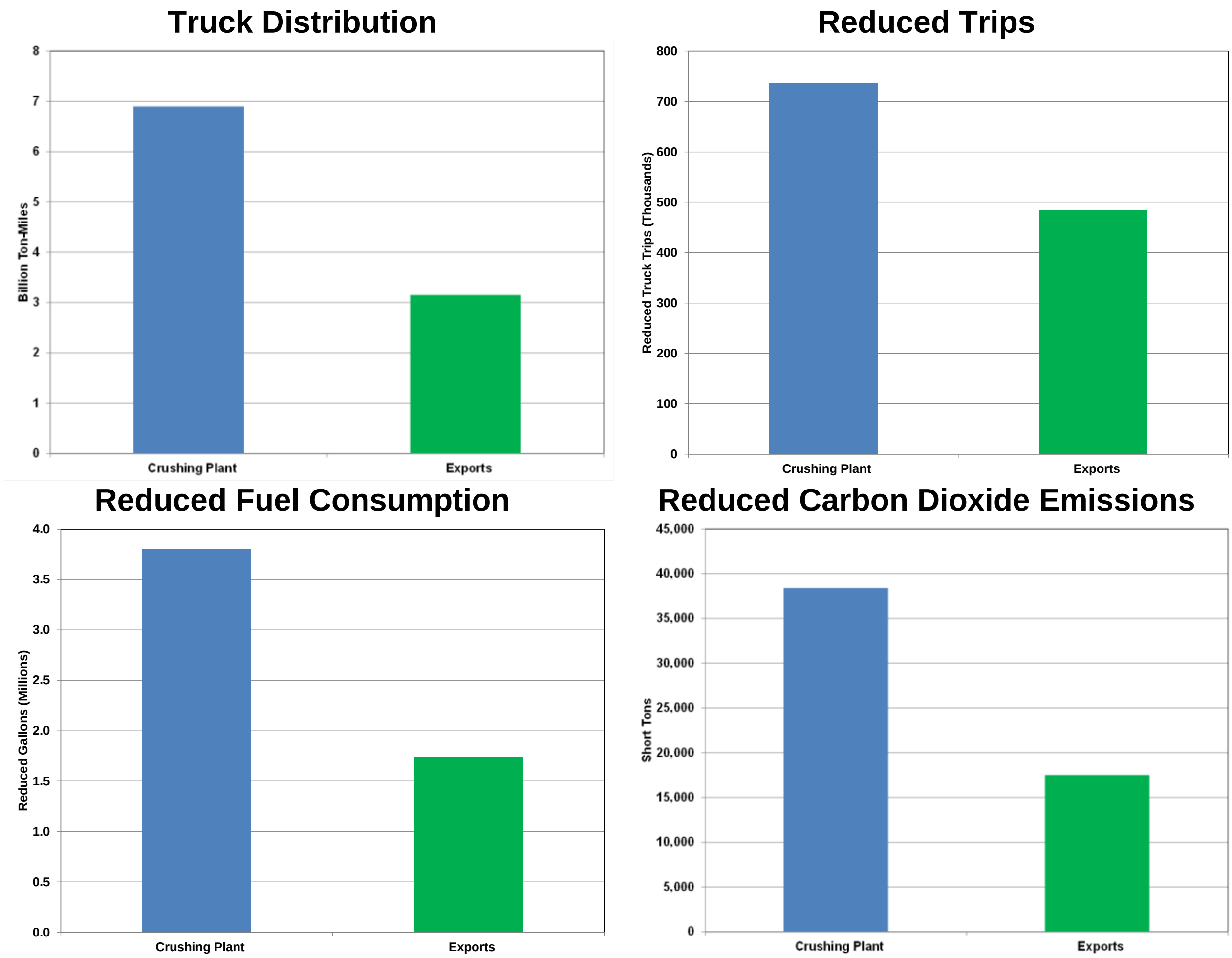
- When accounting for the soybean moves as to export or crushing plant, the average distance is 699 miles and 1,227 mile; respectively.
    - The average move from farm through crushing plant to market position requires 135 miles by truck, 444 miles by rail, and 120 miles by barge.
    - The average move from farm to export position requires 66 miles by truck, 739 miles by rail, and 422 miles by barge.

Table 74: U.S. Distribution of Combined Soybean and Soybean Products to End User by Mode

	Thousand Bushels	Average Distance (Miles)	Total Ton-Miles (Thousands)	Truck Ton-Miles (Thousands)	Rail Ton-Miles (Thousands)	Barge Ton-Miles (Thousands)
Total	3,300,000	955	94,564,352	10,028,380	58,178,799	26,353,751
Crushing Plant	1,699,963	699	35,662,648	6,878,937	22,663,330	6,116,958
Soybean	1,699,963	140	7,135,934	4,157,723	1,775,246	1,202,965
Soybean Meal	1,359,971	590	24,082,193	2,473,447	17,528,833	4,079,912
Soybean Oil	320,160	463	4,444,522	247,768	3,359,251	834,080
Exports	1,600,037	1,227	58,901,704	3,149,442	35,515,468	20,236,793

Source: USDA, USACOE, USITC, AAR, Informa

Figure 22: U.S. Combined Soybean and Products to Export or Crushing Plant Distribution by Truck, and Reduced Trips, Fuel Consumption and Carbon Dioxide Emissions using Higher Truck Weights to 97,000 Pounds



Source: USDA, USACOE, USITC, Informa

- U.S. distribution of soybean and soybean products using heavier trucks could reduce truck traffic by 1.2 million trips.
    - Crushing plants that produce valued added products and jobs benefits significantly more than the export market.

Table 75: U.S. Combined Soybean and Soybean Products to End User Reduced Trips using Higher Truck Weights

	Average Distance (Miles)	Truck Ton-Miles (Thousands)	Truck Trips (80,000 LB GW)	Truck Trips (97,000 LB GW)	Reduced Trips (Thousands)
Total	955	10,051,329	7,222	6,000	1,222
Crushing Plant	700	6,901,887	4,355	3,618	737
Soybean	140	4,157,723	2,669	2,217	452
Soybean Meal	591	2,496,396	1,247	1,036	211
Soybean Oil	463	247,768	439	365	74
Exports	1,227	3,149,442	2,868	2,382	485

Source: USDA, USACOE, USITC, Informa

- U.S. distribution of soybean and soybean products using heavier trucks could reduce fuel and carbon dioxide emissions by 5.5 million and 56 thousand tons, respectively.
    - Crushing plants would save 4 million gallons and 38 thousand tons of fuel and carbon dioxide emissions, respectively.

Table 76: U.S. Combined Soybean and Soybean Products to End User Reduced Fuel and Carbon Dioxide Emissions using Higher Weight Trucks

	Truck Ton-Miles (Thousands)	Truck (80,000 LB) (Gallons)	Truck (97,000 LB) (Gallons)	Reduced Fuel (Gallons)	Reduced Emissions (Tons)
Total	10,051,329	67,008,862	61,476,020	5,532,842	55,904
Crushing Plant	6,901,887	46,012,579	42,213,375	3,799,204	38,387
Soybean	4,157,723	27,718,152	25,429,497	2,288,655	23,125
Soybean Meal	2,496,396	16,642,643	15,268,479	1,374,163	13,885
Soybean Oil	247,768	1,651,784	1,515,399	136,386	1,378
Exports	3,149,442	20,996,283	19,262,645	1,733,638	17,517

Source: USDA, USACOE, USITC, Informa

- Higher truck weights would save the soybean industry $11 million to $28 million, depending on the price of fuel.
    - Crushing plants save $11 million and exports moves save $19 million.

Table 77: U.S. Combined Soybean and Soybean Products Reduced to End User Fuel Expense using Higher Weight Trucks to 97,000 Pounds

	Reduced Fuel (Gallons)	Reduced Fuel Savings ($2 per Gallon)	Reduced Fuel Savings ($3 per Gallon)	Reduced Fuel Savings ($4 per Gallon)	Reduced Fuel Savings ($5 per Gallon)
Total	5,532,842	$11,065,684	$16,598,525	$22,131,367	$27,664,209
Crushing Plant	3,799,204	$7,598,408	$11,397,611	$15,196,815	$18,996,019
Exports	1,733,638	$3,467,276	$5,200,914	$6,934,552	$8,668,190

Source: USDA, USACOE, USITC, Informa

B. Soybean Production Forecast

- Since the 1990s, the area planted to soybeans has expanded from nearly 60 million acres in 1990 to about 75 million starting in 2000. Since 2000, there were two noticeable contractions in plantings first in 2005 and then 2007 to less than 65 million acres. During 2008, farmers planted nearly 76 million acres and have remained at that level. In 2013 through 2022, soybean acreage is expected to increase to over 90 million acres as shown in Table 78.

- Through 2022, changes in the twelve select states will vary little. Informa is assuming China will expand its consumption of corn and soybeans, and will drive world crop production. Another key driver for corn is ethanol production. Because ethanol has essentially reached the mandated level, U.S. acreage is expected to shift towards soybeans.

Table 78: Soybean Area Planted by Select States

	2001	2006	2012	2013	2014	2015	2016	2017	2022
Soybean Planted Area (Thousand Acres)									
OH	4,600	4,650	4,600	4,450	4,876	5,149	5,178	5,119	5,265
IN	5,600	5,700	5,150	5,200	5,698	6,016	6,050	5,982	6,152
IL	10,700	10,100	9,050	9,450	10,354	10,933	10,995	10,872	11,180
MN	7,300	7,350	7,050	6,700	7,341	7,752	7,795	7,708	7,927
IA	11,000	10,150	9,350	9,300	10,190	10,760	10,821	10,699	11,003
MO	4,950	5,150	5,400	5,600	6,136	6,479	6,516	6,442	6,625
ND	2,150	3,900	4,750	4,650	5,095	5,380	5,410	5,350	5,501
SD	4,500	3,950	4,750	4,600	5,040	5,322	5,352	5,292	5,442
NE	4,950	5,050	5,050	4,800	5,259	5,553	5,585	5,522	5,679
KS	2,850	3,150	4,000	3,600	3,945	4,165	4,189	4,142	4,259
KY	1,240	1,380	1,480	1,650	1,808	1,909	1,920	1,898	1,952
TN	1,070	1,160	1,260	1,560	1,709	1,805	1,815	1,795	1,846
U.S.	**74,075**	**75,522**	**77,198**	**76,493**	**83,814**	**88,500**	**89,000**	**88,000**	**90,500**
Selected States	**60,910**	**61,690**	**61,890**	**61,560**	**67,452**	**71,223**	**71,625**	**70,821**	**72,833**

Source: USDA and Informa Economics

Notes: Bold numbers represent Informa forecasted acres. Select Tot is the total amount for the 9 Midwestern states.

- By 2022, U.S. soybean yield is expected to increase to 48 bushels per acre as summarized in Table 79.

Table 79: Soybean Yield by Select States

	2001	2006	2012	2013	2014	2015	2016	2017	2022
Soybean Yield (Bushel per Acre)									
OH	41	47	45	49	51	51	51	52	54
IN	49	50	44	50	52	52	53	53	55
IL	45	48	43	49	51	51	51	52	54
MN	37	45	44	39	40	41	41	41	43
IA	44	51	45	45	47	47	47	48	50
MO	38	38	30	35	36	37	37	37	39
ND	34	32	35	30	31	31	32	32	33
SD	32	34	31	40	41	42	42	42	44
NE	46	50	42	52	54	54	55	55	58
KS	32	32	23	35	36	37	37	37	39
KY	40	44	40	49	51	51	51	52	54
TN	34	39	38	48	50	50	50	51	53
U.S.	**40**	**43**	**40**	**43**	**44**	**45**	**45**	**46**	**48**
Selected States	**41**	**44**	**39**	**43**	**45**	**45**	**46**	**46**	**48**

Source: Informa Economics

Notes: Bold numbers represent Informa's forecast. Select Ave is the average amount for the 9 Midwestern states.

- Total soybean production will expand from an estimated 3,033 million bushels in 2012 to 4,270 million bushels in 2022. Among the select states production will increase from 2,399 million bushels in 2012 to 3,472 million bushels in 2022 as shown in Table 80

Table 80: Soybean Production by Select States

	2001	2006	2012	2013	2014	2015	2016	2017	2022
Soybean Production (Thousand Bushels)									
OH	187,780	217,140	206,550	217,070	245,139	261,864	265,195	264,529	284,518
IN	273,910	284,000	226,160	259,000	292,491	312,446	316,421	315,626	339,477
IL	477,900	482,400	383,990	460,600	520,159	555,647	562,717	561,303	603,719
MN	266,400	322,625	304,500	258,570	292,005	311,927	315,896	315,102	338,913
IA	480,480	510,050	414,295	415,350	469,058	501,060	507,435	506,160	544,408
MO	186,200	194,180	158,100	193,900	218,973	233,912	236,888	236,293	254,149
ND	70,685	121,905	163,185	138,300	156,183	166,839	168,962	168,537	181,273
SD	143,040	130,900	143,960	182,000	205,534	219,557	222,350	221,791	238,551
NE	222,950	250,500	207,085	247,000	278,939	297,970	301,761	301,003	323,748
KS	87,360	98,560	85,725	123,900	139,921	149,467	151,369	150,989	162,398
KY	48,800	60,280	58,800	80,360	90,751	96,943	98,176	97,929	105,330
TN	35,360	44,070	46,740	72,960	82,394	88,016	89,135	88,912	95,630
U.S.	**2,890,682**	**3,196,726**	**3,033,581**	**3,257,746**	**3,679,000**	**3,930,000**	**3,980,000**	**3,970,000**	**4,270,000**
Selected States	**2,480,865**	**2,716,610**	**2,399,090**	**2,649,010**	**2,991,549**	**3,195,648**	**3,236,305**	**3,228,174**	**3,472,116**

Source: USDA and Informa Economics

C. Farmer Truck Trips and Fuel Savings Based on Soybean Production Forecast

- As soybean production has increased, the number of truck loads required to transport the harvest has increased as well. A typical semi-tractor trailer used to haul grain can be loaded with about 900 bushels of soybeans, which when combined with the weight of the truck and trailer is under the federal gross legal weight limit of 80,000 lbs.

- According to elevator operators about 90% of grain and soybeans are currently hauled in a semi-tractor trailer, and this has been increasing over time as more farmers have purchased larger trucks to more efficiently move their harvest.
- The remaining 10% of grain and soybeans are hauled in grain wagons or straight trucks (less than 80,000 lbs gross vehicle weight). By 2022 the amount of grain and soybeans hauled in semi-tractor trailers will virtually be 100%.

- Based on the soybean production forecast and the average semi-tractor trailer size of 80,000 lbs. (900 bushels per shipment), the number of semi-tractor trailer trips hauling soybeans to an initial storage location off-farm in the U.S. is forecast to increase 57% from 3.0 million in 2012 to 4.7 million and increase 63% among the select states from 2.4 million in 2012 to more than 3.9 million in 2022 as shown in Table 81.

Table 81: Number of Soybean Truck Loads Using Current Federal Weight Limit of 80,000 pounds by Select States from Farm

	2001	2006	2012	2013	2014	2015	2016	2017	2022
Truck Trips (Thousand)									
OH	146	191	207	219	251	271	277	279	316
IN	213	250	226	262	299	323	330	333	377
IL	372	424	384	466	532	574	588	592	671
MN	207	284	305	261	298	322	330	333	377
IA	374	448	414	420	479	518	530	534	605
MO	145	171	158	196	224	242	247	249	282
ND	55	107	163	140	160	172	176	178	201
SD	111	115	144	184	210	227	232	234	265
NE	173	220	207	250	285	308	315	318	360
KS	68	87	86	125	143	154	158	159	180
KY	38	53	59	81	93	100	103	103	117
TN	28	39	47	74	84	91	93	94	106
U.S.	**2,248**	**2,809**	**3,034**	**3,294**	**3,761**	**4,061**	**4,157**	**4,191**	**4,744**
Selected States	**1,930**	**2,387**	**2,399**	**2,678**	**3,058**	**3,302**	**3,380**	**3,408**	**3,858**

Source: Informa Economics

Notes: Based on 900 bushels per truck. Assumes 90% of soybeans were moved by semi-tractor trailer in 2012, 100% by 2022.

- There are many proposed higher federal truck weight limits. The consensus has focused on a 17,000 pound or 21% increase from 80,000 lbs. to 97,000 lbs. For many semi-tractor trailer configurations, a sixth axle will be required to properly distribute the weight across the trailer.

- According to trucking industry representatives, the new sixth axle and complementing equipment will add about 6,000 lbs. to the weight of the trailer. By adjusting for the sixth axle, the net payload weight could increase 11,000 lbs.
  - This is equivalent to 183 additional bushels per truck load (on a soybean bushel weight of 60 lbs.).

- Upgrading from a 41 foot Wilson Tandem Trailer to a 50 foot Tri-Axle increases tare weight from 9,000 pounds to 11,650 pounds. The tare weight of the semi tractors depends on commodities transported and working conditions. For example, a logging operation in the mountains will require a horsepower increase from 450 to 600 and better brakes.
  - A 2,650 tare weight could be assumed for agriculture, but not other industries.

Table 82: Tare Weight Breakdown by Category

Component	Extra Weight (pounds)	Notes
Extra Axle	1,800	Super Single Axle is 1,500 pounds.
Four Tires	608	
Trailer (9 Extra Feet)	242	
Larger Engine Set-up	3,635	Not needed on flat land.
Total	**6,285**	

Source: Forest Resource Associations Inc., Wilson Trailer, Michelin

  - The number of soybean truck loads under this proposed weight limit will reduce the number of loads by nearly 13% from 4.7 million under the current weight limit to 4.1 million in 2022 as shown in Table 84.
    - Not all farmers will upgrade equipment to the higher truck weight limits. To account for those farmers who will upgrade equipment, an assumed adoption rate to the larger hauling equipment was used to calculate the reduction in the number of truck trips. The adoption increased from no change in 2013, 10% change in 2014, 50% in 2017, and 75% by 2022.
    - It is assumed that 90% of grain and soybeans in 2012 were hauled in a semi-tractor trailer from the farm to an initial storage location and will increase to 100% in 2022.

Table 83: Number of Soybean Truck Loads Adopting Truck Weight of 97,000 pounds by Select States from Farm

	2001	2006	2012	2013	2014	2015	2016	2017	2022
Truck Trips (Thousand)									
OH	146	191	207	219	246	260	260	256	276
IN	213	250	226	262	294	310	310	305	329
IL	372	424	384	466	523	551	551	542	586
MN	207	284	305	261	293	310	309	304	329
IA	374	448	414	420	471	497	497	489	528
MO	145	171	158	196	220	232	232	228	247
ND	55	107	163	140	157	166	166	163	176
SD	111	115	144	184	207	218	218	214	231
NE	173	220	207	250	280	296	296	291	314
KS	68	87	86	125	141	148	148	146	158
KY	38	53	59	81	91	96	96	95	102
TN	28	39	47	74	83	87	87	86	93
U.S.	**2,248**	**2,809**	**3,034**	**3,294**	**3,697**	**3,901**	**3,899**	**3,836**	**4,142**
Selected States	**1,930**	**2,387**	**2,399**	**2,678**	**3,006**	**3,172**	**3,170**	**3,119**	**3,368**

Source: Informa Economics
Notes: Based on 1,083 bushels per truck. Assumes 90% of soybeans were moved by semi-tractor trailer in 2012, 100% by 2020.

Table 84: Reduction in Soybean Truck Loads through Adoption of 97,000 pound Truck Weight Limit by Select States from Farm

	2014	2015	2016	2017	2018	2019	2020	2021	2022
Truck Trips (Thousands)									
OH	4	11	17	24	27	30	33	37	40
IN	5	13	21	28	32	35	39	44	48
IL	9	23	36	50	56	63	70	78	85
MN	5	13	20	28	32	35	39	44	48
IA	8	20	33	45	51	57	63	70	77
MO	4	10	15	21	24	26	29	33	36
ND	3	7	11	15	17	19	21	23	26
SD	4	9	14	20	22	25	28	31	34
NE	5	12	20	27	30	34	37	42	46
KS	2	6	10	13	15	17	19	21	23
KY	2	4	6	9	10	11	12	14	15
TN	1	4	6	8	9	10	11	12	13
U.S.	**64**	**160**	**258**	**355**	**398**	**444**	**493**	**549**	**602**
Selected States	**52**	**130**	**210**	**288**	**324**	**361**	**401**	**446**	**490**

Source: Informa Economics
Notes: Assumes no adoption of 97,000 pound semi-tractor trailer until 2014.

- The reduction in the number of truck trips will reduce the amount of fuel consumed. Nearly all soybeans are initially hauled by truck, whether to a local elevator, processing plant or river terminal, and most within a 30 to 50 mile radius. However, according to elevator operators, about 80% of the loads originate between 18 and 20 miles.

- To estimate how much fuel consumption would be saved and the number of truck miles reduced, it was assumed that each roundtrip was 35 miles.

- The reduction is the number of trips required would save 4.1 million gallons of fuel, assuming a 75% adoption rate. The lower fuel mileage from an extra axle results in a 2.4 million gallon reduction. The net fuel savings is 1.7 million gallons.

- Based on various diesel fuel prices and change in fuel consumption, and number of truck trips required under a higher weight limit, soybean farmers could realize between $4 million with diesel prices at $2 per gallon and over $8 million with diesel priced at $5 per gallon as summarized in Table 85. The savings in truck miles per year would total about 21 million miles.

Table 85: Fuel Cost Savings using Higher Truck Weights in 2022

	Reduced Fuel Savings ($2 per Gallon)	Reduced Fuel Savings ($3 per Gallon)	Reduced Fuel Savings ($4 per Gallon)	Reduced Fuel Savings ($5 per Gallon)
Number of Trips Saved	602,179	602,179	602,179	602,179
Miles Round Trip	35	35	35	35
Miles per Year	21,076,282	21,076,282	21,076,282	21,076,282
Miles per Gallon 97,000 GVW	5.14	5.14	5.14	5.14
Gallons of Diesel Saved	**4,100,444**	**4,100,444**	**4,100,444**	**4,100,444**
Total Trips 80,000 GVW	4,142,265	4,142,265	4,142,265	4,142,265
Percent 97,000 GVW	75%	75%	75%	75%
Miles Round Trip	35	35	35	35
Miles per Year 80,000 GVW	108,734,455	108,734,455	108,734,455	108,734,455
Miles per Gallon	5.80	5.80	5.80	5.80
Gallons of Diesel 80,000 GVW	18,747,320	18,747,320	18,747,320	18,747,320
Total Trips 97,000 GVW	4,142,265	4,142,265	4,142,265	4,142,265
Percent 97,000 GVW	75%	75%	75%	75%
Miles Round Trip	35	35	35	35
Miles per Year 97,000 GVW	108,734,455	108,734,455	108,734,455	108,734,455
Miles per Gallon	5.14	5.14	5.14	5.14
Gallons of Diesel 80,000 GVW	21,154,563	21,154,563	21,154,563	21,154,563
Gallons of Diesel Lost	**(2,407,243)**	**(2,407,243)**	**(2,407,243)**	**(2,407,243)**
Gallons of Diesel Net Saved	**1,693,201**	**1,693,201**	**1,693,201**	**1,693,201**
Cost per Gallon	**$2**	**$3**	**$4**	**$5**
Fuel Cost Savings	**$3,386,401**	**$5,079,602**	**$6,772,802**	**$8,466,003**

Source: Informa Economics

Note: Assumes 75% adoption rate of 97,000 pound truck configurations.

- By 2022 farmers in the selected states will reduce fuel consumption 1.3 million gallons by adopting a higher truck weight as shown in Table 86. Not surprisingly, the larger soybean production states benefit the most.

Table 86: Fuel Saved with Farm Moves Adopting Higher Truck Weights to 97,000 Pounds by Select States

	2014	2015	2016	2017	2018	2019	2020	2021	2022
Fuel Savings (Thousand Gallons)									
OH	10	26	43	62	70	80	90	101	113
IN	12	31	52	74	84	95	107	121	135
IL	21	55	92	131	150	169	191	215	239
MN	12	31	51	74	84	95	107	121	134
IA	19	49	83	118	135	153	172	194	216
MO	9	23	39	55	63	71	80	91	101
ND	6	16	28	39	45	51	57	65	72
SD	8	22	36	52	59	67	75	85	95
NE	11	29	49	70	80	91	102	115	128
KS	6	15	25	35	40	46	51	58	64
KY	4	10	16	23	26	30	33	38	42
TN	3	9	15	21	24	27	30	34	38
U.S.	**147**	**387**	**649**	**928**	**1,058**	**1,198**	**1,349**	**1,521**	**1,693**
Selected States	**119**	**314**	**527**	**755**	**860**	**974**	**1,097**	**1,237**	**1,377**

Source: Informa Economics

- Farmers in the selected states can expect to save $5.5 million in 2022 if the road weight limits are increased as shown in Table 87. The larger soybean production states benefit the most.

Table 87: Fuel Cost Savings with Farm Moves by Adopting Higher Truck Weights to 97,000 Pounds by Select States

	2014	2015	2016	2017	2018	2019	2020	2021	2022
Fuel Savings (Thousand Dollars)($4 per Gallon)									
OH	$39	$103	$173	$247	$282	$319	$360	$405	$451
IN	$47	$123	$206	$295	$336	$381	$429	$484	$538
IL	$83	$219	$367	$525	$598	$677	$763	$860	$958
MN	$47	$123	$206	$295	$336	$380	$428	$483	$538
IA	$75	$197	$331	$473	$539	$611	$688	$776	$864
MO	$35	$92	$154	$221	$252	$285	$321	$362	$403
ND	$25	$66	$110	$158	$180	$203	$229	$258	$288
SD	$33	$86	$145	$207	$236	$268	$302	$340	$378
NE	$45	$117	$197	$282	$321	$363	$409	$461	$514
KS	$22	$59	$99	$141	$161	$182	$205	$231	$258
KY	$14	$38	$64	$92	$104	$118	$133	$150	$167
TN	$13	$35	$58	$83	$95	$107	$121	$136	$152
U.S.	**$588**	**$1,547**	**$2,595**	**$3,713**	**$4,231**	**$4,791**	**$5,397**	**$6,085**	**$6,773**
Selected States	**$478**	**$1,258**	**$2,110**	**$3,019**	**$3,440**	**$3,895**	**$4,389**	**$4,948**	**$5,507**

Source: Informa Economics

D. Individual Cost Scenarios

- Although most grain moves off the farm to an elevator within 20 miles, specialty grain and specific varieties that processors demand could travel distances up to

250 miles by truck one-way. Specialty growers will benefit the greatest from an increase in truck weights.

- The impact of a higher truck weight at 97,000 pounds across four fuel price scenarios was evaluated with distances of 20 miles and 250 miles. The first scenario was the 250 mile move with diesel priced at $2, $3, $4 and $5 per gallon and the second scenario was a 20 mile move. The scenarios were developed from discussions with various participants in the marketing chain.

- The scenarios assumed the average farmer planting 500 acres of soybeans per farm and an average soybean yield of 45 bushels per acre. The current average yield per acre is around 44 bushels per acre; however, yields are forecast to exceed 50 bushels per acre.
  - With production of 22,500 bushels, the farmer would require four fewer trips under the higher truck weight limit. Under the current law of 80,000 pound GVW (900 bushels), a Class 8 truck achieves about 5.80 miles per gallon (mpg). Under a heavier weight limit at 97,000 pounds (1,083 bushels), it is estimated that fuel consumption will fall by 11% to 5.14 mpg.

- Labor costs were assumed to be $15 per hour based on enterprise budgets in several eastern Corn Belt states. Discussions with elevators indicated that the average wait time at the elevator was one hour during harvest. It was understood that a heavier truck would have a slightly longer unload time, but the reduction in the number of trucks would result in a 10% lower wait time or a 6 minute time savings overall. Travel time assumes an average speed of 50 miles per hour.
- Most elevators and processors have already upgraded their equipment to handle the extra weight. As a result, the system should not incur extra expenses retrofitting for a higher weight limit.

- The 250 mile scenario is summarized in Table 88. A farmer delivering soybeans 250 miles at the higher truck weight limit will save in fuel expense $268 annually with diesel priced at $2 per and $671 at $5 per gallon, and this despite a lower fuel mileage with a heavier weight limit. Labor costs will be lowered $728 annually. The total savings on a per bushel basis is approximately $0.044 with fuel at $2 and $0.062 per bushel with fuel at $5. A farmer driving 250 miles essentially makes one trip per day and with a heavier truck weight the farmer will save four days travel time.

- A truck that travels 250 miles is likely to run on an interstate. In states where truck weights are heavier, the farmer may not be able to fully take advantage of the state regulations. As a result, the increase in federal truck weight limits is very important for longer distance moves. For the state, shifting some of the overweight traffic to federal interstates would result in fewer repairs needed for state highways. In addition, a properly configured 97,000 pound GVW is safer than an overweight 80,000 pound GVW.

Table 88: Comparison of Higher Truck Weight Savings on Fuel and Labor by Various Diesel Prices for a 250 Mile Soybean Shipment

	$2 per Gallon		$3 per Gallon		$4 per Gallon		$5 per Gallon	
Inputs	**80,000 GVW**	**97,000 GVW**	**80,000 GVW**	**97,000 GVW**	**80,000 GVW**	**97,000 GVW**	**80,000 GVW**	**97,000 GVW**
Distance Traveled	250	250	250	250	250	250	250	250
Roundtrip (Miles)	500	500	500	500	500	500	500	500
Number of Acres	500	500	500	500	500	500	500	500
Average Yield	45	45	45	45	45	45	45	45
Total Production (Bushels)	22,500	22,500	22,500	22,500	22,500	22,500	22,500	22,500
Bushels per Truck	900	1,083	900	1,083	900	1,083	900	1,083
Annual Trips	25	21	25	21	25	21	25	21
Miles per Gallon	5.80	5.14	5.80	5.14	5.80	5.14	5.80	5.14
Cost per Gallon	$2	$2	$3	$3	$4	$4	$5	$5
Annual Diesel Cost	4,310	4,042	6,466	6,063	8,621	8,084	10,776	10,105
Annual Savings (Fuel)		**$268**		**$403**		**$537**		**$671**
Average Weight Time (Minutes)	60	54	60	54	60	54	60	54
Travel Time (Minutes)	600	600	600	600	600	600	600	600
Labor Costs (Hour)	$15	$15	$15	$15	$15	$15	$15	$15
Annual Labor Costs	4,125	3,397	4,125	3,397	4,125	3,397	4,125	3,397
Annual Savings (Labor)		**$728**		**$728**		**$728**		**$728**
Annual Savings (Fuel and Labor)		**$997**		**$1,131**		**$1,265**		**$1,399**
Savings per Bushel		**$0.044**		**$0.050**		**$0.056**		**$0.062**

Source: USDA, State Extension Offices, Industry Sources, Informa

- The second scenario is for a 20 mile shipment and is summarized in Table 89. A farmer with a heavier truck hauling the soybeans 20 miles with diesel at $2 per gallon will save $21 dollars annually in fuel costs or $54 with diesel at $5 per gallon. Labor costs will be lowered $145 annually. The total savings on a per bushel basis is approximately $0.0074 at $2 fuel and $0.0088 per bushel with $5 diesel. A farmer driving 20 miles essentially will save one day of travel time during harvest. In years when weather conditions limit the harvest window, one day can save yield damage. For example, harvesting the soybeans before a major winter storm arrives.

- For states that already allow heavy trucks during harvest, from the farm to the elevator it is likely the farmer will travel a state or county road. As a result, the economic savings for the farmer is minimal. For the state, the adoption of 97,000 pound GVW truck configuration would save money by reducing the wear and tear on the infrastructure that occurs with operating above prescribed weight limits. The extra axle actually lowers the weight on each axle.

Table 89: Comparison of Higher Truck Weight Savings on Fuel and Labor by Various Diesel Prices for a 20 Mile Soybean Shipment

	$2 per Gallon		$3 per Gallon		$4 per Gallon		$5 per Gallon	
Inputs	80,000 GVW	97,000 GVW	80,000 GVW	97,000 GVW	80,000 GVW	97,000 GVW	80,000 GVW	97,000 GVW
Distance Traveled	20	20	20	20	20	20	20	20
Roundtrip (Miles)	40	40	40	40	40	40	40	40
Number of Acres	500	500	500	500	500	500	500	500
Average Yield	45	45	45	45	45	45	45	45
Total Production (Bushels)	22,500	22,500	22,500	22,500	22,500	22,500	22,500	22,500
Bushels per Truck	900	1,083	900	1,083	900	1,083	900	1,083
Annual Trips	25	21	25	21	25	21	25	21
Miles per Gallon	5.80	5.14	5.80	5.14	5.80	5.14	5.80	5.14
Cost per Gallon	$2	$2	$3	$3	$4	$4	$5	$5
Annual Diesel Cost	345	323	517	485	690	647	862	808
Annual Savings (Fuel)		**$21**		**$32**		**$43**		**$54**
Average Weight Time (Minutes)	60	54	60	54	60	54	60	54
Travel Time (Minutes)	48	48	48	48	48	48	48	48
Labor Costs (Hour)	$15	$15	$15	$15	$15	$15	$15	$15
Annual Labor Costs	675	530	675	530	675	530	675	530
Annual Savings (Labor)		**$145**		**$145**		**$145**		**$145**
Annual Savings (Fuel and Labor)		**$167**		**$177**		**$188**		**$199**
Savings per Bushel		**$0.0074**		**$0.0079**		**$0.0084**		**$0.0088**

Source: USDA, State Extension Offices, Industry Sources, Informa

IX. Global Truck Weights and its Effect on Containers and Intermodal Transportation

- Most foreign countries have higher standard truck weights than the U.S. A summary of truck weights by select country is shown in Table 90.
  - Of the Scandinavian countries, Sweden has the highest truck weight at 60 metric tons while Russia allows 38 metric tons.
  - Brazilian soybean farmers have a distinct competitive advantage hauling soybeans by being able to haul 57% more volume than U.S. farmers.

Table 90: Maximum Truck Weights of Foreign Countries Compared to the U.S.

Country	Metric Tons	Pounds	Percent Above United States
United States	36.3	80,000	0%
Russia	38.0	83,776	5%
Canada *	39.5	87,083	9%
European Union	40.0	88,185	10%
China	43.0	94,799	18%
Mexico	48.5	106,924	34%
South Africa	56.0	123,459	54%
Brazil	57.0	125,663	57%
Scandinavia	60.0	132,277	65%

Source: The Linde Group; Prof. Johan Wideberg; and Heavy Truck Weight and Dimension Limits in Canada.
Notes: Many trucks in Canada are larger, 8-axle B-Train is 62.5 metric tons or 137,789 lbs.

- Containers play an important role in international trade. Countries ship goods to and from each other in containers that can be 20, 40 or 45 foot in length.
  - Trade between the U.S. and other countries can be slowed by inefficiencies with different weight requirements for trucks.
    - If a container is overweight, the truck must be configured in the U.S. to meet the 80,000 pound limit.
    - Shippers can obtain overweight permits, but the regulations change from state to state and even within a state. Additionally, the cost of a permit can change anytime the governing group meets. This problem typically occurs in local counties.

- Weight specifications vary by container size. When exporting grain, dry containers are used. Grain shipments for export are usually loaded into 20 (TEU, twenty-foot equivalent) or 40 (FEU, forty-foot equivalent) foot containers. The maximum gross weight for an FEU dry container is approximately 67,200 pounds while a TEU is approximately 52,900 pounds as shown in Table 91.

- The tare weight is the weight of a clean and empty container. The gross weight equals the tare weight and the weight of the payload.

Table 91: Typical International Ocean Container Dimensions

Description	20 Foot (TEU)	40 Foot (FEU)	45 Foot
Maximum Gross Weight	52,900	67,200	71,656
Tare Weight	4,850	7,782	10,449
Payload	48,050	59,417	61,200
Capacity (Cubic Feet)	2,376	2,376	3,037

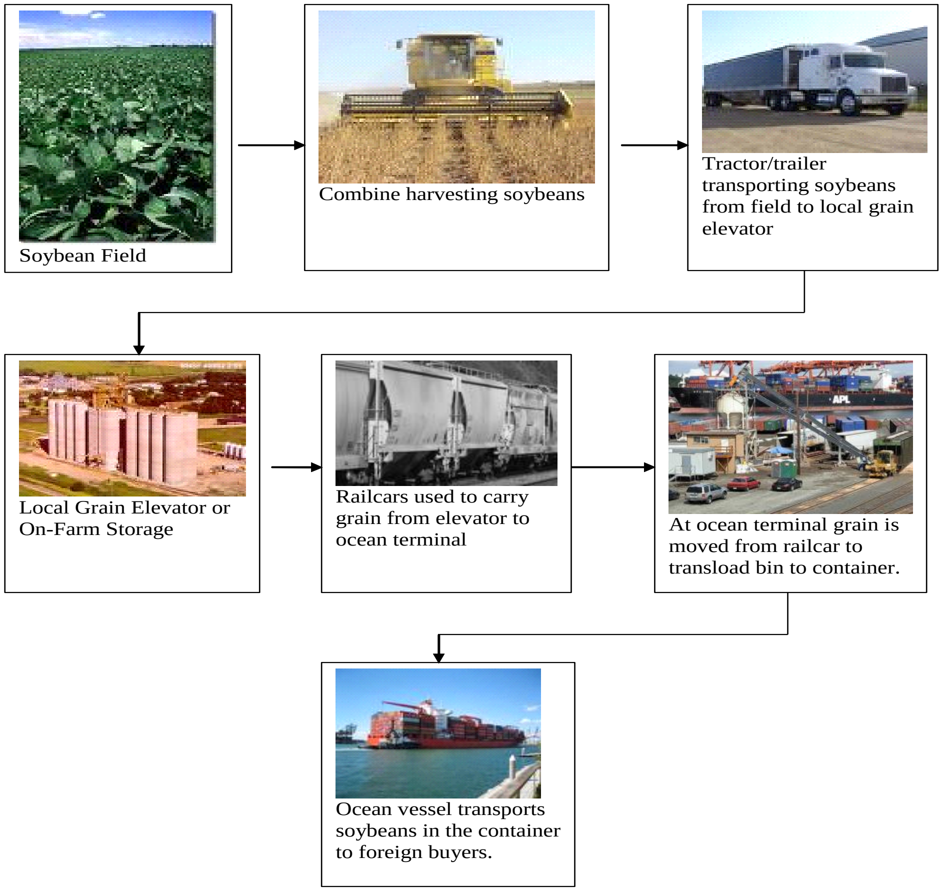
Source: http://www.export911.com/e911/ship/dimen.htm and http://www.shipping-container-housing.com/shipping-container-standard-dimensions.html

- The weights mentioned in Table 91 apply for intermodal rail moves. Many of those loaded containers originated on the West Coast and near high population centers such as Chicago.
    - Once railed to an inland intermodal yard the container was trucked to a distribution facility.
    - Once emptied the container would be railed back to the West Coast to be loaded back on a container ship destined for Asia.
        - Some of the empty containers are loaded with soybeans before being positioned back to the West Coast and loaded on a container vessel.
        - Some countries prefer containers due to their ease of handling and lower quantities of soybeans required.

- However, the weight of a container heading back to the West Coast is limited by the railroads. Rail weight limits vary by railroad and track locations. Class I railroads publically list their track weight limits.
    - According to BNSF, weight limits across their network range from 220,000 lbs. to 286,000 pounds for 4-axle railcars. As a result of track weight limits, the configuration of railcars and the proper loading pattern on a double-stack intermodal railcar (stacking containers two high, two FEUs, one on top of the other, or two TEUs on the bottom and on FEU on top) is important for efficient moves.
    - Twenty foot containers have lower centers of gravity requiring two TEUs be placed below an FEU in the double-stack intermodal railcar "well." However, two FEUs can be stacked on top of each other.

- In another example of a container move, soybeans are trucked from the farm to a local elevator. The grain is then loaded into a covered hopper railcar (approximately 105 tons per car) and railed to a port where the soybeans are transloaded from the covered hopper car into a surge bin and then into a container. The standard ratio of containers per railroad covered hopper grain car is about 4 to 1. The containers are then moved to a container terminal and loaded onto the ship for export. Most container shipments of soybeans are shipped to China, Japan, or Taiwan. A flowchart showing the movement of soybeans from field to export position by container is shown in Figure 23.

Figure 23: Flowchart of Containerized Grain from Farm to Export



Source: Informa Economics

X. Interviews and Discussions with Industry Representatives

Informa conducted interviews and engaged in discussions with industry representatives to estimate the number of loading or receiving facilities that would need to upgrade their scales to accommodate heavier trucks. Interviews were conducted with state trucking associations and managers at grain and soybean processing facilities.

A. Results from Conversations with Associations

- The use of heavier weight limits is currently in place in 22 states that were given special exemptions and grandfathered rights to allow trucks to haul in excess of 80,000 pounds. In addition, during harvest, most states allow a 10% overweight policy for grain trucks. This is very important because out of the 4 million miles of highway in the U.S., 150,000 are national highways, 45,000 to 64,000 miles are interstates, and the rest are state and county roads.

- Most associations' interest in raising the truck weight limits is limited due to the fact they believe 80% of trucks cube out before reaching 80,000 lbs. As a result, only industries that are limited by the weight restrictions express an interest towards increasing the weight limit.

- Associations discussed how increased truck weights have worked in states that allow heavier truck weights. In South Dakota for example, a truck could be carrying a load over 100,000 pounds, but in order to cross the border into another state, it must abide by that state's weight limit law. Long-haul movers would like to eliminate this inefficiency. A first step in eliminating the different weight limits across states is to increase the federal limit to 97,000 pounds, which would pressure on states to follow suit. Shorter distance moves within South Dakota, such as moves early in the marketing chains, are realizing the efficiencies of a higher truck weight limit.
    - For example, a large beer manufacturing company advocates increased truck weights. One scenario that the company uses to promote its position involves trucks traveling from a brewery in Houston to retail stores in San Antonio. Their trucks weigh 35,000 pounds empty and can carry approximately 45,000 pounds of beer before reaching 80,000 pounds. If the weight limit was to increase to 97,000 pounds, each truck could increase its load to 60,000 pounds. Every week, about 5.9 million pounds of beer is shipped from Houston to San Antonio in 128 trucks, the increase in truck weight would decrease the amount of truck trips to 96. The impact for the company and environment would be a reduction of 807 gallons in diesel fuel per week, depending on the cost of fuel; this could be $3,000 to $4,000 per week just from one brewery to one location. The impacts to the entire system would be significant. In addition, there would be a reduction in CO_2 emissions of 17,996 pounds each week. The impact to roads and bridges would be felt as well, as the total weight reduction would be 1.1 million pounds.

- According to associations, the opposition to heavier truck weights comes from state politicians, unions and other civic organizations. There is minimal opposition for heavier trucks hauling grain from the farm to the elevator or processor. The opposition comes when products are moved from the processor to further processing or to retail. These moves typically are longer hauls and on more congested highways where safety concerns are greatest.

- Those that oppose higher truck weight limits include unions, railroads, and other highway safety advocates.
    - For example, the general public is often concerned about the safety of children and represents a strong contingency for politicians.
    - Unions are opposed to the decrease in labor, and railroads fear a shift of cargo to trucks and possible damage to its infrastructure if intermodal shipments result in heavier trains carrying heavier containers.
    - There would be a large cost involved in converting shortline railroad tracks to support heavier trains, not to mention the importance shortlines have for local agriculture.
        - For example, according to the Minnesota Department of Agriculture, shortline railroads have provided continued operation of rail service to the agricultural community that otherwise would have lost service through rail abandonment.
        - Due to low freight volumes in rural areas, shortline railroads (Class II & III railroads) are the primary carriers to haul agricultural products to connect with Class I railroads that move commodities and products to final market destination" (Assessing Feasibility of Intermodal Transport of Agricultural and Related Products on Short Line and Regional Railroads, 2008).

- Some of the associations mentioned their research has shown that trucks are more efficient at 97,000 pounds with an additional axle on the trailer. The addition of the sixth axle would increase payloads between 6,000 to 15,000 pounds according to various contacts. The sixth axle helps distribute the weight in a more balanced manner.

B. Results from Conversations with Grain Elevator Managers

Grain elevator managers from the twelve states in the mentioned earlier were contacted to discuss additional cost that would be needed at their grain elevators if the increase in truck weight takes place. The key points from these conversations are summarized below.

- Nearly all grain elevators in the Midwest have updated to larger scales with dimensions of 75 feet to 85 feet in length and 120,000 pound weight limits during the past decade.

- The cost to upgrade to these larger scales ranged from \$50,000 to \$150,000 based on the amount of concrete added and the brand name of scale.

- All respondents contacted said they have already upgraded their scales to accommodate heavier and longer trucks; however, it was mentioned that some of the smaller grain elevators still have scales that have 90,000 pound limits.

- These smaller elevators handle mostly straight-trucks and grain wagons (less than 650 bushels) which have draw areas within 10 miles.

- In South Dakota, most trucks moving grain already exceed 100,000 pounds. The semis pull extra “pups” behind their trailers for increased efficiency.

- Most of the pits at Midwestern elevators are capable of handling the increase in weights. Some elevators have four pits with the ability to unload 75,000 bushels per hour during harvest.

- Some elevators pits would slow down the unloading of extra volume by only a few minutes.

- In the spring time, most Midwestern states are affected by the spring thaw weight laws. Usually the trucks are only allowed to carry 6 tons per axle. This has an impact on planting (fertilizer, chemicals, and seed).

C. Results from Conversations with Soybean Processing Managers

The focus of the conversations with soybean processors was based on the same questions asked to grain elevator managers. However, additional questions focused on the distance of travel the soybean oil and soybean meal take to the next processor or feedlot. The infrastructure at these processors is very similar to the grain elevators in that the scales are capable of handling 120,000 pounds.

- Similar to grain elevators, the draw areas are within a 35 to 50 mile radius for most of the grain; however, some of the processors will draw grain from 250 miles away.
  - Usually these cases are based on the farmer sending a specialty grain to a processor.
  - Upon leaving the processor, the meal will travel by truck or rail. Usually this is about 250 miles to 300 miles by truck and to the southeastern U.S. by rail.
  - Soybean oil is mostly transported by truck up to 250 miles to 300 miles; however some of the processors do sent the oil by rail.

- A former soybean processing manager said the issue of an increase in truck weight limits will find more support from companies that handle human consumption products instead of animal consumption. The reason is human consumption involves more steps and more transportation cost to process an edible human product compared to feeding animals, which may have half the total transportation cost because of fewer moves. This is consistent with what Informa discovered during literature reviews.

XI. Appendix A: Soybean Production

Most soybeans produced in the United States are harvested across the Corn Belt. More than three-quarters of the 2012 harvest took place in ten states including Illinois, Indiana, Iowa, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin. Over the last decade, US soybean production has ranged from 2,454 million bushels in 2003 to 3,197 million in 2006 as shown in Table 92. For 2013, soybean harvest is forecast at 3,257 million bushels. Iowa and Illinois have consistently led the country in soybean production.

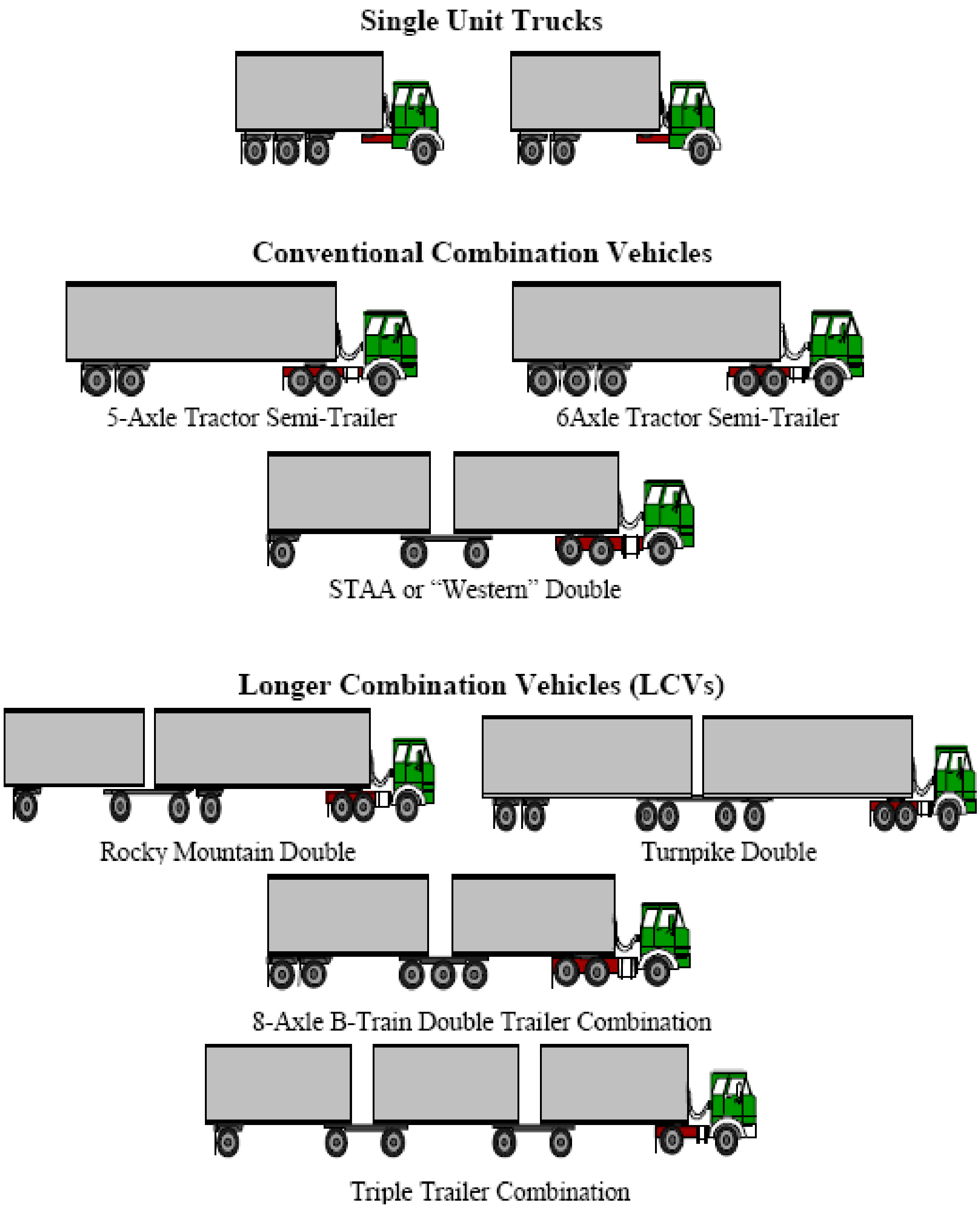
Table 92: Soybean Production by State (million bushels)

STATE	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Alabama	6,650	4,785	3,000	3,885	12,250	17,200	8,970	9,735	15,075	18,060
Arizona	-	-	-	-	-	-	-	-	-	-
Arkansas	122,850	102,000	107,450	101,520	123,500	122,625	110,250	126,280	135,880	144,000
California	-	-	-	-	-	-	-	-	-	-
Colorado	-	-	-	-	-	-	-	-	-	-
Connecticut	-	-	-	-	-	-	-	-	-	-
Delaware	8,840	4,732	5,576	4,030	5,308	7,686	5,536	6,636	7,140	6,520
Florida	578	256	135	288	1,102	1,292	690	432	780	990
Georgia	8,370	4,550	3,500	8,550	12,865	15,840	6,630	2,970	8,063	8,360
Idaho	-	-	-	-	-	-	-	-	-	-
Illinois	495,000	439,425	482,400	360,180	428,640	430,100	466,075	423,225	383,990	460,600
Indiana	284,280	263,620	284,000	220,340	244,350	266,560	258,505	240,695	226,160	259,000
Iowa	497,350	525,000	510,050	448,760	449,655	486,030	496,230	475,345	414,295	415,350
Kansas	111,110	105,450	98,560	86,130	120,250	160,600	138,125	101,520	85,725	123,900
Kentucky	57,200	53,320	60,280	30,250	47,610	68,160	47,260	57,720	58,800	80,360
Louisiana	32,670	28,900	30,240	25,800	31,350	36,660	41,820	35,280	51,290	51,230
Maine	-	-	-	-	-	-	-	-	-	-
Maryland	21,285	15,980	15,810	10,725	14,550	19,950	15,810	18,135	22,325	19,000
Massachuset	-	-	-	-	-	-	-	-	-	-
Michigan	75,240	76,615	91,540	71,600	69,930	79,600	88,740	85,360	85,570	83,160
Minnesota	232,650	309,400	322,625	267,325	264,860	284,800	328,950	274,560	304,500	258,570
Mississippi	61,500	58,035	42,900	58,320	78,400	77,140	76,230	70,200	87,750	85,140
Missouri	223,200	181,670	194,180	175,125	191,140	230,550	210,405	190,165	158,100	193,900
Montana	-	-	-	-	-	-	-	-	-	-
Nebraska	218,500	235,330	250,500	196,350	225,990	259,420	267,750	261,360	207,085	247,000
Nevada	-	-	-	-	-	-	-	-	-	-
New Hampsh	-	-	-	-	-	-	-	-	-	-
New Jersey	4,326	2,548	3,010	2,480	2,700	3,654	2,208	3,268	3,666	3,567
New Mexico	-	-	-	-	-	-	-	-	-	-
New York	6,708	7,896	9,108	7,917	10,396	10,922	13,392	11,911	14,352	12,784
North Carolin	51,000	39,420	43,520	30,360	55,110	59,500	40,300	41,480	62,410	44,640
North Dakota	82,110	105,850	121,905	108,630	105,280	116,100	138,380	114,840	163,185	138,300
Ohio	207,740	201,600	217,140	199,280	161,280	221,970	220,320	217,920	206,550	217,070
Oklahoma	8,700	7,930	3,655	4,680	9,000	12,090	11,875	3,445	3,900	8,370
Oregon	-	-	-	-	-	-	-	-	-	-
Pennsylvania	19,550	17,220	17,000	17,630	17,200	20,470	20,790	21,560	24,960	24,990
Rhode Island	-	-	-	-	-	-	-	-	-	-
South Carolin	14,310	8,610	11,310	8,140	16,960	13,843	10,465	9,180	12,580	8,060
South Dakota	140,080	134,750	130,900	136,080	138,040	175,980	157,320	150,590	143,960	182,000
Tennessee	48,380	41,800	44,070	19,190	49,640	68,850	43,710	40,320	46,740	72,960
Texas	8,640	5,980	3,720	3,450	5,023	4,750	5,550	1,710	2,860	2,520
Utah	-	-	-	-	-	-	-	-	-	-
Vermont	-	-	-	-	-	-	-	-	-	-
Virginia	20,670	15,555	15,810	13,750	18,240	21,090	14,040	22,000	24,360	23,600
Washington	-	-	-	-	-	-	-	-	-	-
West Virginia	828	595	672	462	738	779	540	817	980	945
Wisconsin	53,475	69,520	72,160	55,890	55,650	64,800	82,315	74,865	70,550	62,800
Wyoming	-	-	-	-	-	-	-	-	-	-
US Total	3,123,790	3,068,342	3,196,726	2,677,117	2,967,007	3,359,011	3,329,181	3,093,524	3,033,581	3,257,746

Source: Informa Economics

XII. Appendix B: Truck Configurations

Figure 24: Vehicle Configurations



Source: US Department of Transportation's "Comprehensive Truck Size and Weight Study," 2000

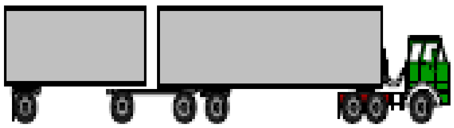
Table 93: Characteristics of Typical Vehicles and How They are Currently Used

Configuration Type	Number of Axles	Common Maximum Weight (Pounds)	Current Use
Single-Unit Truck	3	50,000 to 65,000	Single-unit trucks (SUT) are the most commonly used trucks. They are used extensively in all urban areas for short hauls. Three-axle SUTs are used to carry heavy loads of materials and goods in lieu of the far more common two-axle SUT.
	4 or more	62,000 to 70,000	SUTs with four or more axles are used to carry the heaviest of the construction and building materials in urban areas. They are also used for waste removal.
Semitrailer	5	80,000 to 99,000	Most used combination vehicle. It is used extensively for long and short hauls in all urban and rural areas to carry and distribute all types of materials, commodities, and goods.
	6 or more	80,000 to 100,000	Used to haul heavier materials, commodities, and goods for hauls longer than those of the four-axle SUT.
STAA Double	5, 6	80,000	Most common multitrailer combination. Used for less-than-truckload (LTL) freight mostly on rural freeways between LTL freight terminals.
B-Train Double	8	105,500 to 137,800	Some use in the northern plains States and the Northwest. Mostly used in flatbed trailer operations and for liquid bulk hauls.
Rocky Mountain Double	7	105,500 to 129,000	Used on turnpikes in Florida, the Northeast, and Midwest and in the Northern Plains and Northwest in all types of motor carrier operations, but most often it is used for bulk hauls.
Turnpike Double	9	105,500 to 147,000	Used on turnpikes in Florida, the Northeast, and Midwest and on freeways in the Northern Plains and Northwest for mostly truckload operations.
Triple	7	105,500 to 131,000	Used to haul LTL freight on the Indiana and Ohio Turnpikes and in many of the most western States, used on rural freeways between LTL freight terminals.

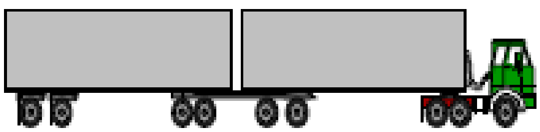
Source: US Department of Transportation's "Comprehensive Truck Size and Weight Study," 2000

LCV's Nationwide – These are longer combination vehicles that operate in 16 states west of the Mississippi River and on turnpikes in 5 states east of the Mississippi River. The 2000 DOT study's LCV Nationwide scenario assumed LCV operations on a nationwide network.

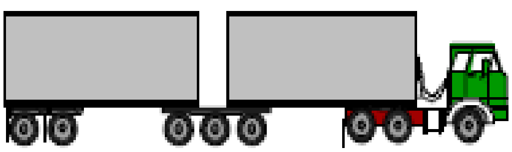
Figure 25: Longer Combination Vehicles (LCV) Nationwide Scenario



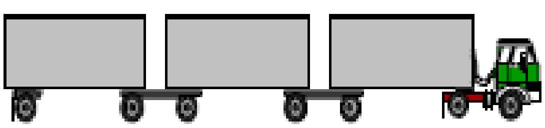
7-axle Rocky Mountain Double
Maximum weight – 120,000 pounds



9-axle Turnpike Double
Maximum Weight – 148,000 pounds



8-axle B-train double
Maximum weight – 124,000 pounds (33-foot trailers)



Triple-trailer combination
Maximum weight – 132,000 pounds

Main Feature

- Broad national LCV operations

Available Highways

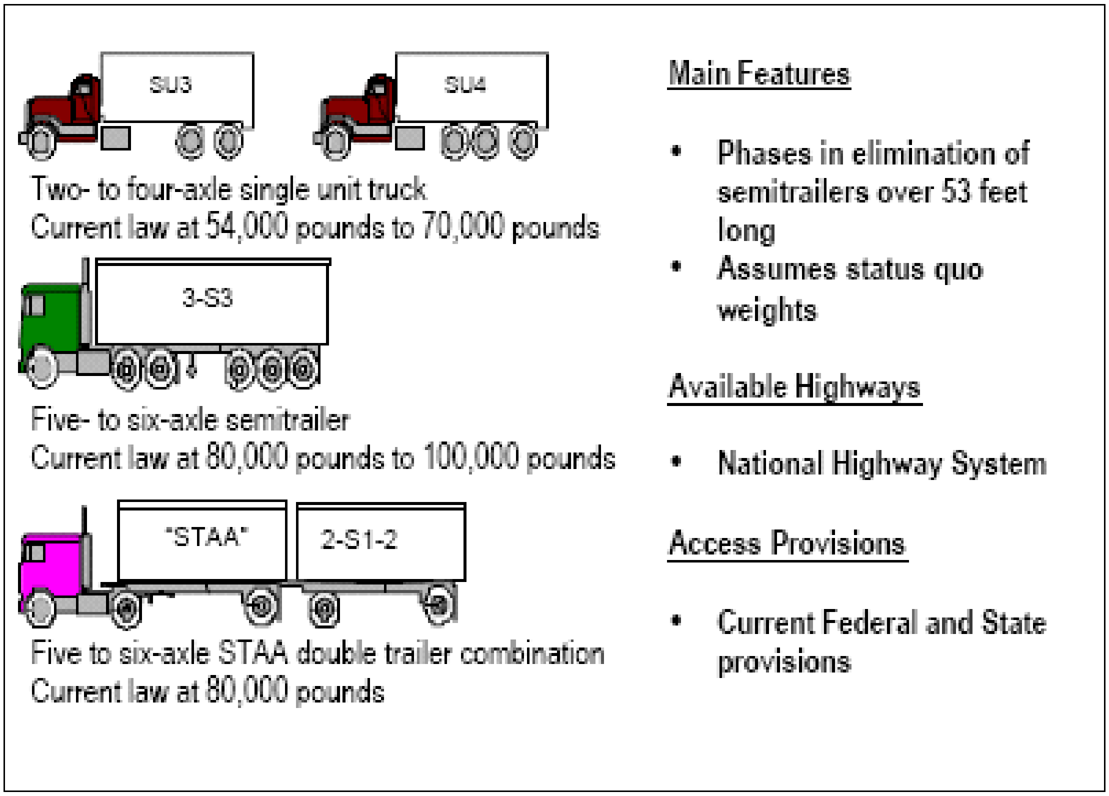
- RMDs and TPDs – 42,000 mile analysis network
- Triples – 60,000 mile analysis network
- 8-axle B-train double – National Network for STAA vehicles

Access Provisions

- RMDS and TPDs – none off the analysis network
- Triples – State issued permits
- 8-axle B-train doubles – current Federal and State provisions

H.R. 551 Scenario Vehicles used in 2000 DOT Study – "The Safe Highways and Infrastructure Preservation Act" was introduced in 1994 and again in 1997. The bill would federalize certain areas of truck regulation that are now state responsibilities. Specifically H.R. 551 contains three provisions related to Federal truck, size and weight (TS&W) limits: (1) it would phase out trailers longer than 53 feet, (2) it would freeze state grandfather rights, and (3) it would freeze weight limits (including divisible load permits) on non-interstate portions of the National Highway System.

Figure 26: H.R. 551 Truck, Size and Weight Scenario Vehicles



Source: US Department of Transportation's "Comprehensive Truck Size and Weight Study," 2000

XIII. Appendix C: Coalition for Transportation Productivity

Table 94: Companies Included in Coalition for Transportation Productivity

Supporting Associations	**Supporting Companies**
American Frozen Food Institute Agricultural Transportation Efficiency Coalition (AgTEC) Alabama Forestry Association American Forest & Paper Association Black Hills Forest Resource Association Council for Citizens Against Government Waste(CCAGW) Colorado Potato Administrative Committee Colorado Timber Industry Association Florida Forestry Association Fresh Produce Association Food Marketing Institute Forest Resources Association Grocery Manufacturers Association Hardwood Federation Idaho Grower Shippers Association Idaho Potato Commission Intermountain Forest Association International Foodservice Distributors Association International Dairy Foods Association Kentucky Forest Industries Association Louisiana Forestry Association Maine Pulp and Paper Association Manufacture Alabama Michigan Forest Products Council Mississippi Forestry Association Mississippi Loggers Association Missouri Forest Products Association National Association of Manufacturers (NAM) National Black Chamber of Commerce National Confectioners Association National Industrial Transportation League (NITLeague) National Lumber and Building Material Dealers Association National Milk Producers Federation National Potato Council National Private Truck Council National Taxpayers Union Northeastern Loggers Association North Carolina Forestry Association Northwest Food Processors Association Ohio Forestry Association Oregon Potato Commission Paper and Forest Industry Transportation Committee Shelf-Stable Food Processors Association Snack Food Association United Fresh Produce Association Virginia Forest Products Association Washington State Potato Commission Western Growers Wisconsin Manufacturers & Commerce Wisconsin Paper Council	AbitibiBowater Anthony Forest Products Archer Daniel Midland(ADM) Ball Brothers Produce Basic American Foods Boise Cascade LLC Boise Inc. Campbell Soup Company Claremont Forest Inc. Coca-Cola Company Con-way Dannon Dean Foods Deere & Company Delta Timber Company Domtar Flambeau River Papers Floyd Wilcox & Sons, Inc. (Wilcox Marketing Group) FMC Corporation General Mills, Inc. GPOD of Idaho Glatfelter Green Bay Packaging H-E-B Idaho Forest Group Idahoan Foods International Paper Kraft Foods, Inc Larsen Farms Longview Fibre Paper and Packaging Inc LP Corp. LyondellBasell Industries Mennel Milling Company MillerCoors Modern Transportation Services MWV National Frozen Foods Corp Neiman Enterprises, Inc. Nestlé USA Nestlé Waters North America Newark Group NewPage Oldcastle Architectural, Inc. Potandon Produce Rayonier R.R. Donnelley & Sons Co. Safe Handling Inc. Schwan Food Company Simplot Smurfit Stone Container Corp Sun Glo of Idaho, Inc. Sunny D SuperValu Inc. Taylor Produce, Inc. Temple-Inland Total Transportation Services US Foodservice/Alliant Logistics Verso Paper Wada Farms

XIV. Appendix D: Literature Review

Below a list of sources for various subjects related to increasing the GVW of trucks. Jodi L. Carson, P.E., Ph.D. a Research Engineer for Texas Transportation Institute at the Texas A&M University System in College Station, Texas prepared the literature review for American Association of State Highway and Transportation Officials (AASHTO)

A. Infrastructure Preservation—Pavements

a) Domestic Experience

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F. Highway Geometrics

a) Domestic Experience

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