Topic Paper #3

Truck Transportation Demand

On August 1, 2012, The National Petroleum Council (NPC) in approving its report, *Advancing Technology for America's Transportation Future*, also approved the making available of certain materials used in the study process, including detailed, specific subject matter papers prepared or used by the study's Task Groups and/or Subgroups. These Topic Papers were working documents that were part of the analyses that led to development of the summary results presented in the report's Executive Summary and Chapters.

These Topic Papers represent the views and conclusions of the authors. The National Petroleum Council has not endorsed or approved the statements and conclusions contained in these documents, but approved the publication of these materials as part of the study process.

The NPC believes that these papers will be of interest to the readers of the report and will help them better understand the results. These materials are being made available in the interest of transparency.

National Petroleum Council
Future Transportation Fuels Study:
Truck Demand Group Findings

Submitted to the

National Petroleum Council

By the

American Transportation Research Institute

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1.0 INTRODUCTION

According to a recent estimate, the total tonnage of primary freight shipments in the U.S. will increase from approximately 13 billion tons in 2009 to more than 16 billion tons in 2021, an increase of roughly 25 percent over 12 years.[1] Trucks share of this tonnage is expected to increase from 68.0 percent in 2009 to 70.7 percent by 2021.[2] Based on these projections, the number of trucks, the miles driven and fuel consumed is expected to increase in future years.

The truck demand group has selected two policy areas where public policy changes could decrease the amount of fuel consumed by large trucks between now and 2050. Those policy areas include:

- State and National Policy Regarding Use of Higher Productivity Vehicles (HPVs);
- National Infrastructure Policy Related to Congestion Mitigation

The most common tractor-trailer configuration[3] operating in the U.S. is the five-axle tractor-semitrailer. Such configurations are limited to 80,000 lbs and have one trailer that is 53' in length or less. Higher productivity vehicle (HPV) configurations, which include longer combination vehicles (LCVs), can operate at gross vehicle weights (GVW) greater than the federal maximum of 80,000 pounds and/or may carry more than one trailer. Examples of HPVs include a six-axle tractor-trailer, a Rocky Mountain double, a triple trailer combination and a turnpike double (see Figure 1). HPVs have been found to have many benefits, including improved fuel efficiency due to an increase in ton-miles per gallon of fuel consumed that is realized through the use of such configurations.

[1] American Trucking Associations. U.S. Freight Transportation Forecast to 2021. 2009.
[2] Ibid.
[3] Combination vehicles, as opposed to single unit vehicles, are comprised of a tractor and one or more trailers.

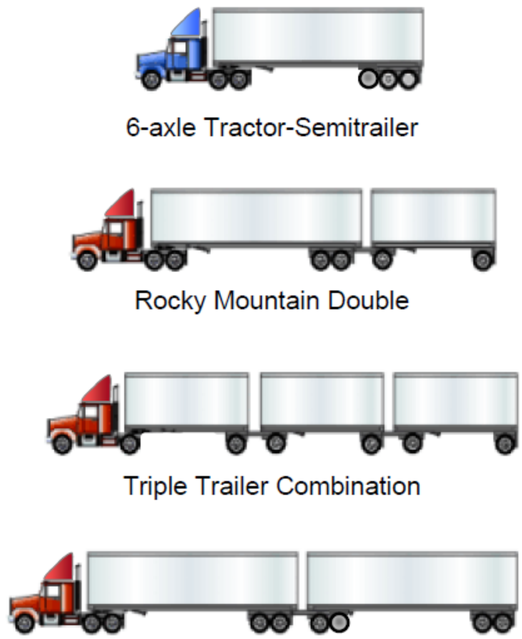

Figure 1. Higher Productivity Vehicle Configurations

Numerous studies have shown that the current state of the nation's highway infrastructure, and congestion in particular, have a significant impact on fuel consumption. Truck travel in congested conditions is less efficient than at free flow speeds since trucks consume more fuel in stop-and-go conditions and at slower speeds. There is clearly an opportunity for federal transportation policy to play an important role in improving and enhancing truck mobility by investing in the nation's highway infrastructure. Motor carriers may also have an opportunity to alleviate congestion to a small degree through operational changes.

The Federal Highway Administration (FHWA) measured recurring congestion on the National Highway System (NHS) in 2007 for both passenger vehicles and truck traffic. Researchers found that peak travel period congestion resulted in vehicles slowing to below posted speed limits on 11,700 miles of highway and created stop-and-go conditions on an additional 6,700 miles (see Figure 2).

The study also estimates recurring peak-period congestion for the year 2040 assuming no increases in the network capacity. As shown in Figure 3, it is estimated that traffic would slow on 20,300 miles of the NHS and create stop-and-go conditions on an additional 39,000 miles.

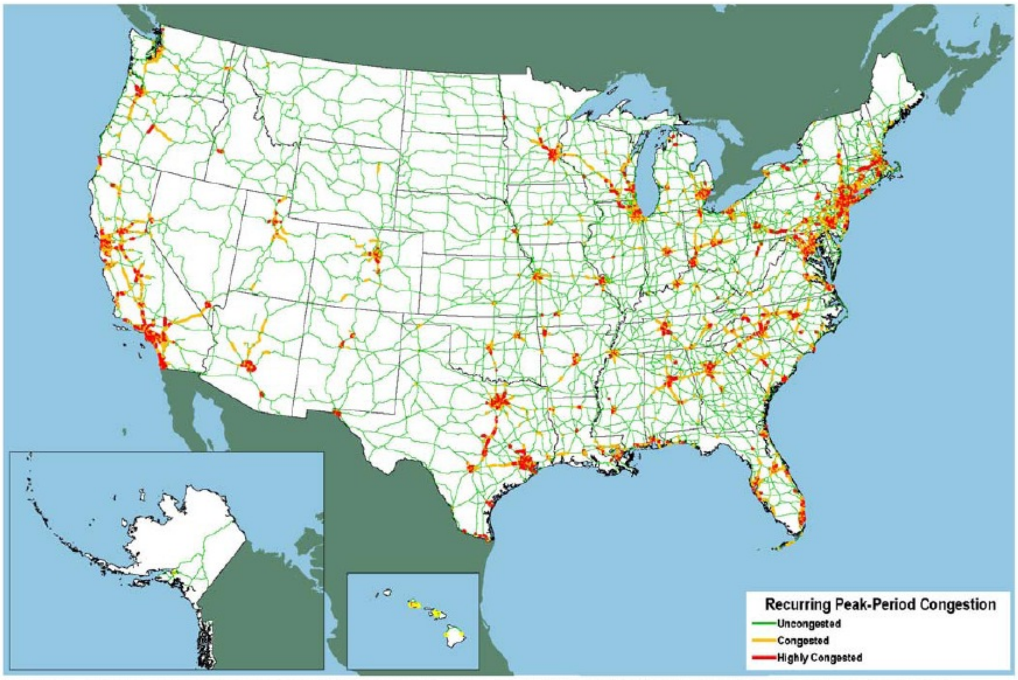

Figure 2. Peak-Period Congestion on the NHS, 2007[4]

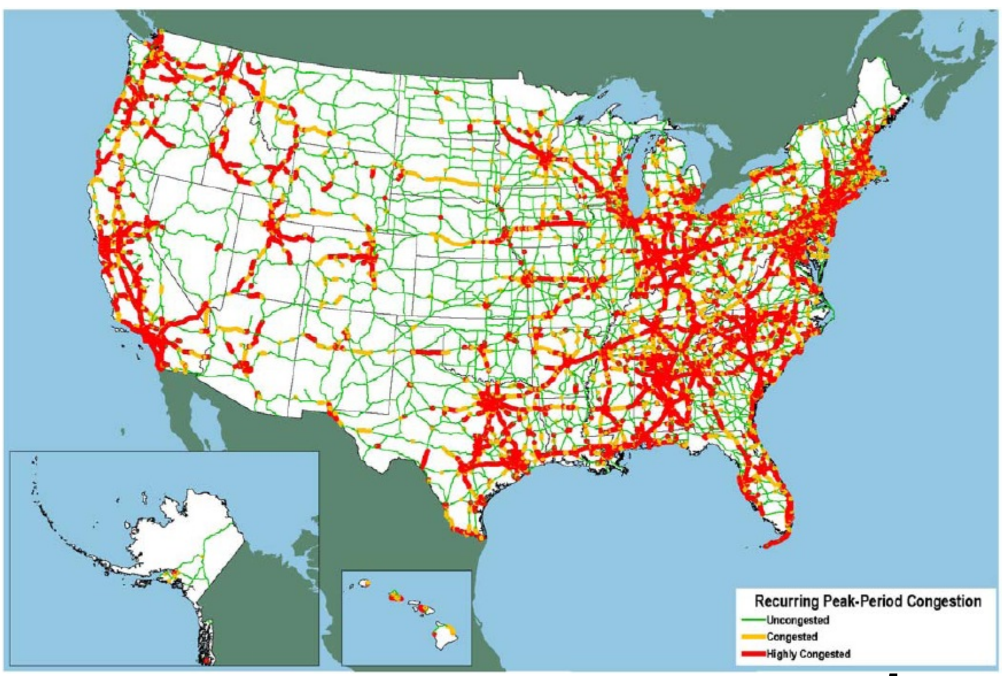

Figure 3. Peak-Period Congestion on the NHS, 2040[5]

[4] United State Department of Transportation. *Freight Facts and Figures, 2010.* Washington, DC. 2010.
[5] Ibid.

2.0 State and National Policy Regarding Use of Higher Productivity Vehicles

As previously stated, HPVs are truck configurations that allow for weights above 80,000 pounds, which is the federal GVW limit, and/or truck configurations that include multiple trailers (e.g. double and triple trailer configurations). While the use of HPVs is regulated through a myriad of rules at the federal and state level[6], and special permitting is typically required to use such configurations, there is currently a push to broaden the use of HPVs for reasons related to fuel consumption and productivity.

Improved Fuel Economy

For the purposes of this report, improved fuel economy is the most critical benefit found through the use of HPVs. Such configurations offer the benefit of increasing ton-miles per gallon of fuel consumed. The research indicates that while HPVs may consume more fuel on a per mile basis, the improved efficiencies of these higher weights results in less fuel consumed and fewer emissions generated in moving a fixed amount of freight (e.g. per ton-mile).

Woodrooffe et al. (2010) detail a benchmarking study that included forty vehicles from 10 countries.[7] The focus of this benchmarking study is vehicle productivity and efficiency in regard to the movement of freight. The vehicles were classified in three separate categories: workhorse vehicles (most common and can travel on most roads); high-capacity vehicles (may be restricted to a certain class of road); and very high-capacity vehicles (may be restricted to specific highways or routes). The study found that the productivity and efficiency of heavy vehicles is most affected by size and weight regulations.

The Ontario Ministry of Transportation initiated a one-year LCV pilot program in 2009.[8] The program goal was to monitor and analyze LCV operations by allowing a limited number (up to 100) of LCVs on designated Ontario highways. In a program publication, the Ministry of Transportation asserted that each LCV used approximately one-third less fuel than two tractor-trailers. This resulted in one third fewer greenhouse gas emissions for each LCV on the road and could lead to a reduction in greenhouse gas emissions of 200,000 tonnes a year.

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[6] See Pt. 658, App. C: Appendix C to Part 658 — *Trucks over 80,000 pounds on the interstate system and trucks over STAA lengths on the national network.* http://www.fmcsa.dot.gov/rules-regulations/administration/fmcsr/fmcsrruletext.aspx?reg=r23CFR658AppendixC

[7] Woodrooffe, J., Glaeser, K., & Nordengen, P. *Truck Productivity, Efficiency, Energy Use, and Carbon Dioxide Output: Benchmarking of International Performance*. Transportation Research Board. Washington, DC. 2010.

[8] Ontario Ministry of Transportation. *Ontario LCV Pilot Program Questions and Answers*. Available online: http://www.mto.gov.on.ca/english/trucks/lcv/questions-and-answers.shtml August, 2010.

The potential energy and emissions impacts of expanding the federal GVW exemption to portions of Maine's Interstate Highway System were investigated in the report *Energy and Emissions Impacts of Operating Higher Productivity Vehicles Update: 2008*.[9] The performance of a 6-axle vehicle configuration operating at a maximum GVW of 100,000 pounds was analyzed over two roughly parallel routes between Augusta and Brewer, Maine. It was found that an average fuel savings of 1 to 2 gallons per trip could be saved by using the alternative interstate route, despite a longer travel distance. Greenhouse gas emissions were also estimated to decrease per trip by 6 to 11 percent for CO_2 and 3 to 8 percent for particulate matter, NO_x and NMHC for the alternative interstate route.

Due to new on-road heavy-duty diesel engine emission standards that went into effect beginning in 2007, researchers updated previous findings (September 2004) on the energy and emissions impacts which can result from operating CMVs at various weights and configurations.[10] Six common vehicle configurations were modeled over a typical route to estimate fuel consumption and emissions. Increases in fuel efficiency (expressed as ton-miles per gallon [TM/gal]) were observed for nearly every HPV configuration. For example, vehicles operating at 120,000 pounds GVW had increases in TM/gal that ranged from 15 to 31 percent and increases of 33 percent were observed for vehicles operating at 140,000 pounds GVW. Additionally, the improved fuel efficiencies found in this research translate to decreases in greenhouse gas emissions.

A Canadian Trucking Alliance report documents potential benefits of HPV operations in the Quebec, Alberta, Manitoba and Saskatchewan provinces.[11] The focus of this research was the Turnpike Double configuration (a Class 7 or 8 tractor pulling two semi-trailers). This combination is frequently used for transporting a high volume of light density goods. By collecting actual fuel consumption data, this report supports previous assertions that HPVs can yield fuel consumption savings of 30 percent.

Spurred by findings from the Comprehensive Truck Size and Weight (CTS&W) Study[12] conducted by the US DOT, the Western Governors' Association (WGA) requested a study examining the "Western Uniformity Scenario."[13] This research assumed that the rules freezing the current LCV regulations was lifted and that there was coordination

[9] Tunnell, M.A. *Estimating Truck-Related Fuel Consumption and Emissions in Maine: A Comparative Analysis for a 6-axle, 1000,000 Pound Vehicle Configuration.* Maine Department of Transportation. Augusta, ME. September 2009.

[10] Tunnell, M.A. *Energy and Emissions Impacts of Operating Higher Productivity Vehicles, Update 2008.* The American Transportation Research Institute. Arlington, VA. March 2008.

[11] Canadian Trucking Alliance. Evaluating Reductions in Greenhouse Gas Emissions Through the Use of Turnpike Double Truck Combinations, and Defining Best Practices for Energy Efficiency. L-P Tardif & Associates Inc. In Association with Ray Barton Associates Ltd. December, 2006.

[12] The Comprehensive Truck Size and Weight Study, published in 2000, examined issues surround the federal truck size and weight limits. Several operational scenarios were analyzed and significant productivity benefits were found for each. Estimated reductions in total VMT under the two HPV (nationwide use of LCVs and triples) scenarios were approximately 20 percent. (See footnote 13.)

[13] United States Department of Transportation. *Western Uniformity Scenario Analysis: A Regional Truck Size and Weight Scenario Requested by the Western Governors' Association*. April 2004.

among states in LVC weights, dimensions and routes. The study found that under this scenario freight transportation fuel consumption could decrease by 12 percent with a corresponding 25 percent reduction in truck vehicle miles traveled (VMT).

The study also found that longer combination vehicles do not necessarily consume more fuel than a shorter combination vehicle at the same weight. This is due to other factors that influence a truck's fuel consumption. The study notes that a truck's diesel fuel consumption also depends on the miles of operation at its given weight, speed and the roadway grade.

In a study commissioned by Alberta Infrastructure, researchers found that LCVs were significantly more efficient that conventional tractor-trailer combinations.[14] The use of LCVs within the Alberta province would yield an annual freight savings of $42.1 million for the provincial economy. Additionally, the annual diesel fuel consumed by freight transportation could be reduced by 32 percent when LCVs were utilized versus semi-trailers. This equates to an annual fuel savings of 15 million liters or approximately 4 million gallons.

Finally, an examination of issues surrounding the federal truck size and weight limits was conducted by the FHWA.[15] Several analyses were performed, including a uniformity scenario, two North American Trade scenarios, an H.R. 551 scenario and two HPV scenarios. Significant productivity benefits were found for each scenario. The four scenarios allowing heavier vehicles weights (both North American Trade scenarios, and nationwide LCVs and triples) all show large (70% or greater) decreases in 5-axle truck travel and very large increases in HPV travel. Total VMT was estimated to decrease by approximately 10 percent under each of the North American Trade scenarios. Estimated reductions in total VMT under the two HPV (nationwide use of LCVs and triples) scenarios were approximately 20 percent.

Regulations

The Federal government began regulating truck size and weight limits in 1956 with the construction of the Interstate Highway System. Congress established a maximum gross vehicle weight limit of 73,280 pounds along with maximum weights of 18,000 pounds on single axles and 32,000 pounds on tandem axles for vehicles operating on the Interstate system. The Federal-Aid Highway Act Amendments of 1974 increased the maximum GVW to 80,000 pounds and to 20,000 pounds on single axles and 34,000 pounds on tandem axles. This increase was due in part to the raising fuel costs at the time. The Surface Transportation Assistance Act of 1982 expanded the federal authority, essentially overriding several more restrictive "barrier" states located along the Mississippi that had not adopted the previous size and weight limit increase. The most

[14] Woodrooffe, J. and Ash, L. *Economic Efficiency of Long Combination Transport Vehicles in Alberta.* Woodrooffe and Associates. March, 2001.
[15] United States Department of Transportation. *Comprehensive Truck Size and Weight Study.* August 2000.

recent legislation related to truck size and weight limits was in the Intermodal Surface Transportation Efficiency Act of 1991, which froze the limits previously established in 1974.

As can be seen in Figure 4, several states currently allow longer combination vehicles (without special permitting) on portions of the NHS.

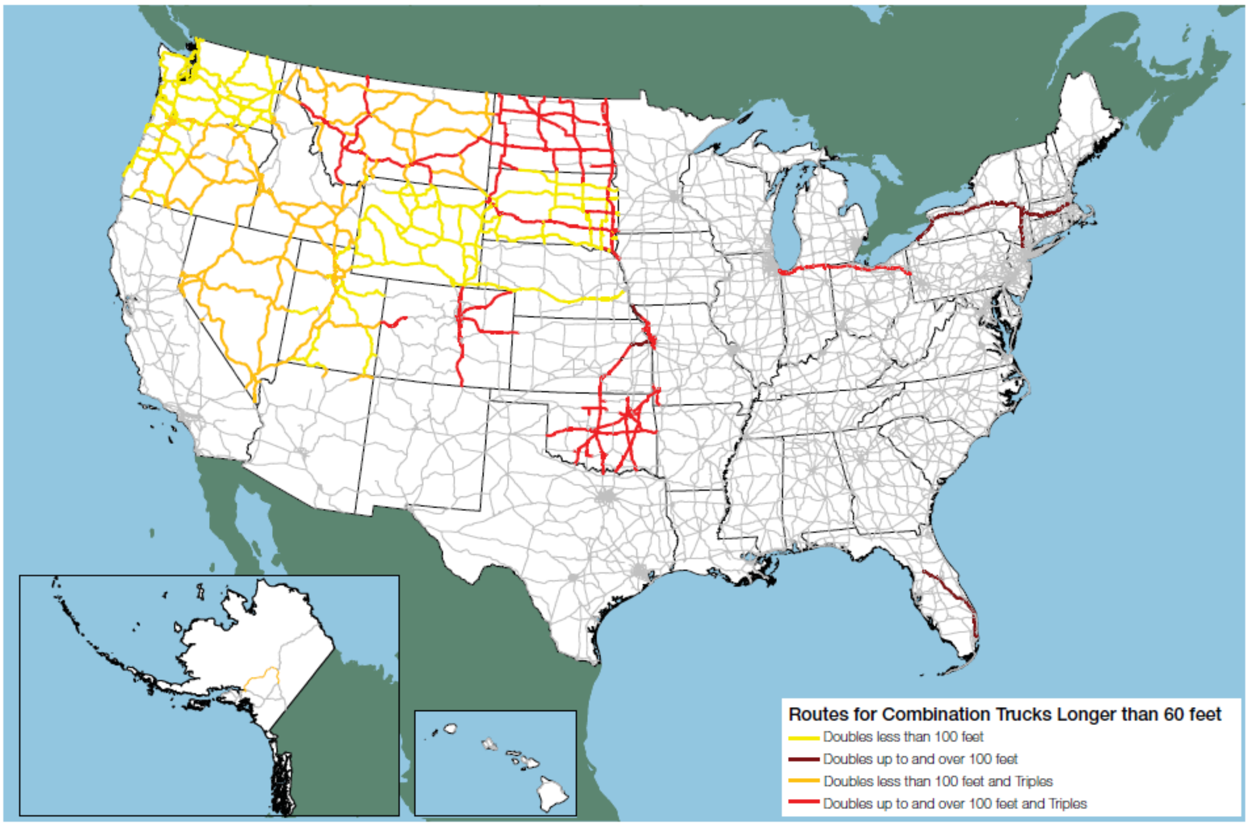

Figure 4. Permitted Longer Combination Vehicles on the National Highway System: 2009[16]

Since 1982, states, motor carriers, shippers and other stakeholder groups have proposed changes to the federal truck size and weight limits and several states have sought exemptions from the federal GVW limit. For example, in 1998 the Transportation Equity Act for the 21st Century provided an exemption from the federal weight limit on the Maine Turnpike and a portion of Interstate 95. In late 2009, Congress approved a bill that created a pilot program in Maine and Vermont which allowed 108,000 to 120,000-pound six-axle trucks to operate on interstate highways in Vermont and 100,000-pound six-axle trucks on all Maine interstate highways. This program was allowed to expire in mid-December, 2010 despite being highly successful.

[16] United State Department of Transportation. *Freight Facts and Figures, 2010.* Washington, DC. 2010.

In January 2011, two U.S. Senators (Patrick Leahy [D-Vermont] and Susan Collins [R-Maine]) announced they will introduce a bill to make the expired pilot program in Maine and Vermont permanent. The Vice President of the Champlain Oil Company stated that the company saved 43,400 gallons of diesel fuel and traveled 320,000 fewer miles during the year-long pilot program since they were able to deliver freight more efficiently.[17]

Industry Adoption

Adoption of new configurations will depend on the value of such configurations to individual trucking companies as well as their ability to incorporate new configurations into operations.[18] Adoption is thus driven by the aforementioned factors related to where HPVs could operate according to a new regulatory scheme as well as what type of configurations are allowed to operate.

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[17] Truckinginfo Article. *Bill Would Make Larger Truck Pilot Program Permanent* http://www.truckinginfo.com/news/news-print.asp?news_id=72795. January 26, 2011

[18] *I-70 Dedicated Truck Lanes Feasibility Report. Phase 1: The Business Case for Dedicated Truck Lanes.* June, 2010.

3.0 National Infrastructure Policy and Trucking Industry Mobility

The status of highway infrastructure, particularly urban interstate corridors, will have a significant impact on fuel consumption by trucks between the present date and 2050. It has been documented by numerous studies that there is not enough capacity on the nation's highways to meet the demand of passenger vehicles and large trucks. The result of this deficiency is that there are more vehicles on some roadways than there is space, thus slowing travel (often to a standstill) during the morning and evening peak travel periods. The outcome of such congested travel is inefficient use of motor fuels due to slow speeds, stop-and-go traffic and idling. These inefficiencies are realized especially by large trucks; not only does acceleration from a stop require that the weight of the truck be moved forward, but also the thousands of pounds of cargo that are within a typical trailer.

The following discussion outlines the problems associated with congested highway travel as well as policy solutions that may decrease the level of congestion over the next several decades.

The Effect of Congestion on Fuel Consumption and Cost Estimations

Current research outlines the correlation between fuel consumption and speed for large trucks.[19] A 2010 Transportation Research Board report states that "the effect of the increased transient behavior at low speeds is to raise the quantity of fuel consumed at low speeds. This is mainly due to the wasting of energy with service brakes and the associated need for propulsion energy during the next acceleration event. In addition, some power trains are less efficient under transient operation than under steady operation."[20] This occurs with great frequency in every major urban area; fuel is wasted during the stop-and-go traffic that results from congestion.

According to the 2009 Urban Mobility Report from the Texas Transportation Research Institute, congestion caused American drivers to travel 4.8 billion hours more and to purchase an additional 3.9 billion gallons of fuel at a cost of $115 billion.[21] The trucking industry's share of the extra fuel cost was $33 billion.[22] The impact of congestion on the trucking industry not only drives commodity prices up, but also adversely affects supply chains since trucks carry everything from raw materials to manufactured goods. The report recommends several approaches for alleviating congestion, including adding capacity to critical corridors through additional lane construction or constructing new streets and highways.

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[19] *Technologies and Approaches to Reducing the Fuel Consumption of Medium- and Heavy-Duty Vehicles*, Committee to Assess Fuel Economy Technologies for Medium- and Heavy-Duty Vehicles; National Research Council; Transportation Research Board, 2010. pp 32-36. http://www.nap.edu/catalog.php?record_id=12845
[20] Ibid.
[21] Schrank, D., Lomax, T., and Turner, S. *2009 Urban Mobility Report.* Texas Transportation Research Institute. December 2010.
[22] Ibid.

The Florida Department of Transportation, in conjunction with researchers at the Department of Planning and Urban Development, University of Florida, used historical data (2003 – 2007) on traffic densities throughout the state to show that traffic congestion is on the rise in every county, including rural areas.[23] The study found that traffic increased each year expect 2007 which mirrored the national pattern. Calculations estimated that costs attributable to congestion ranged from approximately $5 billion in 2003 to almost $7 billion in 2007 for Florida motorists. While the research did not specifically quantify the congestion costs for trucks, the authors noted that the increased levels of congestion directly contribute to higher shipping costs, delayed or missed deliveries and increased inventories due to the unreliability of the transportation system.

In 2007, the Oregon Department of Transportation initiated a research initiative to determine the costs associated with travel time by vehicle type.[24] Researchers considered costs associated with travel time as separate from vehicle operating costs. The Oregon DOT utilized state specific data in conjunction with national trends to estimate the value of travel time for three vehicle types: passenger vehicles, light trucks and heavy trucks. Estimates included both on- and off-duty travel. Table 1 displays the estimated value of one hour of travel time by vehicle type for 2007 in Oregon.

Table 1. Estimated Value of One Hour of Travel-Time by Vehicle Class Oregon 2007

Vehicle Class	Average Value
Automobiles	$17.58
Light Trucks	$21.32
Heavy Trucks	$30.93

Current and Future Levels of Congestion

Currently, congestion regularly occurs on most urban interstate interchange systems during the AM and PM peak travel periods. A report by the American Transportation Research Institute (ATRI) assessed the relative congestion levels at several significant freight bottlenecks across the U.S.[25] ATRI calculated the average travel time for trucks during weekdays in 2009 passing through 100 previously identified bottlenecks and then assigned a relative rank in order to compare the relative congestion severity experienced at each bottleneck. Two locations in Chicago (I-290 at the I-90/I-94 interchange and I-90 at the I-94 split) experience the highest levels of congestion relative to the 100 locations. As can be seen in Figures 5 and 6, these areas

[23] Blanco, A.G., Steiner, R.L., Peng, Z. and Shmaltsuyev, M. *The Economic Cost of Traffic Congestion in Florida.* Florida Department of Transportation. Aug. 2010.
[24] *The Value of Travel-Time: Estimates of the Hourly Value of Time for Vehicles in Oregon, 2007.* Oregon Department of Transportation. June 2008.
[25] Short, Jeffrey. *2009 Bottleneck Analysis of 100 Freight Significant Highway Locations.* American Transportation Research Institute, Arlington, VA, 2010.

experienced significant peak travel period congestion, with averages travel rates well below the posted speed limit. These results are fairly typical of many urban areas across the nation.

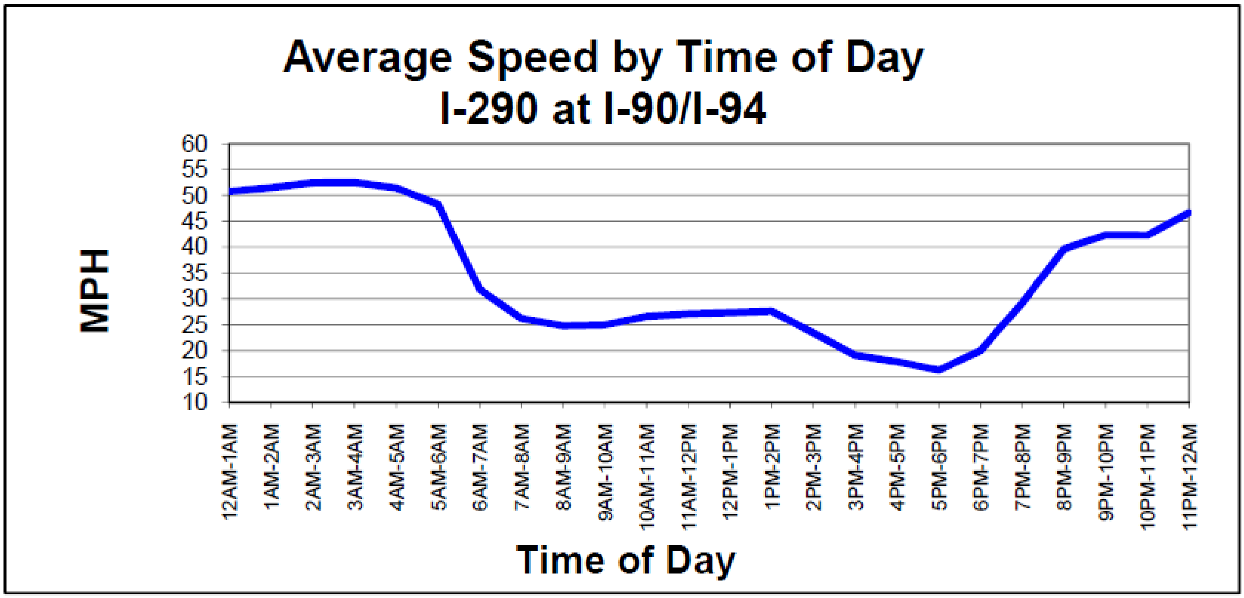

Figure 5. Average Truck Speed at I-290 and I-90/I-94 in Chicago, 2009[26]

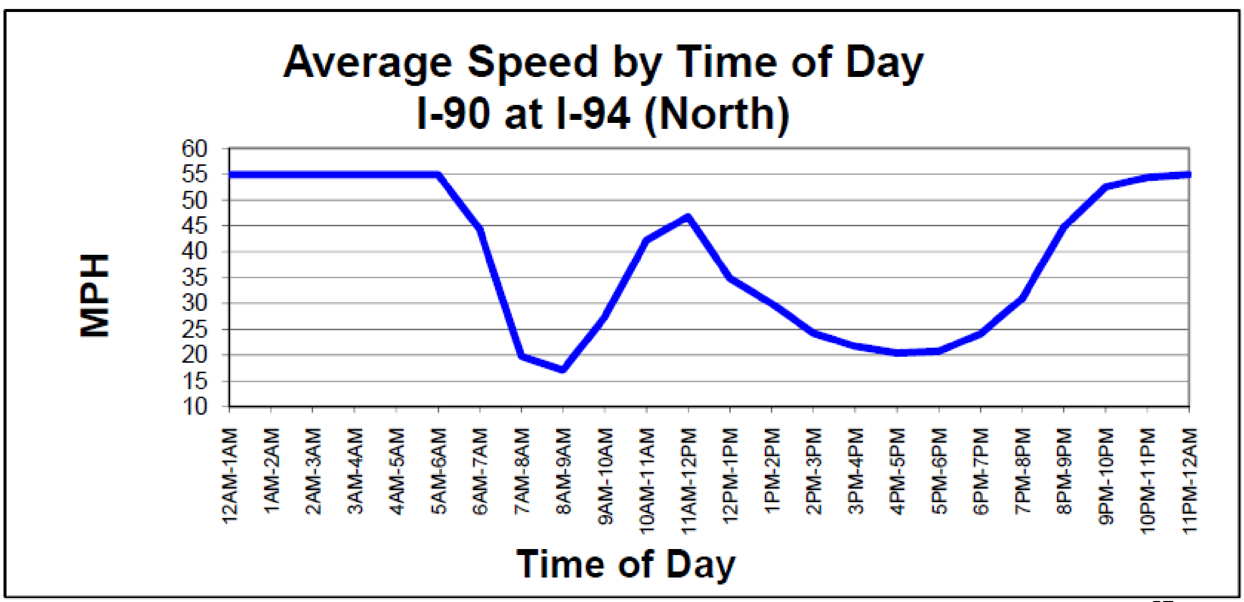

Figure 6. Average Truck Speed at I-90 and 1-94 (North) in Chicago, 2009[27]

[26] Short, Jeffrey. *2009 Bottleneck Analysis of 100 Freight Significant Highway Locations.* American Transportation Research Institute, Arlington, VA, 2010.
[27] Ibid.

Congestion is predicted to be even more prevalent, and to affect more citizens, in the coming decades due in part to increases in demand for freight movement. A 2008 U.S. Government Accountability Office (GAO) report found that by 2035 the volume of goods shipped by truck will likely increase by 98 percent.[28] Such an increase, when compounded with a likely increase in the passenger vehicle VMT, will strain current transportation systems. If the capacity and quality of infrastructure do not improve, congestion levels will likely increase in intensity and scope. This will in turn lead to less efficient fuel economy for greater numbers of trucks.

An American Association of State Highway and Transportation Officials (AASHTO) report argues that freight transportation is facing a "capacity crisis."[29] In this report, it is stated that interstate traffic grew 150 percent from 1980 to 2006, while at the same time capacity only increased 15 percent. The report asserts that many current systems are at or near capacity and additional investments will be required to maintain and improve infrastructure in order to meet anticipated demands. Bottlenecks at major highways and urban interstate interchanges are also cited by the AASHTO report as a major hindrance on the freight transportation system causing strings of delay across commerce routes. A report by ATRI found that congested travel at many of the nation's worst bottlenecks cripples truck movement and fuel economy, with average vehicle speeds as low as 15 mph during AM and PM peak periods.[30]

A 2009 U.S. Department of Transportation (USDOT) report further outlines issues related to the supply and demand of U.S. roadways.[31] The report asserts that the increases in freight volume already realized are threatening freight transportation system performance. Infrastructure enhancements between 1980 and 2007 increased miles of public roadways by 5 percent; during the same time period, however, VMT increased 98 percent and the number of commercial trucks using the transportation system increased 56 percent. A large increase in truck travel is expected by 2035, and is predicted to increase to 600 million miles per day. The number of roadway miles facilitating a significant amount of truck travel could swell to 230 percent (over 14,000 miles).

This same 2009 USDOT report predicts that increases in volume will have significant impacts on congestion. The report states that 2002 congestion levels slowed traffic to below posted speed limits on over 10,600 miles of the NHS and resulted in stop-and-go conditions for an added 6,700 miles. By 2035, if network capacity is not increased, congestion will expand to 40 percent of the NHS. Furthermore, traffic will slow on approximately 20,000 miles of the NHS and expand stop-and-go conditions to add 45,000 more miles. Increases in traffic volumes and miles traveled will be followed by increased fuel consumption. Highway freight transportation saw a 19 billion gallon per

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[28] United States Government Accountability Office. *Freight Transportation: National Policy and Strategies Can Help Improve Freight Mobility* GAO-*08-287.* Washington, DC, 2008.
[29] American Association of State Highway and Transportation Officials. *Unlocking Freight.* Washington, DC, 2010.
[30] Short, Jeffrey. *2009 Bottleneck Analysis of 100 Freight Significant Highway Locations.* American Transportation Research Institute, Arlington, VA, 2010.
[31] United States Department of Transportation. *Freight Facts and Figures 2009.* Washington, DC, 2009.

year increase in fuel consumption between 1980 and 2007 causing freight trucking to now account for two-thirds of freight transportation energy consumption.

Numerous other reports predict both increased future congestion on the highway system and increased demand for highway infrastructure by both trucks and passenger vehicles.[32, 33]

Solutions: Highway Funding, Infrastructure Investment, Decreased Fuel Consumption and Motor Carrier Operational Practices

Federal transportation policy can play a leadership role in the mitigation of truck congestion with a goal of more efficient energy consumption through better transportation infrastructure. It has been stated by GAO, however, that there exists a need for a national freight transportation strategy with a clearly defined, targeted, and cost effective federal role.[34]

One of the major obstacles to improving transportation infrastructure is funding. State governments, as well as the federally run Highway Trust Fund, are the key sources of revenue dedicated to transportation infrastructure improvement and maintenance. Both state and federal governments raise funds for this task through motor fuels taxes on gasoline and diesel fuel.

At the federal level the tax that supports the Highway Trust Fund has not increased since 1994, though the cost of building and maintaining infrastructure has increased significantly since then due to inflation. Research has shown that even a modest raise in the federal per gallon motor fuels tax would result in a significant increase in transportation funds within the Highway Trust Fund that could be used to revamp the nation's infrastructure.[35] Such an increase could help mitigate congestion and decrease fuel consumption by supporting the construction of new infrastructure.

The private sector will also play a key role in reducing congestion. The 2005 FHWA report *Traffic Congestion and Reliability: Trends and Advanced Strategies for Congestion Mitigation* not only summarized national trends in congestion and highlighted the importance of travel time reliability but also described several strategies for reducing congestion issues.[36] The strategies were grouped into three broader categories: adding more base capacity, operating existing capacity more efficiently and encouraging travel and land use patterns that use the system in a way that produces

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[32] Schrank, David, T. Lomax. *2009 Urban Mobility Report.* Texas Transportation Research Institute, College Station, TX, 2009.
[33] American Trucking Associations. *U.S. Freight Transportation Forecast to 2021*. Arlington, VA, 2010.
[34] United States Government Accountability Office. *Freight Transportation: National Policy and Strategies Can Help Improve Freight Mobility* GAO-*08-287.* Washington, DC, 2008.
[35] Short, Jeffrey; S. Shackelford; D. Murray. *Defining the Legacy for Users: Understanding Strategies and Implications for Highway Funding*. American Transportation Research Institute, Arlington, VA. 2007.
[36] Cambridge Systematics and TTI. *Traffic Congestion and Reliability: Trends and Advanced Strategies for Congestion Mitigation.* FHWA. September, 2005.

less congestion. While all of these strategies would reduce congestion, the operational strategies were shown to alleviate congestion in the short-term and, in many cases, be the most cost effective. One strategy specific to the trucking industry was the electronic screening of trucks. Trucks equipped with a transponder would transmit the relevant information to roadside weight stations/inspection facilities without stopping. The authors noted however, that operational strategies alone were not sufficient to address the nation's congestion issue.

Route optimization systems are another specific step that motor carriers can take to avoid congestion, reduce fuel consumption and enhance productivity.

A significant market penetration of wireless communication and GPS systems provides the potential platform to implement a wide variety of Intelligent Transportation Systems (ITS). The Motor Carrier Efficiency Study utilized funding from the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) act to examine the potential applications of several wireless technologies to enhance motor carrier productivity, reduce fuel consumption and avoid congestion.[37] These applications included:

- Wireless load notification and selection – would allow railroads and motor carriers to coordinate loads, thereby reducing empty miles traveled.
- Truck-specific congestion avoidance – would provide truck specific alternate route information to reduce costly travel delays.

Additionally, the authors noted that, with very few exceptions, delays are most often caused by party other than the motor carrier. These delays and the resulting inefficiencies can be mitigated, at least in part, by improving the quality, accuracy and timeliness of the data that is collected, analyzed and utilized by the industry.

Besides technology applications for reducing congestion, motor carriers in some of the most congested parts of the country (e.g. Manhattan) could potentially shift operations to off-peak travel hours. A pilot program was recently completed by the New York Department of Transportation for example, to shift truck deliveries to between 7:00 p.m. and 6:00 a.m.[38] The twenty participating motor carriers found that, due to the lower congestion levels experienced, the trucks could make more deliveries per shift, consumed less fuel and legal truck parking was more readily available. However, widespread operational changes such as this are unlikely due to constraints on delivery times set by shippers and by receivers who are unwilling to change their operating schedules to accommodate off-peak deliveries. While this change may work for New York City, it is not likely such a program would work for most trucking operations in the United States.

[37] Belella, P. et al. *The Motor Carrier Efficiency Study, Phase 1 Report.* The Federal Motor Carrier Safety Administration. February, 2009.
[38] New York Department of Transportation. *Off-Hour Delivery Program. Available online: http://www.nyc.gov/html/dot/html/motorist/offhoursdelivery.shtml*