Getting the Goods without the Bads:
Freight Transportation Demand Management Strategies to Reduce Urban Impacts

CFIRE 07- 02
September 2013

National Center for Freight & Infrastructure Research & Education
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The State Smart Transportation Initiative

The State Smart Transportation Initiative promotes transportation practices that advance environmental sustainability and equitable economic development, while maintaining high standards of governmental efficiency and transparency.

SSTI, housed at the University of Wisconsin, operates in three ways:

- As a community of practice, where participating agencies can learn together and share experiences as they implement innovative smart transportation policies.
- As a source of direct technical assistance to the agencies on transformative and replicable smart transportation reform efforts.
- As a resource to the wider transportation community, including local, state, and federal agencies, in their efforts to reorient practice to changing social and financial demands.

SSTI participants include nineteen state departments of transportation. These states differ in many respects but share a commitment to rethinking policies and processes to produce better outcomes.

Getting the Goods without the Bads: Freight Transportation Demand Management Strategies to Reduce Urban Impacts

This report was made possible by a matching grant from the National Center for Freight & Infrastructure Research & Education (CFIRE). The purpose of the report is to identify and evaluate strategies to reduce the social costs associated with goods movement in urban areas through transportation demand management (TDM) strategies.

SSTI convened a project advisory committee to advise the research group, particularly in the development of interview questions and identification of interviewees. Special thanks go out to our committee members who donated their time and energy to ensure that this effort was a success:

- Kurt Paulsen, Assistant Professor, Department of Urban and Regional Planning, University of Wisconsin – Madison
- Kathy Leotta, Washington State DOT, Public Transportation Division
- Rod Clark, Wisconsin DOT, Chief – Bureau of Transit, Local Roads, Rail and Harbors, retired

SSTI is also grateful to all of the transportation specialists that completed our survey and took the time to participate in interviews. These include Thomas Murtha (CMAP), Ted Dahlburg (DVRPC), Ron Achelpohl (MARC), Thomas Maguire (New York City), Alexander Trauger (MetroPlan Orlando), Robert Hillier (City of Portland), Frank DeMasi (Boston MPO), Bill Kuttner (Boston MPO), David Trowbridge (City of Madison), and Gerald Rohsler (Morris County, NJ). All of the people interviewed were welcoming and forthright and exemplified the collaborative spirit necessary to find solutions to today's transportation challenges.

Suggested citation: Holloway, Bill, and Chris Spahr. *Getting the Goods without the Bads: Freight Transportation Demand Management Strategies to Reduce Urban Impacts*. University of Wisconsin, Madison: National Center for Freight & Infrastructure Research & Education and the State Smart Transportation Initiative, September 2013.

Technical Report Documentation Page

1. Report No. CFIRE 07-02	2. Government Accession No.	3. Recipient's Catalog No. **CFDA 20.701**	
4. Title and Subtitle **Getting the Goods without the Bads: Freight Transportation Demand Management Strategies to Reduce Urban Impacts**		5. Report Date September 2013 6. Performing Organization Code	
7. Author/s Bill Holloway and Chris Spahr		8. Performing Organization Report No. **07-02**	
9. Performing Organization Name and Address State Smart Transportation Initiative (SSTI) University of Wisconsin-Madison 1180 Observatory Drive, Suite 7122 Madison, WI 53706 And National Center for Freight and Infrastructure Research and Education (CFIRE) University of Wisconsin-Madison 1415 Engineering Drive, 2205 EH Madison, WI 53706		10. Work Unit No. (TRAIS) 11. Contract or Grant No. **DTRT06-G-0020**	
12. Sponsoring Organization Name and Address Research and Innovative Technology Administration U.S. Department of Transportation 1200 New Jersey Ave, SE Washington, D.C. 20590		13. Type of Report and Period Covered **Final Report 01/01/13 – 09/30/13** 14. Sponsoring Agency Code	
15. Supplementary Notes **Project completed for USDOT's RITA by SSTI and CFIRE.**			
16. Abstract **This project identifies and evaluates strategies to reduce the social costs associated with goods movement in urban areas by managing transportation demand. Information about various freight transportation demand management (TDM) strategies was gathered through a review of literature, an online survey, and interviews with implementers. Strategies are compared based on their costs, benefits, and implementation difficulty. Case studies of six US cities using innovative freight TDM strategies are also provided.**			
17. Key Words Transportation, TDM, demand management, freight, urban freight transportation, goods movement, freight transportation externalities, TDM strategies	18. Distribution Statement **No restrictions. This report is available through the Transportation Research Information Services of the National Transportation Library.**		
19. Security Classification (of this report) **Unclassified**	20. Security Classification (of this page) **Unclassified**	21. No. Of Pages 73	22. Price **-0-**

Form DOT F 1700.7 (8-72) **Reproduction of form and completed page is authorized.**

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Executive Summary

Freight Transportation Demand Management (TDM) strategies help to increase overall transportation system efficiency by shifting the routes, travel times, operational characteristics, or transportation modes used to move goods in order to maximize the value of existing transportation infrastructure. These strategies present more sustainable, cost-effective alternatives to increasing capacity on congested highway and roads that offer health, safety, environmental, and livability benefits as well. In addition, freight TDM strategies can, in many cases, reduce friction between freight and the broader community, lessening public opposition to freight transportation activities.

This study focuses on the use of freight TDM strategies in urban settings and informs the National Freight Strategic Planning process required under Moving Ahead for Progress In the 21st Century (MAP-21) by addressing the following questions:

1. What are the costs of transporting freight by highway and railroad in urban areas?
2. How are these costs allocated to shippers, taxpayers, and society?
3. What freight TDM activities are being implemented in the U.S. to reduce the costs to society of goods movement in urban areas?
4. What metropolitan areas are effectively implementing freight TDM strategies?
5. How can local governments most effectively implement freight TDM strategies?

Costs Associated with Urban Goods Movement

Costs associated with urban freight transportation are borne by shippers and carriers as well as by society and include construction and maintenance of roads, traffic enforcement, crashes, and health problems related to noise and pollution. While costs borne by carriers are built into the freight transportation cost structure and are ultimately paid by consumers, costs to society (also called unpriced costs or negative externalities) are more difficult to quantify and are shouldered by taxpayers, society at large, or specific individuals or neighborhoods. Although it is difficult to quantify the negative externalities generated by freight transportation, they are clearly significant.

The Government Accountability Office (GAO) estimates that for each million ton-miles of freight transported, trucking generates over $58,000 in negative externalities compared to around $9,000 in negative externalities for rail freight.[1] The following table summarizes the GAO estimates of marginal societal costs attributable to trucking and rail that are not passed on to consumers.

[1] Todd Litman, "Rebound Effects," Victoria Transport Policy Institute, March 12, 2013, available at http://www.vtpi.org/tdm/tdm64.htm.

Table E.1: Estimated Marginal Societal Costs Attributable to Truck and Rail Freight Not Passed on to Consumers, per Million Ton-Miles (in 1000s of 2013 dollars)

	Trucking	Railroad
Marginal Social Costs		
Marginal Public Infrastructure Costs (e.g., pavement preservation costs)*	$7.45	-
Emissions of Particulate Matter and Nitrogen Oxide	$46.85	$8.52
Accidents	$8.52	$1.06
Congestion	$7.45	-
Marginal Taxes and Fees		
Taxes and Fees Associated with Marginal Freight Activity	$11.71	-
Marginal Social Costs Not Passed on to Consumers		
Unpriced Costs – Marginal Social Costs Minus Taxes and Fees Associated with Marginal Freight Activity	Over $58	Over $9 (but less than trucking costs that are not passed on)

Source: Government Accountability Office, *Surface Freight Transportation* (2011).
*Infrastructure costs and taxes and fees represent averages of data from fiscal years 2000 through 2006.

Freight Transportation Demand Management Strategies

Due to the importance of freight transportation to economic productivity, the expansion and maintenance of highway and road infrastructure is often the default strategy to facilitate freight movement. However, the cycle of highway expansion followed by increasing congestion and further expansion comes at an enormous economic and environmental price. Freight TDM strategies can achieve many of the same goals as infrastructure-based solutions at a far lower cost. Some of the strategies that have been implemented across the U.S. include:

> **Anti-Idling Policies:** Over 110 states, counties, and municipalities in the U.S. have restrictions against idling to reduce harmful emissions and cut down on noise. Restrictions vary widely in their goals, vehicles covered, idling time limits, enforcement, exemptions, and penalties. While many of these policies cover all types of motor vehicles, trucks are the most common targets.[2] Education, consistent enforcement, and sufficiently high penalties for violations are key aspects of implementing effective anti-idling regulations.

[2] Idling Reduction Working Group, "Motor Vehicle Idling Restriction Review: Draft," Louisville, KY (2008).

Designation of Truck Routes: Designating certain roadways for truck traffic is one of the most common ways that cities manage freight transportation demand. Concentrating truck traffic on specific routes allows local governments to:

- Target corridor infrastructure improvements to primary users
- Reduce exposure of residents to noise, emissions, and vibration
- Separate truck traffic from bicycles and pedestrians

Some strategies that municipalities have implemented across the country include creating a standard truck route network, restricting turns on specific routes, and restricting trucks to arterials with exceptions for pick-ups and deliveries. When proposed truck routes are located in industrial areas, opposition is likely to be low. However, proposals to designate truck routes near residential areas and schools are likely to face significant resistance.

Modal Shift: Several studies have identified shifting a portion of the freight currently traveling by truck onto railroads as a solution to increasing highway congestion, fuel consumption, and air pollution.[3] Some strategies that have been implemented across the country to promote modal shift include policies that minimize highway expansion, protect and enhance freight rail service, and promote rail-oriented industrial development on existing and inactive rail rights-of-way. However, generating reductions in truck traffic by promoting modal shift is extremely difficult due to the logistical links between truck and rail freight and community opposition. Trucks are needed to bridge the "last mile" and to transport containers between rail terminals before continuing to their final destination by rail. In Chicago and many other cities, more rail freight begets more truck freight.[4] Another challenge presented by shifting freight from trucks to trains is the often intense resistance from residents who live in close proximity to the railroad lines that will carry the additional freight.

Changing Pickup and Delivery Hours: Strategies based on changing the hours of freight activity serve two main purposes:

1) Promoting or incentivizing off-peak pickup and delivery – reduces the amount of congestion associated with truck traffic and truck loading and unloading during peak travel times.
2) Restricting nighttime truck traffic and/or pickup and delivery – reduces the amount of nighttime noise in cities.

These two strategies are contradictory and in metropolitan areas facing highway capacity constraints, municipalities should be wary of restrictions on nighttime delivery, which could worsen the situation. For cities and regions that are interested in shifting more freight to off-peak hours, working with industry to develop an incentive-based system for

[3] Gorman, 2008; Bryan et al., 2007; Lee et al., 2009; You et al., 2010; ICF, 2009 as cited in Erica Bickford, "Emissions and Air Quality Impacts of Freight Transportation" (PhD Dissertation, University of Wisconsin, 2012).
[4] Tom Murtha (Senior Planner, Chicago Metropolitan Agency for Planning), Randy Deshazo (Policy Analyst, Chicago Metropolitan Agency for Planning) in discussion with the authors, May 15, 2013.

voluntary off-peak pickup and delivery can achieve significant benefits without generating too much opposition from carriers or incurring large enforcement costs.

Intelligent Transportation Systems: Intelligent Transportation Systems (ITS), defined by the Federal Highway Administration as "electronics, communications, or information processing used singly or in combination to improve the efficiency or safety of a surface transportation system," have had major impacts on the freight transportation sector. Many ITS applications can manage demand by providing drivers and dispatchers with information that allows them to avoid congested areas or otherwise increase the efficiency of their operations in ways that benefit both the carrier and the broader community. Some of these technology solutions include variable message signs, real-time GPS guidance and traffic updates, web-based vehicle scheduling, and load matching systems. While there are safety concerns related to the use of mobile apps during vehicle operation, dynamic messaging signs, audio information, and the use of mobile apps by drivers when safely parked can all improve transportation system efficiency, lowering costs and emissions. ITS strategies represent a low-cost alternative to large-scale infrastructure projects and often have wide appeal.

Land Use Strategies: Industrial waterfront lands, as well as other centrally located freight and industrial sites, are under significant pressure in many cities for commercial and residential redevelopment. In many cases, because of high relocation costs, rail yards and ports may remain in central city areas while distribution centers, factories, warehouses, and other associated uses move to the urban fringe, resulting in increased truck VMT, congestion, and emissions. In order to counter these negative impacts and boost economic development and livability, many cities and MPOs are focusing on land use strategies to maintain and encourage multi modal freight activities within the central city. Zoning regulations are one of the most effective tools that cities have to retain freight intensive land uses in urban areas. Two specific strategies that have been implemented include:

1) Freight Villages – Zoning districts created to foster or maintain freight and industrial activities
2) Industrial Zoning Overlay Districts – special zoning districts, overlaying the existing base zoning classifications, which preserve land with uniquely valuable assets, such as deep water berth access or rail infrastructure, for industrial use

Isolating freight from other land uses and locating freight intensive uses near key transportation infrastructure is generally well received by residents and businesses. Maintaining freight land uses in central areas, however, can be difficult due to development pressures for residential or commercial uses. Additionally, rezoning areas for industrial purposes can receive significant opposition from businesses and residents looking to promote commercial and residential purposes. Emphasizing the jobs, economic development, and transportation benefits of these industrial areas can make creating and preserving them more palatable.

Parking Policies: Providing adequate curbside parking space for commercial vehicles—whether through pricing or time limits—reduces truck double-parking, increases pickup and delivery efficiency, and reduces congestion. Some strategies that cities have implemented to improve availability of parking for freight loading and unloading include:

- Longer loading zones
- Metered loading zones
- Increasing loading zone availability
- More specific signage
- Increased enforcement
- Education and outreach

Collecting data to better understand the barriers facing trucks picking up and delivering goods in downtown areas is critical to developing appropriate parking solutions. Implementing parking policies, such as paid commercial parking, is relatively inexpensive and is usually well received by carriers because it increases turnover of vehicles in loading zones and reduces downtown congestion.

Planning Information Strategies: In order to designate or revise a truck route network, implement delivery time restrictions or incentives, or preserve freight intensive land uses in appropriate locations without generating land use and transportation conflicts, decision makers need to understand how and where freight is moving and the existing freight policy landscape. The first step is to understand where key freight nodes and transportation corridors are located. Next, because freight crosses jurisdictional boundaries, it is important to understand policies in nearby jurisdictions that impact the movement of freight. Regional planning agencies, which lack the authority to pursue other freight TDM strategies on their own, are well positioned to collect and distribute this type of information to their constituent jurisdictions and to lead intraregional efforts to harmonize freight land use and transportation policies.

Case Studies

This report highlights six case studies of metropolitan regions within the U.S. that have implemented the TDM strategies described above. These metropolitan areas include:

- Chicago, IL
- Philadelphia, PA
- Kansas City, MO
- New York, NY
- Orlando, FL
- Portland OR

To develop these case studies, information was gathered from existing literature as well as surveys and interviews conducted for this study. The involvement of stakeholders in developing and implementing TDM strategies was a common theme found in each case study. In order for TDM strategies to work, the involvement of a variety of stakeholders, including shippers, carriers, union representatives, residents, and the commercial sector is critical to the planning process and each strategy needs to be paired with a strong educational component.

Findings

Most of the freight TDM strategies currently in use have significant potential to increase efficiency for businesses as well as reduce negative externalities associated with urban freight transportation. Two of these strategies, however, may create more problems than they solve: restrictions on nighttime freight delivery are likely to exacerbate regional congestion and increase transportation costs, and efforts to affect modal shift from truck to rail may face strong community opposition and end up generating more truck trips than they eliminate.

The table below summarizes the impacts of each TDM strategy on external and private costs as well as their implementation difficulty.

Table E.2: Freight TDM Strategy Impacts and Implementation Difficulty

TDM Strategy	External Costs					Private Costs		Difficulty to Implement
	Congestion	Health	Safety	Noise	Livability	Shipper & Receiver Costs	Carrier Costs	
Anti-idling Policies	0	+	0	+	+	0	+	Low
Designation of Truck Routes	+	+	+	+	+	+	≈	Medium
Modal Shift	≈	≈	≈	≈	≈	≈	≈	High
Off-Peak Pickup and Delivery	+	+	+	-	≈	≈	+	Medium
Restrictions on Nighttime Delivery	-	-	≈	+	≈	≈	-	Medium
ITS Solutions	+	+	0	0	+	+	+	Low
Land Use Strategies	+	+	+	+	+	+	+	Medium /High
Parking Policies	+	+	+	+	+	+	+	Low
Planning Information Strategies	+	+	+	+	+	+	+	Low

Beneficial Impact	+	Detrimental Impact	-	No Impact	0	Dependent upon other variables	≈

Introduction

In recent years there has been a growing interest in using transportation demand management (TDM) strategies to reduce vehicle emissions, personal transportation costs, congestion, and costs borne by society at large for the construction and maintenance of roads, highways, and parking facilities. TDM strategies broadly defined—including location-efficient development, promotion of alternative transportation modes, improved modal integration, and commute trip reduction programs—present more sustainable, cost-effective alternatives to increasing capacity on congested highways and roads. Expanding highway capacity to reduce peak-period congestion is not only extremely expensive, its benefits tend to be largely consumed by induced demand, trips that would have otherwise been made on other routes, at other times, on other modes, or which would not have been made at all.[5]

Historically, TDM strategies have targeted drivers of single occupant passenger vehicles with information, education, and sometimes incentives to carpool, use public transit, walk, bike, telecommute, work different hours, or otherwise adjust their travel behavior to reduce traffic congestion. Freight transportation has generally been left out of the conversation.

Due to the importance of freight transportation to economic productivity the expansion and maintenance of highway and road infrastructure is often the default strategy to facilitate freight movement. However, the cycle of highway expansion followed by increasing congestion and further expansion comes at an enormous economic and environmental price. Transportation agency revenues are unable to maintain this cycle in the face of increasing freight and passenger travel demand and rising construction costs. In addition to fiscal constraints, public interest in more sustainable, livable communities is also pushing transportation agencies towards change.

States, municipalities, and the federal government have all implemented TDM policies to reduce the costs to society associated with goods movement. Specific measures include anti-idling policies, designation of truck routes, truck-to-rail modal shift, restricted or incentivized delivery hours, intelligent transportation systems (ITS), land use strategies, and parking policies. Measures like these, which seek to optimize the transportation system by channeling demand to maximize the value of existing transportation infrastructure, can be described broadly as freight TDM activities. These policies have been driven by a variety of different motivations but economic development, air quality concerns, and congestion mitigation are common goals.

While many TDM strategies are implemented in response to societal costs of cargo movement, freight transportation industry stakeholders also stand to benefit from reduced congestion and increased operational efficiency as well as through better relationships with their communities. Community opposition, which can result in new policies and regulations affecting the freight industry, is a significant threat to freight industry activities in urban areas. By taking an active role in promoting strategies that lessen the negative impacts of goods movement on their communities, freight shippers and carriers can generate goodwill that will translate into a more freight-friendly policy landscape in the future.

[5] Todd Litman, “Rebound Effects,” Victoria Transport Policy Institute, March 12, 2013, available at http://www.vtpi.org/tdm/tdm64.htm

This study highlights the efforts across the country to ensure that the freight industry remains successful in the goods movement that is critical to sustaining vibrant communities. Metropolitan areas that have implemented freight TDM strategies have generally received positive feedback from the freight industry in regards to the strategies. In many cases, reducing the costs to society of freight transportation translates into increased efficiency in goods movement.

The recently enacted federal transportation bill, Moving Ahead for Progress In the 21st Century (MAP-21), requires the development of a National Freight Strategic Plan within 3 years. The plan must include strategies to improve freight intermodal connectivity and best practices to improve the performance of the national freight network and mitigate the impacts of freight movement on communities.[6] The fiscal and environmental challenges facing society in dealing with these issues will inhibit traditional highway-focused solutions and necessitate innovation through more cost-effective and environmentally sustainable freight TDM activities. The present study informs the National Freight Strategic Planning process by addressing the following questions:

1. What are the costs of transporting freight by highway and railroad in urban areas?
2. How are these costs allocated to shippers, taxpayers, and society?
3. What freight TDM activities are being implemented in the U.S. to reduce the costs to society of goods movement in urban areas?
4. What metropolitan areas are effectively implementing freight TDM strategies?
5. How can local governments most effectively implement freight TDM strategies?

In seeking to answer these questions the project team faced several limitations. While this report provides concrete examples of how and why freight TDM strategies have been implemented in metropolitan areas, it relies primarily on qualitative assessments of their costs and benefits. This is due to the lack of sufficient quantitative data due to the limited public availability of existing data, the lack of implementation cost information, and the difficulty of attributing outcomes to specific freight TDM strategies.

It is important for cities considering new freight TDM strategies to be able to estimate the likely impacts in their community. Future research at the community level to more thoroughly quantify the costs and benefits of different freight TDM strategies would be beneficial. Aggregating this type of detailed quantitative data would provide another level of understanding that would allow cities to make better decisions regarding the implementation of freight TDM strategies and more easily communicate potential benefits to stakeholders.

The following sections detail the costs associated with urban goods movement, freight TDM strategies that have been implemented in urban areas across the U.S., case studies of six regions where innovative freight TDM strategies have been put into practice, and, in the conclusion, provides a summary of the costs, benefits, and implementation difficulty of each strategy.

[6] Govtrack.com, "S. 1813 (112th): MAP-21," "Section 1115," available at http://www.govtrack.us/congress/bills/112/s1813/text

Costs Associated with Urban Goods Movement

There is a wide array of costs associated with urban freight transportation. The costs considered by shippers—those paying for the transportation of goods—and carriers—the firms paid to transport goods—include costs for labor, fuel, tolls, and a number of other inputs. While many of these costs are paid directly by the carrier, they are built into the freight transportation cost structure and are ultimately paid by shippers. Other costs associated with freight transportation are much less visible and harder to quantify. Freight transportation costs that are not paid by shippers, such as those associated with the construction and maintenance of roads, traffic enforcement, traffic accidents, health problems due to air pollution, and others, present a much greater challenge to policy makers. These costs to society, also known as negative externalities, or unpriced costs, are difficult to quantify but represent major costs to the public sector as well as to homeowners, residents, and other drivers.

Costs Paid by Shippers

Costs paid by shippers to move goods include labor, fuel, vehicle purchase and maintenance, as well as costs associated with construction and maintenance of the infrastructure they use. These include private costs as well as taxes and fees related to the use of public facilities. These costs are generally passed on to consumers in the competitive market. However, there is considerable uncertainty regarding to what extent trucks pay the cost of the pavement damage that they generate, and it is likely that some of these costs are borne by others.

While transporting freight by rail is significantly more efficient and less expensive over long distances than transporting freight by truck (average transport cost of 2.99 versus 16.54 cents per ton-mile) [7], trains carry somewhat less of our nation's cargo than trucks as measured in ton-miles. **Table 1** shows the maximum amount of cargo that can be transported in a standard semi-trailer or bulk rail car. Each rail car is capable of carrying more than four times the weight of a truck trailer and because trains often are composed of up to 100 rail cars, rail freight is concentrated on far fewer total vehicle moves than is truck freight.

Table 1: Standard Modal Freight Unit Capacities and Estimated Ton-Miles of Domestic Surface Freight Shipped by Mode in 2007

Mode	Modal Freight Unit	Standard Cargo Capacity	Ton-miles (in millions)	Source
Trucking	Truck Trailer	25 Tons	2,040,000	Federal Highway Administration (FHWA)
Railroad	Bulk Car	110 Tons	1,819,633	Bureau of Trans. Statistics, Nat'l Trans. Statistics

Source: Government Accountability Office, *Surface Freight Transportation*, 2011

[7] United States Department of Transportation, "Table 3-21: Average Freight Revenue Per Ton-mile (Current Cent)," available at http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/national_transportation_statistics/html/table_03_21.html

While rail is usually less expensive for longer movements, trucking is often more cost-effective for shorter movements, especially when the associated logistics costs are considered. In addition, rail is often more expensive on light-density lines and fuel efficiency benefits of rail fade for very short trains and cumbersome switching moves. [8]

Multiple market segments are served by the trucking industry, not all of which are competitive with rail. Local and regional trucking accounts for most truck movements in urban areas, and rail is competitive for almost none of this traffic (high-volume moves of sand and gravel, road salt, coal, or oil products are the major exceptions). [9]

Because shippers and carriers seek to minimize their costs and maximize profits, incentivizing changes through taxes and fees can be effective. It has been found that additional taxes or fees will lead businesses to change their behavior to minimize their tax burden. Potential strategies that businesses might use to minimize their tax burden if additional taxes or fees are imposed include:

- Substituting gasoline-powered trucks for diesel-powered trucks or vice versa
- Shipping by rail instead of truck
- Increasing the size of truck loads and reducing empty backhaul trips, thereby shipping more ton-miles with fewer truck miles
- Improving vehicle utilization, thereby shipping more freight using fewer trucks[10]

Similarly, transportation investments that lower logistics, loading, warehousing, or production costs also have the potential to change freight transportation patterns.

This report focuses primarily on identifying practices to reduce the costs to society generated by urban freight transportation. These include all costs that are not paid by those moving the goods and include congestion, safety, noise and vibration, and air pollution.

Costs to Society

Congestion

Congestion costs are typically calculated using the value of time for the people caught in traffic, including commuters, other automobile users, bus riders, business travelers, local truck drivers, and intercity truck drivers. Consequential costs are those that extend beyond the time value. For example, a truck that misses a 15-minute delivery window can: (1) disrupt the production or merchandising of goods by the recipient; (2) interfere with other trucks maneuvering into tight spaces and scheduled door capacity at customer docks; and/or (3) be held outside or turned away—and in the latter case, the Vehicle Miles Traveled (VMT) of local delivery is tripled, as

[8] Joseph Bryan, et al., "Rail Freight Solutions to Roadway Congestion: Final Report and Guidebook; Vol. 586," Transportation Research Board National Research, 2007, accessed September 11, 2013, http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_586.pdf.

[9] Ibid.

[10] Shama Gamkhar and Steptoe and Johnson, LLP, "Dedicated Revenue Mechanisms for Freight Transportation Investment," *Transportation Research Board National Research* Vol. 7 (2012), The Tioga Group; Economic Development Research Group, Inc.

the truck departs for a holding point and returns later. While predictable congestion and resultant delay impose costs on shippers, a lack of travel time reliability can be a much bigger impediment to modern logistics strategies.

The FHWA's Highway Cost Allocation Study, revised in 2000, estimated the marginal costs per mile for a variety of trucks on urban and rural interstate highways. While the study is now 13 years old and construction costs have increased, the relative costs attributable to each vehicle type remain valid. **Table 2** details the estimated congestion costs imposed on road users by trucking and rail freight activity.[11] These costs are due to the additional congestion caused by trucks on the road and the time roadway users spend waiting at rail crossings.[12]

Table 2: Cross-Modal Comparisons of Congestion Costs

	Trucking	Railroad	Trucking to rail ratio
Cost of delay to road users in 2000, (in billions of constant 2013 dollars)	$11.56	$0.62	18.65

Source: FHWA, *Addendum to the 1997 Federal Highway Cost Allocation Study* (2000).

More recent estimates from Delucchi and McCubbin of congestion delay costs per ton-mile (**Table** 3) show a similarly large gap between truck and rail in terms of congestion costs that they impose on road users.

Table 3: Summary of Congestion Delay Cost Estimates by Transport Mode, 2013 (cents)

	Trucking	Railroad
Cost of delay to road users (per ton mile)	0.25 - 0.62	0.03

Source: Delucchi and McCubbin, *External Costs of Transport in the US* (2010).

Safety

The safety impacts of freight transportation are reflected in the number of accidents with injuries and fatalities involving trucks and trains. Safety is a concern of carriers, shippers, other motorists, roadside property owners, and society in general. Factors contributing to truck accidents include driver fatigue, vehicle defects, and unsafe driving behavior by truckers and others on the road. Road conditions and improper loading also influence safety. Injuries and fatalities related to trains are most often related to derailments, collisions between trains and vehicles at at-grade crossings, and pedestrian trespassers in rail yards or on tracks.[13] According to the Government Accountability Office's (GAO) analysis of DOT data nationwide between 2003 and 2007, large trucks were involved in about six times more crashes with fatalities and 17 times more crashes with injuries, per billion ton-miles, than freight rail (**Table 4**).

[11] U.S. Department of Transportation: Federal Highway Administration, "Addendum to the 1997 Federal Highway Cost Allocation Study Final Report," May 2000, available at http://www.fhwa.dot.gov/policy/hcas/addendum.htm.

[12] Mark A. Delucchi and Donald R. McCubbin, "External Costs of Transport in the U.S.," Institute of Transportation Studies; University of California, Davis; January 1, 2010, available at http://escholarship.org/uc/item/13n8v8gq.pdf.

[13] Freight Transport for Development, "Road Safety (Traffic Accidents)," available at http://www.ppiaf.org/freighttoolkit/toolkit/developments-issues/issues/road-safety-traffic-accidents.

Table 4: Average Annual Accident Fatalities and Injuries, per Billion Ton-Miles, Average of 2003 to 2007

Mode	Fatalities	Injuries	Estimated billion ton-miles	Fatalities per billion ton-miles	Injuries per billion ton-miles
Trucks [a]	5,069	111,800	1,997	2.54	56.05
Trains [b]	683	5747	1,739	0.39	3.32

Source: Government Accountability Office, *Surface Freight Transportation*, 2011

[a] Fatalities and injuries reported in Federal Motor Carrier Safety Administration's Large Truck and Bus Crash Facts 2007 (table 1 and table 4). Trucks are defined as over 10,000 gross vehicle weight, which can include some non-freight activity. For example, in 2007, 12.3 percent of large trucks involved in a fatal accident and 13.2 percent involved in accidents with injuries were dump, garbage, or concrete mixer trucks.

[b] Fatalities and injuries reported in Federal Railroad Administration Office of Safety Analysis's accident/incident online data reporting system table 1.07.

The fatality and injury rate per mile of vehicle travel have declined steadily for many years due to a reduction in alcohol use, increased use of seatbelts, improved vehicle safety, and other factors. However, these reductions have been offset by growth in VMT causing total road fatalities to remain constant. The estimated costs of collisions include medical costs, property damage, lost productivity, insurance administration, emergency services, and the much more difficult to monetize costs of fatalities and pain and suffering. In the case of travel by road, the estimated cost of collisions is greater than every other social cost except travel time.[14] Delucchi and McCubbin have estimated collision costs by transport mode (**Table 5**). The wide range of costs attributed to trucking collisions is mainly due to differences in key valuation parameters, such as the value of life lost or of pain and suffering, and in the definition and estimation of crash-related externalities.

Table 5: Summary of Collision Cost Estimates by Transport Mode, 2013 (cents)

	Trucking	Railroad
Accident Cost (per ton mile)	0.13 - 2.30	0.25

Source: Delucchi and McCubbin, *External Costs of Transport in the US* (2010).

Noise and Vibration

Noise from freight operations, such as train whistles, horns, braking, loading and unloading, and other activities can become an annoyance to neighbors, especially during late hours. Very often, freight-related noise is accompanied by vibration. Vibration is often caused by the movement of heavy freight and machinery. Vibration not only can be an annoyance resulting in complaints, but it also can result in actual property damage at certain frequencies over sustained periods of time, and may necessitate improved construction or infrastructure retrofits for buildings.

Having freight operations deemed a nuisance can result in costly or demanding mitigation techniques such as sound barriers, quiet zones, no-jake/air-braking zones, restricted gate or terminal hours, and restricted routes.[15] The external cost of noise from transport includes the value of damages from excess noise experienced, as well as the costs of any defensive actions or

[14] Delucchi, "External Costs of Transport in the U.S."

[15] Envision Freight, "Freight Land Use Conflicts," accessed March 4, 2013, available at http://www.envisionfreight.com/issues/index.html.

avoidance behavior.[16] Freight-related noise is often a prominent enough problem that it measurably affects the value of homes. Econometric or "hedonic" price analyses measure this effect by estimating the sales price of a house as a function of a number of important characteristics, including the ambient noise level or distance from a major noise source. **Table 6** displays the estimated noise-related costs of trucking and freight rail transportation. [17]

Table 6: Summary of Noise Cost Estimates by Transport Mode, 2013 (cents)

	Trucking	Railroad
Noise Cost (per ton-mile)	0.0 - 6.1	0.06

Source: Envision Freight, *Freight and Land Use Conflicts* n.d.

Studies also have shown a connection between environmental noise exposure and health. These studies have shown that noise exposure can contribute to cardiovascular disease, cognitive impairment in children, sleep disturbance, tinnitus (the sensation of sound in the absence of an external sound source), and annoyance levels. [18]

Air pollution

Diesel exhaust is known to cause adverse effects on human health. While not a significant contributor to carbon monoxide (CO) and hydrocarbon (HC) emissions, diesel exhaust contains relatively large amounts of particulate matter (PM) and nitrogen oxide (NOx). According to a GAO assessment of EPA's latest national emissions inventory data (2002), freight trucks produced over six times more fine particulate matter and over four times more nitrogen oxide on a ton-mile basis than freight locomotives. Additionally, trucks emitted the highest levels of greenhouse gas (CO2 equivalents) among the freight modes—about eight times more than freight rail.[19]

NOx and fine particulate matter (PM2.5) are two key regulated emissions typically comprising the majority of estimated air pollution external costs.[20] When natural and miscellaneous sources are left out, diesel vehicles are responsible for 23% of PM2.5 emissions and can account for as much as 35% in urban areas. These particles are small enough to penetrate deep into the lungs, causing short- and long-term health problems. Short-term exposure can cause acute symptoms such as eye, throat, or bronchial irritation, lightheadedness and nausea. Diesel heavy-duty vehicles (HDVs) also account for 34% of NOx emissions, while 5% of the NOx emissions are from gasoline HDVs. Once emitted, NOx can react with other chemicals in the air and form PM2.5. In addition, NOx and HC together form smog, which hinders visibility.
Table 7 and **Table 8** detail the GAO's estimates of PM2.5 and NOx emissions and their cost impacts due to truck and freight rail transportation.

[16] Delucchi, "External Costs of Transport in the U.S."
[17] Ibid.
[18] World Health Organization et al., "Disease Control Priorities Related to Mental, Neurological, Developmental and Substance Abuse Disorders," 2006, available at http://www.dcp2.org/file/64/.
[19] U.S. Government Accountability Office, "Surface Freight Transportation."
[20] U.S. Government Accountability Office, "Surface Freight Transportation."

Table 7: Estimated Tons of Freight Related $PM_{2.5}$ and NO_X Emissions, per Million Freight Ton-Miles for Trucks and Locomotives in 2002

Mode	Estimated tons of PM2.5 Emissions	Estimated Tons of NO_X Emissions	Estimated millions of ton-miles	Estimated Tons of PM2.5 per million ton-miles	Estimated tons of NO_X per million ton-miles
Trucks	229,754	5,824,060	1,928,914	0.1191	3.0193
Rail Locomotives	28,690	1,083,320	1,605,532	0.0179	0.6747

Source: Government Accountability Office, *Surface Freight Transportation* (2011).

Table 8: Estimated Damages of Freight-Related PM2.5 and NOx Emissions per Ton-Miles for Trucks and Locomotives in 2002

Mode	Estimated damages per ton of PM2.5 emissions (2013 dollars)	Estimated damages per ton of NO_X emissions (2013 dollars)	Estimated damages from PM2.5 per million ton-miles (thousands of 2013 dollars)	Estimated damages from NO_X per million ton-miles (thousands of 2013 dollars)	Total estimated damages from NO_X and PM2.5 per million ton miles (thousands of 2013 dollars)
Trucks	$267,737	$4,903	$31.89	$14.82	$46.71
Rail Locomotives	$267,737	$4,903	$4.78	$3.31	$8.09

Source: Government Accountability Office, *Surface Freight Transportation* (2011).

Air pollution emissions have seen a dramatic decline over the past 20 years due to improvements in engine design and fuel quality. Regulatory changes should contribute to further reductions in air pollution emissions over the next 20 years. Regulations impacting new locomotives constructed in 2015 and later are expected to generate large emissions reductions, decreasing PM emissions by up to 90% and SOx emissions by up to 80%.[21] Diesel fuel has also grown significantly cleaner in recent years, with both trucks and locomotives now using ultra-low sulfur diesel fuel (ULSD), which has a sulfur content of 15 ppm. Even without additional emissions reduction technologies, such as PM filters, the change to ULSD from the low sulfur diesel fuel (500 ppm) previously used by trucks can reduce emissions 5-9%.[22] Locomotives, which used fuel with a sulfur content of up to nearly 3000 ppm until 2007, converted in 2012 to ULSD, which will yield substantial emissions improvements, even for existing engines.

[21] U.S. Environmental Protection Agency, "Locomotives," Accessed March 8, 2013, available at http://www.epa.gov/otaq/locomotives.htm.

[22] U.S. Environmental Protection Agency, "Retrofits and Cleaner Fuels," accessed March 12, 2013, available at http://www.epa.gov/region1/eco/diesel/retrofits.html#usdf.

Pavement Damage

Trucking companies use highways that are paid for by all taxpayers and, while they pay much more than passenger vehicles in taxes and fees, the roadway damage costs are borne by all users. Higher levels of heavy truck traffic typically require significant capital expenditure on bridges, ramps, highway geometric features such as horizontal and vertical curves and shoulders, truck stops, weigh stations, signage, etc., as well as higher routine maintenance costs. Railroad infrastructure, in contrast to highway infrastructure, is primarily owned and maintained by the rail companies. Problems caused by railroads are much more internalized than those caused by trucks. Because railroads themselves cause and suffer from the effects of railway congestion and track deterioration, they have an incentive to invest in track and equipment based on the marginal effects on train speed, line capacity, and life cycle costs of the track structure.[23]

The extent of damage to pavement by vehicles depends on a number of factors including the weight and axle configuration of the vehicle, and the design of the roadway. Estimates of pavement damage by trucks range from 5 to 55 cents per mile depending on the weight of the truck. The heavier the vehicle, the more damage to pavement and bridges it causes. A four-axle, single unit truck weighing 60,000 pounds can cause six times as much pavement damage as a comparable truck weighing 40,000 pounds. Damage to pavement is the largest per-mile external cost of truck use. [24]

The FHWA's Highway Cost Allocation Study, revised in 2000, estimated the marginal costs per mile for a variety of vehicles on urban and rural interstate highways. While the study is now 13 years old and construction costs have increased, the relative costs attributable to each vehicle type remain valid. The pavement costs represented in **Table 9** represent the contribution of a mile of travel by different vehicles to pavement deterioration and the costs of repairing the damage.

Table 9: Marginal Costs of Urban Highway Use by Trucks Due to Pavement Damage, 2000

Vehicle Class	Pavement Damage (Cents per Mile)
40,000 pound 4-axle Single Unit Truck	3.1
60,000 pound 4-axle Single Unit Truck	18.1
60,000 pound 5-axle Combination Truck	10.5
80,000 pound 5-axle Combination Truck	40.9

Source: FHWA, *Addendum to the 1997 Federal Highway Cost Allocation Study* (2000).

Public Cost Recovery Strategies

Highway user charges are fees upon owners and operators of motor vehicles for their use of public highways. The traditional purpose of these fees has been to finance highway improvement and maintenance programs. The federal government and many states deposit large parts of their highway user revenues in dedicated highway trust funds. This shows a direct relationship

[23] Bryan, et al., "Rail Freight Solutions to Roadway Congestion".

[24] Congressional Budget Office, "Spending and Funding for Highways," *Economic and Budget Issue Brief* (Jan. 2011), available at http://www.cbo.gov/sites/default/files/cbofiles/ftpdocs/120xx/doc12043/01-19-highwayspending_brief.pdf.

between highway user fees and highway program financing. Federal highway user revenues come from taxes on fuels, heavy trucks, truck tires, and a heavy vehicle use tax (HVUT) on trucks with registered weights over 55,000 pounds. Analyses of economic costs attributed to different vehicle classes are important in considering the economic efficiency of highway user fees. As discussed in this report, the external costs of truck and rail transportation include environmental, safety, and delay costs imposed on others as well as infrastructure costs. Highway cost allocation studies (HCAS) traditionally have focused on the extent to which each vehicle class pays its fair share of highway costs for which it is responsible. This report focuses primarily on the costs that are not borne by transportation agencies, but by motorists and society at large. These costs include environmental, safety, congestion, and other costs associated with highway use. Transportation agencies have attempted to combat these external costs through regulatory and programmatic initiatives to reduce crashes, emissions, and other negative consequences of highway use that create costs for society. Significant progress has been made in reducing many of the costs to society of highway use, but substantial costs remain.

On average, trucking generates significantly more unpriced costs (costs to society) than freight rail. The GAO estimates that trucking generates over $58,000 per million ton-miles in costs to society compared to just over $9,000 in costs to society per million ton–miles of rail freight. [25] **Table 10** summarizes the GAO estimates of marginal social costs attributable to each freight mode not passed on to consumers, per million ton-miles.

Table 10: Estimated Marginal Societal Costs Attributable to Truck and Rail Freight Not Passed on to Consumers, per Million Ton-Miles (in 1000s of 2013 dollars)

	Trucking	Railroad
Marginal Social Costs		
Public Infrastructure Costs (e.g., pavement preservation costs)*	$7.45	-
Emissions of Particulate Matter and Nitrogen Oxide	$46.85	$8.52
Accidents	$8.52	$1.06
Congestion	$7.45	-
Marginal Taxes and Fees		
Taxes and Fees Associated with Marginal Freight Activity	$11.71	-
Marginal Social Costs Not Passed on to Consumers		
Unpriced Costs – Marginal Social Costs Minus Taxes and Fees Associated with Marginal Freight Activity	Over $58	Over $9 (but less than trucking costs that are not passed on)

Source: Government Accountability Office, *Surface Freight Transportation* (2011).
*Infrastructure costs and taxes and fees represent averages of data from fiscal years 2000 through 2006.

[25] U.S. Government Accountability Office, "Surface Freight Transportation: A Comparison of the Costs of Road, Rail, and Waterways Freight Shipments That Are Not Passed on to Consumers," January 26, 2011, available at http://www.gao.gov/products/GAO-11-134.

Freight Transportation Demand Management Strategies

The previous section of this report focuses on the costs associated with urban freight transportation with an emphasis on the costs borne by society. While much has been done to reduce these costs to society, substantial costs remain. Strategies that involve significant infrastructure improvements, including the construction of grade-separated rail lines, expansion of highways to include truck only lanes, or retrofitting existing streets to better accommodate freight, require significant infrastructure investments that can put strain on the budgets of struggling state and local governments.

TDM strategies offer a low-cost option for state and local governments to address the costs to society in their communities. This section describes some of the strategies that are currently being implemented across the United States:

- Anti-idling policies
- Designation of truck routes
- Policies to promote modal shift
- Adjusting delivery hours
- Intelligent transportation systems
- Land use strategies
- Parking policies
- Planning information strategies

A summary table of the impacts of these strategies on the costs to society, as well as the level of difficulty of implementation, can be found in the conclusion of this report.

Anti-Idling Policies

Truck idling occurs for various reasons including operating the heat or air conditioning, powering accessories, and protecting the truck engine during cold weather.[26] While auxiliary power units (APUs) can power climate control and electronics when a truck's main engine is turned off, truckers without APUs spend an average of roughly 1,800 hours a year idling their engines. With trucks consuming about1 gallon of fuel per hour, this amounts to over 1.2 billion gallons of diesel fuel each year.[27] Each year truck idling generates 11 million tons of carbon dioxide, 136,000 tons of carbon monoxide, 180,000 tons of nitrogen oxide, and 5,000 tons of particulate matter.[28] In addition, truck idling causes significant wear and tear on engines. The U.S. Department of Energy estimates that, in terms of engine wear, idling engines operate at 3-11% efficiency compared to 40% efficiency while driving, and that U.S. firms spend $1 billion each year on idling-related engine repairs.[29]

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[26] Metropolitan Council of Governments as cited in Center for Energy and Environmental Policy, "Investigating the Cost, Liability and Reliability of Anti-Idling Equipment for Trucks," University of Delaware, 2007.

[27] Stodolsky et al., as cited in Center for Energy and Environmental Policy, "Investigating the Cost, Liability and Reliability of Anti-Idling Equipment for Trucks," University of Delaware, 2007.

[28] NYSERDA, 2004 as cited in Center for Energy and Environmental Policy, "Investigating the Cost, Liability and Reliability of Anti-Idling Equipment for Trucks," University of Delaware, 2007.

[29] U.S. DOE, 2006 as cited in*:* Center for Energy and Environmental Policy, "Investigating the Cost, Liability and Reliability of Anti-Idling Equipment for Trucks," University of Delaware, 2007.

Over 110 states, counties, and municipalities in the U.S. have restrictions against idling to reduce the amount of harmful emissions and cut down on noise. Restrictions vary widely in their goals, vehicles covered, idling time limits, enforcement, exemptions, and penalties. While many of these policies cover all types of motor vehicles, freight vehicles—defined as "trucks," "commercial vehicles," "diesel vehicles," "heavy duty vehicles" or other terms—are the most common targets.[30]

The Louisville, Kentucky Idling Reduction Working Group performed a review on idling restrictions implemented across the United States. According to the Working Group[31], jurisdictions cite the following reasons for their anti-idling regulations:

- Emission reduction
- General air quality
- General public health
- NAAQS Attainment
- Noise control
- Odor control
- Toxics reduction
- Tourism management

Of the jurisdictions that have anti-idling policies, 11% are county regulations, 24% are state regulations, and 64% are local regulations. The restrictions appear in the form of local laws, ordinances, regulations, and statutes. Most allow idling for a 1-15 minute idling period, with 5 minutes being most common.

In most cases local law enforcement authorities are responsible for enforcing anti-idling regulations; however, some jurisdictions assign enforcement responsibilities to health departments, parking authorities, or other local officials. Violators are identified either through complaints by local residents or through law enforcement patrols with a combination of both strategies being the most common. Minimum penalties range from $20 to $500, while maximum penalties range from a low of $50 up to $10,000, with some jurisdictions reporting no maximum penalty. While most of these penalties are aimed at drivers, some provide for penalties to vehicle owners or the owner of property where idling is taking place.

Most anti-idling regulations include certain exemptions based on conditions, activities, or vehicle type. **Table 11** lists the types and frequencies of exemptions in the local, state, and county anti-idling regulations identified by the Louisville Air Pollution Control District's Idling Reduction Working Group in 2008.

[30] Idling Reduction Working Group, "Motor Vehicle Idling Restriction Review: Draft," Louisville, KY, 2008, available at http://www.louisvilleky.gov/APCD/Stakeholder/Idling.htm.

[31] Ibid.

Table 11: Types and Frequencies of Exemptions in Local, State, County Anti-Idling Regulations, 2008

Exemption		Jurisdiction Type			Total
		Local	County	State	
Conditions	Traffic Conditions/Signals	25	7	22	**54**
	Min. Temp.	22	2	11	**35**
	Comm. Passenger Comfort	9	5	11	**25**
	Necessary Operation of Heat/Air	7	1	14	**22**
	Comm. Passenger Safety	4	3	3	**10**
	Max. Temp.	4	1	3	**8**
	Queuing	1	1	6	**8**
	Weather Conditions	2	2	2	**6**
	Time of Day	3	0	0	**3**
	Unforeseeable/Unavoidable Event	1	0	1	**2**
	State and Fed. Emergencies	0	0	1	**1**
	Noise Limits are Met	1	0	0	**1**
Activities	Operation of PTO or Aux. Equip. (Task Related)	34	11	24	**69**
	Maint. & Repair Requirements	19	8	21	**48**
	Emergency Vehicle in an Emergency Situation	15	5	14	**34**
	Load/Unload Passengers	12	2	9	**23**
	Sleeping in Vehicle	8	3	12	**23**
	State or Federal Inspection	8	0	10	**18**
	Operation of Defroster	3	2	10	**15**
	Manufacturer's Specs.	4	4	7	**15**
	Daily Vehicle Inspection	2	2	4	**8**
	Operators Place of Business	4	0	1	**5**
	Equip. Operates Intermittently	2	1	0	**3**
	Load/Unload Location Activities	1	0	2	**3**
	Collection of Solid Waste/Recycling	0	0	3	**3**
Vehicles	Emergency Vehicles	15	3	3	**21**
	Alt. Fuel/Tech. Vehicles (Hybrid, Biofuel, etc.)	6	2	3	**11**
	Armored Vehicles	1	0	8	**9**
	Official Vehicles (Federal, State, Military, etc.)	4	0	3	**7**
	Public Utility Vehicles	6	0	1	**7**
	Public Transit Buses	2	0	4	**6**
	Construction & Maint. Vehicles	4	0	0	**4**
	School Buses	1	0	3	**4**
	Airport Ground Support Equipment	1	0	2	**3**
	Private Passenger Vehicles	2	0	1	**3**
	Snow Removal Vehicles	0	0	1	**1**
	Historic Vehicles	0	0	1	**1**

Source: Louisville Air Pollution Control District's Idling Reduction Working Group.

Minneapolis's Anti-Idling Vehicle Ordinance[32] was adopted in 2008 in response to human health concerns associated with increased rates of cancer, heart and lung disease, asthma, and allergies. The City of Minneapolis cites the purpose of the ordinance as improving air quality, saving energy, protecting human health, improving engine performance, and decreasing maintenance

[32] City of Minneapolis Code of Ordinances, "Title 3, Chapter 58," Adopted June 6, 2008, available at http://www.minneapolismn.gov/www/groups/public/@regservices/documents/webcontent/convert_283965.pdf

needs.[33] Under the ordinance, commercial diesel powered vehicles are permitted to idle for 5 consecutive minutes under normal operations and may idle no more than 30 consecutive minutes at loading and unloading locations. Vehicle operators can be fined up to $200 for violations. Exemptions are made to protect health and safety, and include idling in traffic and in extreme temperatures.

Minneapolis Environmental Services is responsible for enforcement of the ordinance. However, the agency has focused more on education of citizens and city staff about the ordinance than actual enforcement. Flyers, an educational "warning ticket", and a web page[34] have been created as part of this campaign. Through education the city hopes that the regulation will be largely self-policing. However, citizens may report violations via the City's "311" hotline.

Implementation

Cities, counties, and states considering policies to reduce truck idling should be sure to consider how rules will be publicized, the logistics of enforcement, penalties for violations, and responsibility. Education, consistent enforcement, and sufficiently high penalties are important to effect changes in vehicle operator behavior. Because non-owner drivers are often unable to implement changes to their vehicles, designating responsibility for violations to vehicle owners and/or property owners can increase the equity of anti-idling rules. Penalties can act as an incentive for vehicle owners to invest in APUs or other idle reducing technologies. Similarly, imposing fines on the owners of property where idling violations take place can encourage them to enforce anti-idling standards on their own. In order to develop the most effective and equitable idle reduction policies, community and industry stakeholders, and specifically vehicle operators, should be involved.

Designation of Truck Routes

Truck traffic is an unavoidable byproduct of the goods movement necessary to support urban areas. However, these trucks—which often share the roads with passenger vehicles, bicycles, and pedestrians—create a variety of negative impacts including congestion, emissions, noise, and safety concerns for other road users as well as nearby residents and businesses. Designating certain roadways for truck traffic is one of the most common ways that cities manage freight transportation demand. Concentrating truck traffic on specific routes allows local governments to:

- Target infrastructure improvements to primary users by providing more generous turning radii and greater overhead clearance on truck routes.
- Reduce exposure of residents to noise, emissions, and vibration by identifying truck routes that avoid residential areas.
- Separate truck traffic from bicycles and pedestrians by reducing truck traffic on key pedestrian and bicycle thoroughfares.

[33] American Council for an Energy-Efficient Economy, "Case Study - Minneapolis Anti-Idling Vehicle Ordinance," n.d., available at http://aceee.org/files/pdf/case-studies/Minneapolis_Anti-Idling.pdf.

[34] City of Minneapolis Health Department, "Anti-idling Vehicle Ordinance," August 2008, available at http://www.minneapolismn.gov/environment/air/airquality_antiidling_home.

While many cities across the U.S. have implemented truck routes as a means of channeling truck traffic to preferred streets, there are other infrastructure strategies that can achieve similar results. There are several examples of truck-only lanes and roadways in the U.S., including those serving the ports of New Orleans and Boston and the World Trade Bridge in Laredo, Texas. However, these are major infrastructure projects and would not be classified as freight TDM.[35]

Before the City of Orlando designated truck routes, trucks traveling in the city's central business district were spread across the area's roads, mixing with pedestrian, bicycle, and passenger vehicle traffic and causing congestion, safety, and livability concerns. The Downtown Orlando truck route designation system has allowed the city to create a more livable environment on truck-restricted streets and target truck-friendly infrastructure improvements and operational changes to designated truck routes. By restricting trucks to specific routes, the city can more efficiently meet the needs of all modes of transportation.[36]

Standard Truck Route Network

In California, the City of Berkeley's truck route network and associated rules represent one of the most common methods of managing freight travel demand. Trucks in Berkeley are required to stay on the city's designated network of truck routes as much as possible, but are allowed to travel on streets not designated as truck routes to reach pick-up and delivery locations. However, trucks must use the shortest possible route between the truck route network and their destination.

Beyond the regular truck routes in the city, a number of roads are designated as three-, four-, or five-ton maximum routes. Trucks below these limits can use these roads as truck routes; those who exceed the limits must treat them as regular streets.

Turn Restrictions

The New York City DOT alleviated congestion attributed to turning movements in Midtown Manhattan by implementing its THRU Streets Program. The city restricted vehicles from turning off of THRU streets between the hours of 10 a.m. and 6 p.m. significantly improving the flow of traffic by eliminating obstructions created by vehicles waiting for pedestrians before making a turn.[37] Even though THRU streets were not specifically designated as truck routes, carriers began to divert to the THRU streets reducing traffic on "Non-THRU" streets.

Arterials-Only

With few exceptions, Phoenix, Arizona classifies its entire arterial street network, which is composed of section line roads forming a one-mile grid, as truck routes. Trucks may travel on non-arterial streets to make pickups and deliveries as needed but must use the shortest possible route from the arterial network. Phoenix chose to designate all arterial streets as truck routes for the dual purposes of promoting mobility for trucks and spreading out the impact of heavy

[35] "SDOT: Urban Mobility Plan - Briefing Book," available at http://www.seattle.gov/transportation/briefingbook.htm.

[36] Marsha Anderson Bomar, et al., *Urban Freight Case Studies: Orlando*, Federal Highway Administration, November 2009, available at http://ops.fhwa.dot.gov/publications/fhwahop10021/orlandointro.htm.

[37] New York City Department of Transportation, *Thru Streets – An Innovative Approach to Managing Midtown Traffic*, 2004, available at http://www.nyc.gov/html/dot/downloads/pdf/thrustreetsreport04.pdf.

vehicles over the network to dilute their adverse impacts.[38] Because no residential areas in the city are located on arterial routes, the neighborhood impacts of truck traffic are limited.[39]

In addition, the city identified two zones in its central business district within which truck traffic is restricted during certain hours. It also designated major highways in the area as "through truck routes" on which trucks may travel without restriction, even within the truck restricted zones.[40]

Implementation

Before designating truck routes, it is important to study current trends in truck movement and identify the routes with appropriate road geometries within the city to ensure efficient connectivity to downtown areas. All planning authorities with responsibilities for roads in the urban area, as well as the freight transport industry, should be involved in identifying truck routes to ensure that they link key destinations, avoid sensitive populations, and are coordinated across jurisdictional boundaries. Additionally, truck routes should be clearly mapped and identified with road signs and cities should consider adjusting signal timing on truck routes (increasing the yellow and green signal phases to meet increased acceleration and deceleration requirements) to improve the flow of truck traffic.[41]

Policies to Promote Modal Shift

Trucks currently transport 73% of domestic freight by weight.[42] Several studies have identified a modal shift from trucks to rail as a solution to highway congestion, growing fuel consumption, and vehicular pollution.[43] These studies have concluded that, if there were sufficient rail infrastructure in place to support the transition, a large-scale shift of freight from truck to rail would result in a significant reduction in social costs in terms of emissions reductions, congestion, and safety. While governments largely lack control over which transportation mode shippers choose, some efforts have been made to encourage a shift from highway to railroad.

Land Use and Transportation Policy Solutions

Morris County, NJ, a suburban area outside New York City, experiences a large amount of freight traffic leading to congested highways. The county is now promoting modal shift to better balance freight transportation needs with local livability concerns. By minimizing highway capacity expansion, protecting and enhancing freight rail service, and promoting rail-oriented industrial development on existing and inactive rail rights-of way, the county is trying to increase the portion of its freight being moved by rail.

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[38] City of Phoenix, "Digest of Truck Route Ordinances," April 6, 2005, available at http://phoenix.gov/webcms/groups/internet/@inter/@dept/@streets/documents/web_content/truckmap.pdf.

[39] U.S. D.O.T. Volpe Center; prepared for Baltimore City Department of Transportation, "Dundalk Area Truck Impact Study – Final Project Report," November 2006, available at http://ntl.bts.gov/lib/35000/35500/35508/Dundalk_Area_Truck_Impact_Study_Report.pdf.

[40] City of Phoenix, "Digest of Truck Route Ordinances."

[41] Bomar et al., "Urban Freight Case Studies: Orlando."

[42] AASHTO, "*Unlocking Freight: part 2 of a series*," July 2010, available at http://nfl.transportation.org/Documents/UGFR-1-OL.pdf.

[43] Gorman, 2008; Bryan et al., 2007; Lee et al., 2009; You et al., 2010; ICF, 2009 as cited in Erica Bickford, "Emissions and Air Quality Impacts of Freight Transportation" (PhD Dissertation, University of Wisconsin, 2012).

Investment Solutions

Some strategies are more cost intensive and, while achieving the goal of modal shift, involve infrastructure expansion components that fall outside the realm of strict TDM. The Kansas State Rail Service Improvement Fund, started in 1999, began as an annual revolving loan program to provide low-interest loans to short-line railroads to maintain infrastructure. While economic development is a major goal of this program, it also is intended to reduce highway maintenance costs and provide air quality benefits by maintaining or increasing the share of freight moving by rail instead of truck. This program is funded indefinitely at $5 million annually and has widened its focus to include capacity expansion projects such as construction of new passing tracks and interchanges, new rail spurs, and grain elevator improvements to increase the number of rail cars that can be loaded.[44]

Implementation

While there are clear benefits to a shift from truck to rail for long distance freight movement and for freight traveling through cities, truck-to-rail modal shift may create more problems than it solves when applied to shipments originating or terminating in cities because trucks are needed to bridge the "last mile"—the gap between origins/destinations of shipments and the intermodal terminals where they are loaded or unloaded from trains. In addition, at freight rail hubs containers are often moved by truck between rail terminals before continuing on to their destination by rail. In Chicago and many other cities, more rail freight begets more truck freight.[45]

Another challenge presented by shifting freight from trucks to trains is the often intense resistance from residents who live in close proximity to the railroad lines that will carry the additional freight. One example of the potentially intense resident resistance to increased rail freight volumes is the case of Canadian National Railroad's (CN) acquisition of the Elgin Joliet and Eastern (EJ&E) rail line. Since CN announced its decision in 2007 to buy the EJ&E line between Waukegan, Illinois and Gary, Indiana, residents in the Village of Barrington have steadfastly opposed the acquisition due to the plans for increasing the number and length of trains on the corridor. The EJ&E line had previously carried regular but relatively low-volume traffic. However, CN, a Class I railroad, acquired the line planning to use it as a bypass around railroad congestion in the City of Chicago. Since the acquisition, as CN has increased the number of trains using the line, the additional freight has generated noise, congestion, and safety concerns including worry over how emergency vehicles will arrive at a local hospital. Village President Karen Darch decries the new "monster trains" on the rail line that "basically cuts Barrington in half right through the center of town."[46] Since the Surface Transportation Board's approval of the acquisition in 2009, the legal battles have changed from opposition to the acquisition to demands that a grade-separated crossing be constructed to allow roadway traffic to safely cross over or under the tracks to avoid delays caused by trains stopped at crossings.

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[44] "Freight Rail Funding," State Smart Transportation Initiative, available at http://ssti.us/wp/wp-content/uploads/2011/11/Snapshot.Shortline-RR-Funding.pdf.

[45] Tom Murtha (Senior Planner, Chicago Metropolitan Agency for Planning), Randy Deshazo (Policy Analyst, Chicago Metropolitan Agency for Planning) in discussion with the authors, May 15, 2013.

[46] David Schaper, "Monster Trains and a Monster Problem in Chicago," *National Public Radio*, March 24, 2009, accessed September 12, 2013, http://www.npr.org/templates/story/story.php?storyId=102310177.

Rail network inflexibility is another major hurdle for efforts to promote modal shift. Trains are restricted to existing rail infrastructure and the expense of acquiring new right-of-way and laying new track, particularly in urban areas, is generally prohibitive. Since rail spurs serving factories and other freight-generating facilities are less common than they once were, it is necessary for most goods shipped by rail to make the first and last segments of their trips by truck. As on-line purchasing and quick delivery times grow in importance, the flexibility and speed of trucks will maintain their position of dominance in urban freight transportation.

Freight logistics decisions are extremely complex, involving land values and receiver inventory capacity, fuel prices, rail network connectivity, rail freight pricing, and other factors. Building new urban freight rail capacity is extremely costly, and in many cases additional rail freight will lead to additional truck freight. However, preserving existing freight rail infrastructure and rail accessible industrial areas can, at least, provide businesses an alternative to truck-only shipping. It may be appropriate in some cases for the public sector to provide financial assistance in the form of loans or grants for the construction of industrial rail spurs, which allow shippers to avoid first and last mile truck trips. Cities interested in assisting in the construction of new industrial rail spurs or other infrastructure to promote rail freight should conduct a thorough community outreach effort to communities abutting the rail lines likely to see traffic increases to ensure that increasing rail traffic will not create undue hardship.

Adjusting Delivery Hours

Strategies based on changing the hours of freight activity serve two main purposes:

1) Off-peak pickup and delivery – to reduce the amount of congestion associated with truck traffic and truck loading and unloading during peak travel times within cities
2) Nighttime restrictions – to reduce the amount of nighttime noise in cities

Off-Peak Pickup and Delivery

Reducing peak hour truck traffic in cities through encouraging carriers to make pickups and deliveries during off-peak hours can reduce roadway congestion and associated emissions. However, because of the many stakeholders involved in goods movement, developing appropriate incentives can be difficult. A Port Authority of New York and New Jersey study investigating off-hour delivery incentives found that commercial trucking firms already attempt to avoid peak period travel but that pickup and delivery schedules are driven by the needs of the businesses and individuals that are shipping and receiving goods.[47] Trucking companies interviewed as part of the study were skeptical that higher daytime tolls for trucks would result in a shift towards off-peak activity since businesses typically want goods delivered during business hours.[48] For this reason, working with commercial retailers to promote off-peak deliveries is more effective than charging a modest toll for trucks entering into cities to make deliveries.

While few studies have quantified the environmental benefits of off-peak delivery programs in metropolitan areas, it is clear that they have been successful in reducing peak period delivery

[47] Vilain and Wolfrom, 2000 as cited in Jose Hoguin-Veras et al., "Integrative Freight Demand Management in the New York Metropolitan Area," U.S. Department of Transportation, September 30, 2010, available at http://www.transp.rpi.edu/~usdotp/DRAFT_FINAL_REPORT.pdf.

[48] Ibid.

trips, which benefits shippers and carriers by reducing delivery time and increasing reliability. New York City's 2009 Off-Hour Delivery Pilot resulted in increased travel speeds by 75% to the first delivery stop. A 2007 off-peak pilot program at Sainsbury's Garratt Lane grocery store, in London, used low-noise equipment to limit the negative neighborhood noise impact of the new schedule and larger trucks to reduce the number of delivery truck trips required. This resulted in savings of about 700 working hours, or $25,000 per year.[49]

While there are many benefits, both public and private, to off-peak delivery, one of the biggest impediments is higher labor costs at receiving locations. Businesses that are only staffed during traditional business hours, such as many small grocery stores and retail shops, may need to pay additional staff to receive deliveries outside of normal business hours. However, unassisted delivery arrangements, while currently uncommon, can greatly reduce these staffing costs. Unassisted deliveries could involve providing a store key to the delivery drivers or using double-door entrances or delivery lockers that enable drivers to deposit goods in a secured area.

Working with businesses to arrange for off-peak deliveries is effective at the receiving end of cargo movement; however, adjustments can also be made at pickup locations. An alternative method of handling costs for off-peak goods movement and incentivizing carriers to move goods outside of the peak travel periods is to add a surcharge at ports to freight moved during the most congested times. Marine terminal operators at the twin ports of Los Angeles and Long Beach launched the OffPeak program in 2005 to increase the proportion of shipping containers being moved during less congested nighttime and weekend hours. Following dramatic growth in freight volumes entering the ports, nearby communities and their elected leadership were increasingly concerned about the congestion and air quality impacts of peak period truck traffic in the area. Concerned that the state would impose a fee on containers moved during traffic periods, the terminal operators formed a non-profit company, PierPass, to administer the OffPeak program to promote off-peak delivery. Under the program, all international container terminals have established at least 4 off-peak shifts for container pickup each week. Weekday off-peak periods are from 6:00 p.m. to 3:00 a.m. and weekend off-peak periods are 8:00 a.m. to 5:00 p.m.[50] In order to offset the costs of operating the terminals during the off-peak hours and incentivize off-peak operations by carriers, a traffic mitigation fee (TMF), currently set at $66.50 per 20-foot container, is assessed on all containers picked up at the terminals between 3:00 a.m. and 6:00 p.m. on weekdays.[51] Nearly 60% of container moves now take place during off-peak hours and the program has generated substantial benefits in terms of congestion and emissions reductions.[52] However, at current levels the TMF is only covering roughly two-thirds of the costs of off-peak terminal operation. Whether the fee level will be adjusted to more fully fund off-peak operations in the future is uncertain.[53]

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[49] London Noise Abatement Society, 2008 as cited in: Jose Holguin-Veras et al., "Integrative Freight Demand Management in the New York Metropolitan Area."

[50] "PierPass OffPeak Schedule," accessed 8/21/13, available at http://pierpass.files.wordpress.com/2013/07/rollingschedule07-20-13.pdf.

[51] PierPass, Traffic Mitigation Fee Increase Announcement, 7/2/2013, available at https://www.pierpass-tmf.org/Documents/TMF%20adjustment%202013%20release_7%202%2013_final.pdf.

[52] Windes & McClaughry Accountancy Corporation, PierPass 2012 Financial Report, April 19, 2013, available at https://www.pierpass-tmf.org/Documents/pierpass-2012-financial-report.pdf.

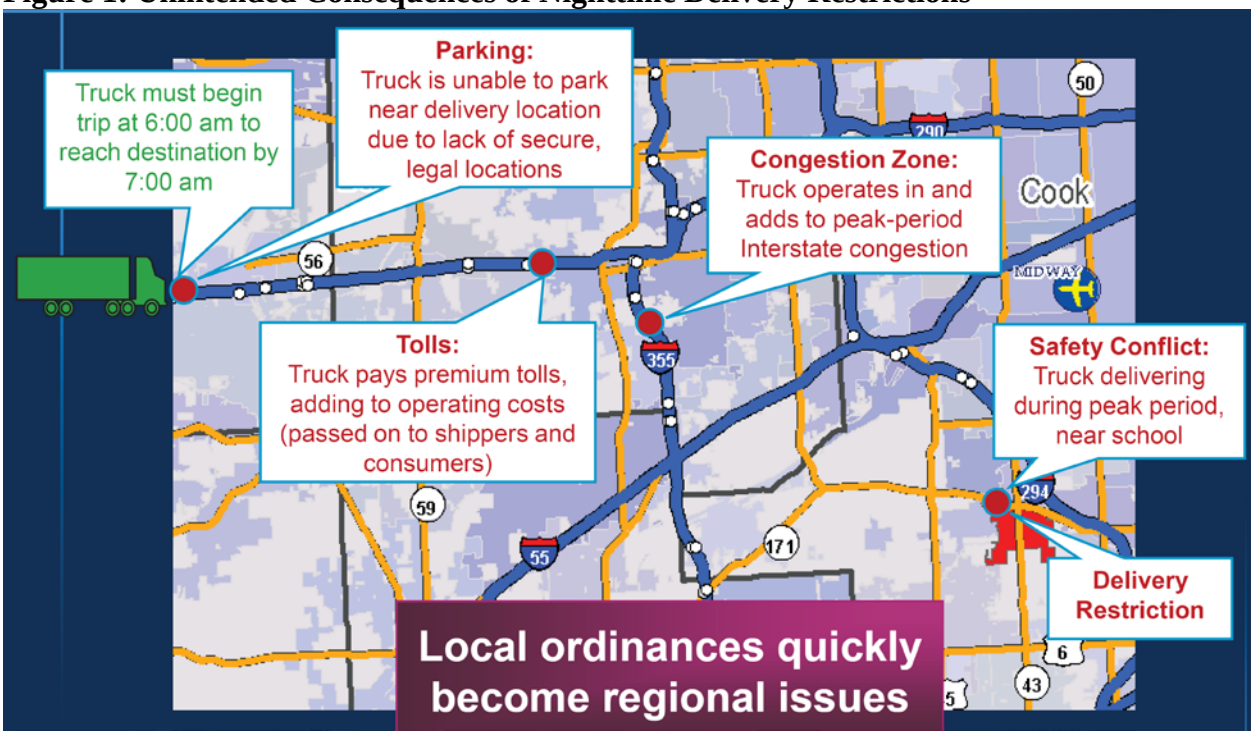
[53] Ibid.

Another challenge to off-peak freight activity is the resistance from residents concerned about nighttime noise. Environmental noise exposure can interfere with sleep patterns, leading to adverse health impacts. However, technologies such as low-noise doors, gates, and lifts can substantially reduce the noise associated with nighttime freight delivery.

Nighttime Delivery and Truck Traffic Restrictions

While cities across the U.S. and in Europe are looking towards off-peak delivery as a way to relieve daytime congestion, many other cities that are concerned about the impact of nighttime truck traffic on their residents have taken the opposite course, banning truck traffic and/or deliveries during nighttime hours. These policies, however, often add to existing daytime congestion and contribute to a regulatory patchwork that is difficult for carriers to navigate and creates unintended consequences and inefficiency elsewhere on the network as shown in **Figure 1**, below.

Figure 1: Unintended Consequences of Nighttime Delivery Restrictions



Source: Cambridge Systematics, "Regional Freight Systems Planning," presented to CMAP, September 2, 2009.

In the Dundalk area of Southeast Baltimore, the city instituted a number of nighttime truck route restrictions over the years in response to residents' complaints about truck traffic to and from the Port of Baltimore impacting their quality of life. However, the restrictions only cover certain street segments and vary in terms of the vehicles covered and the times that they are in effect, making them difficult to enforce, particularly in light of the many other competing law enforcement priorities.[54]

[54] U.S. DOT Volpe Center, "Dundalk Area Truck Impact Study."

Other cities, including Alexandria, Virginia, have truck loading and unloading noise restrictions after business hours for trucks that cause "excessive" noise.[55] These restrictions are often vague and difficult to enforce. Enforcement typically occurs following complaints from residents. In some areas it is difficult for drivers to understand the restrictions due to a lack of coordination among jurisdictions. The Chicago Metropolitan Area, for example, consists of over 250 jurisdictions with uncoordinated truck route and delivery hour restrictions. In some cases, municipalities are not even aware of their own unenforced regulations governing nighttime truck route and delivery restrictions, which may have been passed decades ago.[56]

Implementation

Current restrictions and incentives that limit the hours of freight activity are contradictory. Those concerned with reducing congestion and emissions seek to shift activity to off-peak times while those concerned with reducing nighttime noise impacts shift activity to daytime hours. Given that most large metropolitan areas already face highway capacity constraints during morning and afternoon peak travel periods, municipalities should be wary of restrictions on nighttime delivery that could worsen the situation. Rather than implementing restrictions on nighttime delivery and truck travel, identifying and enforcing a network of truck routes that avoids residential areas is a less heavy-handed option. Municipalities considering nighttime restrictions should consult with their MPO or state DOT to better understand the potential regional transportation impacts of such a policy. For cities and regions that are interested in shifting more freight to off-peak hours, working with industry to develop an incentive based system for voluntary off-peak pickup and delivery can achieve significant benefits without generating too much opposition from carriers or incurring large enforcement costs.

Intelligent Transportation Systems

Intelligent Transportation Systems (ITS), defined by the Federal Highway Administration as "electronics, communications, or information processing used singly or in combination to improve the efficiency or safety of a surface transportation system," have had a major impact on the freight transportation sector. Many ITS applications can manage demand by providing drivers and dispatchers with information that allows them to avoid congested areas or otherwise increase the efficiency of their operations in ways that benefit both the carrier and the broader community. Some of these technology solutions include variable message signs, real-time GPS guidance and traffic updates, web-based vehicle scheduling, and load matching systems.

Variable Message Signs

Variable message signs are used throughout the U.S. to alert motorists to incidents, roadwork, and other traffic disruptions, and guide motorists to alternate routes. The Kansas City region's bi-state traffic management system, KC Scout, is typical of variable message sign systems, using variable message signs to provide information to motorists so that they can avoid traffic incidents, roadwork, and highly congested areas.[57] This reduces truck idling by alerting trucks to

[55] City of Alexandria, VA, "Noise Control | Environmental Quality | City of Alexandria, VA," accessed August 15, 2013, http://alexandriava.gov/tes/oeq/info/default.aspx?id=3840#vehicle.

[56] Murtha and Deshazo, discussion.

[57] Ronald Achelpohl (Assistant Director of Transportation, Mid-America Regional Council), in discussion with the authors, May 23, 2013.

use an alternate route to avoid being stopped in congestion. Variable message signs can also provide directions to available parking areas, reducing the amount of congestion attributable to trucks searching for parking.

Real Time GPS Guidance

GPS guidance systems combined with real-time traffic information can provide truckers with real-time visual routing around congested areas. Dynamic Route Guidance, part of the Cross-town Improvement Project pilot in Kansas City,[58] automatically recalculated travel times during trips based on delay information and provided drivers with verbal directions for quicker alternative routes, if available.

Dynamic Traffic Management

Many cities use ramp metering to maintain a steady traffic flow on freeways. These systems generally rely on traffic sensors embedded in the pavement that provide traffic management centers with information about traffic flow such as the volume and speed of vehicles on freeway ramps. This data is fed to the ramp meters, which automatically alter their cycles to manage traffic flow on ramps and freeways.[59]

The Midtown in Motion program in New York City expands dynamic traffic management into the central business district. Using GPS technology as well as microwave sensors, video cameras, and EZ pass readers, the system allows traffic engineers to identify and respond to traffic conditions in real time by adjusting traffic signal patterns to unplug bottlenecks and smooth traffic flow.[60]

Computerized Scheduling and Shipment Information

Automated terminal appointment systems help to coordinate terminal capacity and operating conditions with drayage truck operators and dispatchers. These systems improve utilization of drayage trucks and increase the efficiency of freight movements to reduce VMT, wait times, fuel usage, and emissions. Through this type of communication system, trucks can arrive when needed and benefit from faster processing and reduced wait times.[61]

Automated scheduling systems also facilitate online information processing. Shipment information can be updated in real time and relayed to terminal operators and trucks before arriving. This helps trucking companies more efficiently dispatch trucks to pick up available loads. The Port of New Orleans, the Georgia Ports Authority, and a number of other major ports currently use automated scheduling and information systems to increase the efficiency of their operations.

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[58] Robert Schiller et al., "Kansas City Cross-town Improvement Project Evaluation: Results and Lessons Learned," November 15, 2012, available at http://docs.trb.org/prp/13-0097.pdf.

[59] "WSDOT – Ramp Meters," accessed August 20, 2013, http://www.wsdot.wa.gov/Traffic/Congestion/rampmeters/.

[60] Seth Solomonow and Nicholas Mosquera, "NYC DOT – Press Releases – Announces Expansion of Midtown Congestion Management System, Receives National Transportation Award," accessed July 25, 2013, http://www.nyc.gov/html/dot/html/pr2012/pr12_25.shtml.

[61] U.S. Environmental Protection Agency, "A Glance at Clean Freight Strategies: Terminal Appointment Systems for Drayage," n.d., available at http://www.epa.gov/smartway/documents/partnership/trucks/drayage/420f06005.pdf.

The Port of New Orleans uses a system called the Gate Entry Management (GEM) system, a web-based application, allows dispatchers to schedule pickups and provide information for pre-clearance prior to the truck's arrival at the port. This technology has improved traffic flow, increased terminal throughput, and improved productivity for trucking companies and terminal operators.

The Georgia Ports Authority (GPA) uses a system called WebAccess to provide real-time access to online data on container shipments. Through WebAccess, customers can update data on container shipments 24 hours a day. GPA estimates that WebAccess has significantly reduced waiting times outside of terminal gates, which has resulted in less truck idling, saving approximately 3,000 gallons of fuel and reducing nitrogen oxide emissions by a half ton and carbon dioxide emissions by 30 tons on peak days.

Load Matching Systems

Similar to automated terminal appointment systems, load matching systems use an online exchange to allow railroads, intermodal facility operators, and truckers to share information about available loads, delivery information, and scheduling. Companies such as Load Match[62] facilitate the transfer of information on loads, trucks, and equipment. Load Match links available trucks with loads and intermodal containers. This service both increases the efficiency of freight carriers and reduces traffic congestion and emissions by reducing the number of empty truck trips.[63]

Implementation

ITS technologies that improve freight efficiency are being rapidly developed and improved upon. Many of these cut costs and shipping times for private industry while also reducing roadway congestion. Some ITS applications, such as dynamic traffic management and variable message signs, fall within the purview of the public sector while others are largely developed and operated by carriers, ports, or other private sector firms. However, even private sector ITS activities often require or benefit from sharing public sector data. Cities, states, and MPOs should provide requested data to private sector ITS developers wherever feasible because more efficient freight operations are generally in the public interest. Cities should also look at how their existing ITS systems can better assist freight operators to increase efficiency. For example, San Francisco's SF Park[64] system, which allows motorists to use mobile devices to determine the location of available parking spaces, is one such system with potential to offer substantial benefits to truckers in the city. Although the system does not currently display truck parking availability or allow trucks to reserve curbside spaces, the technology, having already been developed and deployed for passenger cars, could deliver these or other services to improve urban freight efficiency.

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[62] Loadmatch Website, "About Loadmatch," accessed August 16, 2013, http://www.loadmatch.com/about_loadmatch.cfm.

[63] Ibid.

[64] SFpark Website, "About – SFpark," accessed August 16, 2013, http://sfpark.org/about-the-project/.

Land Use Strategies

Many cities struggle with maintaining freight land uses within the urban core. Development of greenfields in suburban areas has become very attractive to the freight industry due to environmental contamination that exists within inner city industrial areas and the lower cost and larger parcels of land available outside of the city. Industrial waterfront lands, as well as other centrally located freight and industrial sites, are under significant pressure in many cities for commercial and residential redevelopment. For example, in 2009 Harvard University bought Beacon Park in Boston, which was traditionally a CSX rail yard. CSX has since moved its operations to Worcester where double stack trains can arrive from points west.[65] This has significantly increased drayage distances for goods coming into the City of Boston. In many cases, because of high relocation costs, rail yards and ports may remain in central city areas while distribution centers, factories, warehouses, and other associated uses move to the urban fringe, resulting in increased truck VMT, congestion, and emissions. In order to counter these negative impacts and boost economic development and livability, many cities and MPOs are focusing on land use strategies to maintain and encourage multi modal freight activities within the central city. Zoning regulations are one of the most effective tools that cities have to retain freight intensive land uses in urban areas.

Freight Villages

Zoning districts created to foster or maintain freight and industrial activities are sometimes called Freight Villages. Industrially zoned areas are found in cities across the U.S. but the freight village concept involves strategically identifying industrial zones based on transportation accessibility. Freight villages are clusters of freight-intensive land uses such as warehousing, distribution centers, manufacturing, and packaging that act as intermodal freight staging areas with access to rails, trucks, ports, and airports. They improve efficiency by increasing connectivity of the transportation system, across and between modes, and allow for the benefits of agglomeration.

MetroPlan Orlando describes freight villages as having the following characteristics[66]:

1. All freight modes are represented.
2. Land prices are not as high as general commercial properties.
3. Adequate land is developable.
4. Accessible to local arterials for local distribution.
5. Accessible to interstate routes and freeways for regional and national distribution.
6. Accessible to a rail intermodal yard, directly tied to a Class I railroad main line.
7. Accessible to an air cargo oriented airport (with frequent service to domestic and international cities).
8. Accessible to a port offering a wide variety of materials handling options.

MetroPlan Orlando proposed locations for freight villages in the 2030 Long Range Transportation Plan and suggested that local jurisdictions develop a warehousing and logistics (WL) zoning category to ensure appropriate design standards. While freight villages have yet to

[65] Frank DeMasi (Boston MPO Advisory Council Freight Committee), in discussion with the authors, May 21, 2013.
[66] Wilbur Smith Associates, et al., "Freight, Goods and Services Mobility Strategy Plan," Metroplan Orlando, June 2002.

be implemented region-wide in Orlando, the concept is starting to take root in municipal land use policies and stakeholders have recognized the importance of including freight in their visions for the future.

Local governments can support the growth of freight villages through regulatory measures such as zoning designations to direct the development of warehousing and distribution in and around proposed freight villages and require buffers and/or transitional zones between incompatible land uses. Local governments can protect undeveloped land adjacent to freight villages for future freight expansion through zoning, easements and/or purchase.

Industrial Zoning Overlay Districts

Industrial overlay zoning districts can be used to give added protection to parcels of particularly high value for industrial use. With increasing high-end residential development on the waterfront the City of Baltimore approved its Maritime Industrial Zoning Overlay District (MIZOD) in 2004.[67] The MIZOD overlaid the heavy industrial (M-3) zone to protect waterfront property with certain characteristics such as sufficient berthing depth for large ships and good highway or rail access. The MIZOD is in place until 2024 and preserves certain waterfront areas for maritime industrial use by:

- Disallowing Planned Unit Developments (PUD) because they convert industrial land to mixed use
- Prohibiting hotels, motels, taverns, and all other uses not permitted in an M-3 district
- Allowing offices and restaurants as accessory uses only
- Maintaining the underlying heavy industrial (M-3) zoning

Implementation

Implementing land use strategies that will be successful in providing benefits to freight-intensive industries while reducing negative freight impacts on the rest of the community requires the involvement of local residents as well as freight operators, shippers, and receivers. Cities need to keep in mind the transportation infrastructure needs of freight and industrial facilities. The location of highways, waterways, and railroad infrastructure are of the utmost importance in identifying areas for industrial development. In addition, roadway design standards, such as sufficient overhead clearances for trucks, intersection designs that allow adequate turning radii for trucks, and appropriate signage and signalization that facilitate truck traffic should all be considered.

Parking Policies

Poor curbside management for freight deliveries can increase congestion, truck idling, and VMT. Lack of space for trucks to load and unload cargo leads to double parking and increases the time and distance trucks need to drive on crowded city streets looking for a place to park. Ensuring adequate curbside parking space for commercial vehicles, whether through pricing or time limits, reduces truck double-parking and VMT, increases pickup/delivery efficiency, and reduces congestion. Some of the truck parking-related problems facing many cities include:

[67] National Cooperative for Freight Research Program and Suzann S Rhodes, *Guidebook for Understanding Urban Goods Movement*, NCFRP 14 (Washington, D.C: Transportation Research Board, 2012).

- Insufficient on- and off-street loading areas
- Loading zones that are too small for large trucks to use
- Inconsistent enforcement of parking regulations, especially double-parking
- Low turnover of truck parking spaces due to a lack of parking time limits

All of these issues ultimately lead to greater congestion and emissions as well as economic impacts related to higher freight transportation costs and travel time impacts on other road users.

Strategies to Improve Parking for Freight Loading and Unloading

Cities have implemented various strategies to improve the availability of parking for freight loading and unloading while reducing the amount of congestion caused by double parking and illegal parking. Some of these strategies include:

Longer Loading Zones

In Washington, D.C., commercial loading zones have been moved to the approach end of some blocks to make curb parking easier for trucks to access in the hopes of reducing double-parking. Also, loading zones have been extended to 100 feet in length where possible to increase the supply of curbside commercial loading areas.[68]

Metered Loading Zones

Unpriced commercial loading zones provide space where trucks can park between certain hours to load and unload cargo. However, as with many unpriced goods, trucks tend to over consume unpriced parking space. Pricing commercial parking spaces can help ensure that spaces will be available when needed and reduces the likelihood that truck operators will double-park or otherwise add to congestion as they search for available parking.

To combat its truck parking-related congestion, New York City implemented a *Commercial Vehicle Parking Plan* on heavily congested streets in Midtown in 2001.[69] The city replaced single-space parking meters with "Muni-meters" that commercial vehicle operators can use to purchase parking passes for up to three hours.[70] This program has reduced congestion, particularly on narrow crosstown streets, and received the support of the delivery industry due to its effectiveness in reducing congestion and the clarity it provides for enforcement. The delivery industry has commented that while they must now pay for parking, it has reduced their costs due to the decreased number of parking tickets received by their drivers.[71]

[68] Marsha Anderson Bomar, et al., "Urban Freight Case Studies: Washington D.C., " Federal Highway Administration, November 2009, available at http://www.ops.fhwa.dot.gov/publications/fhwahop10018/.

[69] Schaller, et. al., "Parking Pricing and Curbside Management in New York City."

[70] Marsha Anderson Bomar, "Urban Freight Case Studies: New York," Federal Highway Administration, November 2009, available at http://ops.fhwa.dot.gov/publications/fhwahop10019/fhwahop10019.pdf.

[71] Tom Maguire (Assistant Commissioner, Project Development, New York City Department of Transportation), in discussion with the authors, June 3, 2013.

Increase the Availability of Space for Loading and Unloading Activity

Providing more parking, either public or private, for trucks picking up and delivering goods in urban areas can decrease the congestion associated with trucks searching for parking. New York City has eliminated most metered parking for the general public during daytime hours to ensure sufficient space for commercial loading and unloading. Requiring commercial property owners to provide off-street space for loading and unloading activities is another strategy to increase commercial parking availability and reduce traffic congestion.

More Specific Signage

To combat trucks using loading zones as free parking spaces during daytime hours, curbside signs can be used to ensure loading zones are reserved for vehicles that are actively loading and unloading goods.

Increase Enforcement

While loading zones exist in many cities, the level of enforcement can be inconsistent. Improving signage and creating a meter system for paid commercial parking make it much easier for authorities to enforce the parking policies. However, it may also be necessary to increase enforcement personnel or increase penalties to change drivers' decision making in places where parking violations have been seen as simply another cost of business.

Education and Outreach

Educating the public, industry, and law enforcement about parking regulations is important to ensuring successful parking programs. New York City worked closely with stakeholders including the delivery industry when implementing the Paid Commercial Parking program. Stakeholder understanding of parking regulations, and the motivations for them, builds public support and reduces the level of law enforcement needed to ensure that the regulations are followed.

Implementation

The primary motivations for cities to implement or revise truck parking regulations are to reduce congestion, improve air quality, and to better facilitate delivery. Policies that ensure parking space for trucks actively engaged in loading and unloading activities accomplish all of these goals. Time-limited parking meters for commercial vehicles collect revenue to support enforcement, clearly identify violators, and create an incentive for drivers to use the space efficiently. Short of installing meters in loading zones, altering signage to specify "active" loading and unloading is a relatively low cost way of preventing drivers from storing their vehicles in valuable streetside parking areas. Finally, increasing the number and improving the geometry of loading zones to make them more accessible to delivery trucks may also be necessary.

As a first step, cities should collect data to better understand the barriers facing trucks picking up and delivering goods in downtown areas, such as:

- The average time spent by trucks in existing loading zones
- The reasons truckers violate parking regulations
- Loading zone utilization rates through the day at in different areas

Once cities understand when, where, and why violations take place and where truck parking shortages exist, they can develop appropriate solutions.

Planning Information Strategies

In order to designate or revise a truck route network, implement delivery time restrictions or incentives, or preserve freight intensive land uses in appropriate locations without generating land use and transportation conflicts, decision makers need to understand how and where freight is moving and the existing freight policy landscape. The first step is to understand where key freight nodes and transportation corridors are located. Next, because freight crosses jurisdictional boundaries, it is important to understand policies in nearby jurisdictions that impact the movement of freight. Regional planning agencies, which lack the authority to pursue other freight TDM strategies, are well positioned to collect and distribute this type of information to their constituent jurisdictions and to lead intraregional efforts to harmonize freight land use and transportation policies.

Freight Land Use Inventories

Many cities have conducted land use inventories using GIS data, field visits, and stakeholder input. In Philadelphia, the Delaware Valley Regional Planning Commission (DVRPC) conducted a study entitled *The Delaware Valley Freight Center Inventory: Taking Stock of a Vital Regional Asset*, which identified freight intensive land uses. DVRPC labeled these land uses as "Freight Centers" and defined them as contiguous land parcels that are dedicated to light manufacturing, heavy manufacturing, distribution, transportation, quarry/mining, and utility. DVRPC later mapped these land uses and made them available on their website to be used by stakeholders to identify where freight intensive land uses should be preserved in the Philadelphia, Camden, and Trenton metropolitan regions.

Freight Transportation Policy Catalog

The Chicago Metropolitan Agency for Planning (CMAP) is currently working with its stakeholders, including local government and freight industry representatives to identify the various restrictions on freight movement in each jurisdiction within the region. Key issues of concern are the designated truck routes and delivery time restrictions within each jurisdiction. Truck route networks may lack linkages between jurisdictions, potentially forcing trucks to choose between travel on unpermitted routes and inefficient circuitous routes on the designated network. Delivery time restrictions, such as those barring deliveries or truck traffic during nighttime hours, often have regional impacts as trucks prohibited from making their deliveries during nighttime hours are forced to travel through the region during peak travel periods, worsening congestion and air quality. Addressing these restrictions is expected to be a focus of a recently-formed Regional Freight Leadership Task Force at CMAP. Although CMAP and the Leadership Task Force have only advisory roles with regard to truck regulations, identifying existing regulations and the discrepancies between those of neighboring jurisdictions will help illustrate the importance of interjurisdictional coordination.

Case Studies

Chicago, IL

Background

The Chicago metropolitan area, consisting of 8.5 million people, originally came to prominence as a critical trade hub due to its location on the Great Lakes and access to the network of inland rivers that served as the nation's primary transportation corridors. As the country expanded westward, the city continued to burgeon as an industrial power. And as railroad construction began in the mid- and late-nineteenth century, the city's location and size made it the obvious location for an inland rail hub. As the nation's second largest city during the advent of the automobile and at the time of the Federal-Aid Highway Act of 1956, which kicked off the construction of the Interstate Highway system, Chicago became a central node in the national highway network.

Today, Chicago's economy is based on manufacturing, printing and publishing, finance and insurance, and food processing.[72] According to the U.S. Department of Commerce[73], an estimated 236,000 of the region's jobs were in transportation and warehousing providing more than $13 billion in personal income for the region's residents. The success of the other industry sectors in Chicago greatly depends on the health of the transportation and logistics sectors in the region. Railroads are still very prominent in Chicago; however, the majority of freight traveling through the city is now shipped by truck. The Illinois Department of Transportation (IDOT) reports that trucks make up approximately 13% of all vehicles on Illinois urban interstates[74], contributing to some of the worst congestion in the U.S.

Issues and Challenges

Chicago faces both rail freight and truck freight challenges. Six of the nation's seven Class I railroads have major terminals in Chicago with nearly 500 freight trains moving in and out of the region each day[75]. Freight trains often cause delay to other freight trains, passenger trains that share the corridors, and roadway traffic at at-grade crossings. According to CMAP, rail companies foresee the length of trains increasing from 125 to 175 cars with predicted economic growth[76]. An increase in train length will cause further motorist delay at at-grade crossings. As rail freight volumes increase, existing safety concerns and train-related noise issues are likely to increase as well.

Despite the extensive rail presence in Chicago, most of the region's cargo is moved by truck. Compared to 631 million tons of freight moved by rail in 2007, nearly 1.5 billion tons was

[72] City-Data.com, "Chicago: Economy – Major Industries and Commercial Activity," accessed July 15, 2013, http://www.city-data.com/us-cities/The-Midwest/Chicago-Economy.html.

[73] B. E. A. U.S. Department of Commerce, "Bureau of Economic Analysis," accessed July 16, 2013, http://www.bea.gov/regional/index.htm.

[74] Office of Planning and Programming, "Illinois Travel Statistics; Table TVT-1," Illinois Department of Transportation, 2012, available at http://www.dot.state.il.us/travelstats/2012_ITS.pdf.

[75] Chicago Metropolitan Agency for Planning, "GO TO 2040", 2010, available at: http://www.cmap.illinois.gov/documents/20583/4a6b00cf-c35f-4ff0-a5e8-e79fd3807f7b.

[76] Ibid.

moved by truck based on CMAP estimates. The high volume of freight moved by truck creates large amounts of truck congestion. CMAP has estimated that on several corridors where trucks total more than 10,000 per day, congestion during morning peak periods increases travel times by an average of 60%.

With over 250 jurisdictions in the Chicago Metropolitan Area, trucks need to traverse a complicated system of state, county, and local roads. Coordination of truck routes among jurisdictions is haphazard, creating a maze of regulations for drivers. Additionally, many municipalities restrict nighttime delivery, forcing trucks to make deliveries during peak travel times and further exacerbating congestion.[77]

Solutions

Many of the challenges presented by freight rail have begun to be addressed by the Chicago Regional Environmental and Transportation Efficiency (CREATE) program, which is a partnership among the State of Illinois, the City of Chicago, and the nation's freight railroads. Started in 2003, CREATE is working to upgrade four critical corridors by constructing flyovers, grade separations, improved signalization, and the modernization of equipment. Many CREATE upgrades are meant to alleviate conflicts between passengers and freight services on the rail system. While rail infrastructure upgrades are critical to improving freight movement, and may even facilitate modal shifts from truck to rail, this report focuses on TDM strategies. For the purpose of this report, infrastructure upgrades, particularly at the level of the CREATE program, are not considered TDM strategies.

Amongst TDM strategies that are considered cost effective and implementable, CMAP has identified the importance of coordination of truck routes, delivery times, and parking restrictions across jurisdictions as a high priority.[78] To do this CMAP is working with stakeholders including local government representatives and freight industry representatives to identify the various restrictions on freight movement in each jurisdiction within the region. Addressing these restrictions is expected to be a focus of a recently-formed Regional Freight Leadership Task Force at CMAP. CMAP and the Leadership Task Force have only advisory roles in addressing truck regulations, but hope that a convincing argument can be made for a more beneficial set of trucking regulations.

The biggest challenges most often involve inconsistent truck route designations. Upon identifying inconsistencies, CMAP has overlaid the network of truck route designations on the roadway network so that they can improve the transportation modeling for trucks. Using regional travel demand models, CMAP can perform scenario testing for the revision of truck route regulations across jurisdictions. This will aid coordination and the development of a more logical and efficient system for the region's truck routes.[79]

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[77] Murtha and Deshazo discussion.

[78] Chicago Metropolitan Agency for Planning, page 316 in "Recommendation: Create a More Efficient Freight Network," 2010, available at http://www.cmap.illinois.gov/documents/20583/4a6b00cf-c35f-4ff0-a5e8-e79fd3807f7b.

[79] Tom Murtha (Senior Planner, Chicago Metropolitan Agency for Planning), Randy Deshazo (Policy Analyst, Chicago Metropolitan Agency for Planning), in discussion with the authors, May 15, 2013.

Along with the coordination of truck routes, delivery times and parking restrictions also can be addressed by local governments. Similar to the strategies of creating regional maps to identify inconsistent truck routes, CMAP can identify delivery time and parking restrictions that adversely impact the flow of cargo. By managing truck delivery times and reducing peak period deliveries, regional efficiencies can be achieved.

Delivery time adjustments can at times create conflicts due to the associated negative externality of noise. As identified earlier in this report, truck noise can disrupt sleeping patterns of residents. Where it is determined that the noise impacts of off-peak deliveries outweigh the benefits associated with reduced congestion, CMAP has identified the strategy of establishing truck parking facilities to reduce the need for peak-period travel. Using centralized freight distribution nodes, Chicago could limit the number and size of trucks in the central area, thus alleviating congestion and idling.[80]

Agencies such as the Illinois Trucking Association (ITA) and the Illinois Truck Enforcement Association (ITEA) are strong supporters of coordinating the system of truck routes, delivery times, and designated truck parking areas across the Chicago metropolitan region. ITA, acting as a trade organization that articulates the concerns of the trucking industry to policy makers and the general public, promotes the coordination of truck routes as a means to increase the efficiency of the trucking industry. ITEA, an association of police officers that specializes in truck enforcement, identifies one of their goals as "uniformity":

> The laws that regulate trucking in Illinois are complicated and extensive, which leads to enforcement that is not uniform across local boundaries. It is our goal to create standards of practice that correctly interprets the law while providing a baseline for consistent enforcement across jurisdictions.[81]

No jurisdictions have objected to the idea of coordinating truck routes, delivery times, and parking restrictions. Since CMAP's role is limited to an advisory position, it will ultimately be the decision of local government officials within the individual jurisdictions to determine if they want to change the designation of truck routes, delivery times or parking areas.

Costs and Benefits

TDM strategies are oftentimes the low-cost and more sustainable solution to transportation problems. When coordinating truck routes across jurisdictions, there is a possibility that roads not previously designated as truck routes will need to become truck routes. Some infrastructure improvements may be necessary when converting a road to a truck route. For example, low clearance issues, weight limits on bridges, and turning radii may need to be addressed. When considering off-peak deliveries, the costs associated with late night noise must be considered. As discussed earlier in this report noise can cause sleep deprivation, which can be associated with adverse health impacts. However, when truck routes are properly designated and enforced, many of the noise impacts to residents can be reduced.

[80] "GO TO 2040."

[81] Illinois Truck Enforcement Association, "About – ITEA," *ITEA*, available at http://illinoistruckcops.org/?page_id=12.

Cost allocation for implementation of these TDM strategies depends on the roadway jurisdiction. At times the costs may fall on local governments. However, if a route is on the National Highway System, federal funding will apply. Additionally, costs can be shared through public private partnerships where carriers, shippers, receivers, local, state, and federal government all contribute to an improved freight system.

Implementing strategies such as coordination of truck routes, delivery times, and parking restrictions across jurisdictions could increase the flow of cargo, reduce truck idling, and reduce congestion. This will save time and fuel, increase productivity, and reduce pollution. More efficient movement of goods through the Chicago region will also benefit private firms and lower prices for consumer goods.[82]

Lessons Learned

While each community faces different challenges in managing freight transportation, Chicago's identity as one of the largest transportation and population hubs of the U.S. creates a unique opportunity to balance freight movement with livability. CMAP is taking a lead in addressing the challenges in Chicago with a systematic approach to identifying problems, brainstorming strategies, obtaining accurate data, and determining what will work best for the region. CMAP recognizes that addressing the complexities created by the web of jurisdictional authorities that regulate freight movement in the region is contingent on public outreach and stakeholder coordination. By helping area governments work together to develop a regionally coordinated approach to freight, CMAP's approach is a low-cost way to squeeze more productivity out of the existing system.

Philadelphia, PA

Background

The Delaware Valley region, made up of nine counties and the City of Philadelphia, is home to 6 million people.[83] The region's multimodal freight transportation network consists of highways, rail lines, ports, airports, and pipelines. Philadelphia was an early leader in freight transportation, with its network of railroads comprising a quarter of the nation's total track in the 1830s. The City grew to become the manufacturing capital of the nation but it eventually followed in the path of other large Northeastern cities with its economy shifting towards the health care, advertising, financial services, law, tourism, and light manufacturing sectors.

Issues and Challenges

As with many older, industrial cities, Philadelphia struggles to maintain its freight infrastructure. With industry playing a smaller role in the economics of the region, maintaining freight infrastructure has become a lower priority for local and state governments. While manufacturing no longer dominates the economy of the Delaware Valley, the region maintains its strategic geographic location in the middle of the densest population center in the United States. Over 100

[82] "GO TO 2040."

[83] U.S. Census Bureau, "Metropolitan and Micropolitan Statistical Areas Totals: Vintage 2012 – U.S Census Bureau," accessed July 23, 2013, http://www.census.gov/popest/data/metro/totals/2012/index.html.

million people live within a 500-mile radius of Philadelphia.[84] This makes the region the center of a huge consumer base and an important distribution hub.

The Delaware Valley Regional Planning Commission (DVRPC) serves the Greater Philadelphia region and works to foster regional cooperation in a nine-county, two-state area.[85] DVRPC has recognized that the economic welfare of the region, particularly its manufacturing and transportation sectors, depends on freight.

Due to the attractiveness of property along the Delaware River, existing industrial facilities in the area face development pressures from both commercial and residential sources. While land use changes in urban areas are often beneficial, in the case of freight facilities less obvious benefits such as jobs and ancillary transportation benefits to businesses are often inadequately considered. An understanding on the part of planners, policy makers, and the public of the links between land use and freight transportation is critical in order to make optimal decisions regarding transportation and land use issues.

Solutions

Delaware Valley Goods Movement Task Force

The Delaware Valley Goods Movement Task force consists of representatives from trucking and railroad industries, ports, airports, shippers, freight forwarders, economic developers, and representatives of DVRPC member governments. The Task force is an advisory committee to DVRPC co-chaired by PennDOT and DVRPC, which provides an avenue for the local freight community to participate in formulating regional policies, plans, and programs. The Task Force's advice and expertise was instrumental in producing the Delaware Valley Freight Center Inventory and the Philly Freight Finder, discussed below.

The Delaware Valley Freight Center Inventory

In an effort to maintain the vitality of the freight industry within the Delaware Valley, DVRPC first recognized that it needed to identify where freight activities are currently operating. Freight centers as defined by the DVRPC report entitled *The Delaware Valley Freight Center Inventory: Taking Stock of a Vital Regional Asset*, are "contiguous land parcels (under either joint or individual ownership) that are dedicated to one of the following types of freight activity: light manufacturing, heavy manufacturing, distribution, transportation, quarry/mining, and utility."[86] DVRPC identified 44 Freight Centers, each 250 contiguous acres or more, in the region by using GIS technology, stakeholder interviews, field visits, and Internet research. The report cites two goals for identifying Freight Centers:

[84] Delaware Valley Regional Planning Commission, "DVRPC Long Range Vision for Freight", Delaware Valley Regional Planning Commission, April 2010, available at http://www.dvrpc.org/reports/09058.pdf.

[85] Delaware Valley Regional Planning Commission, "DVRPC > About Us," accessed August 6, 2013, http://www.dvrpc.org/About/.

[86] Delaware Valley Regional Planning Commission, "The Delaware Valley Freight Center Inventory: Taking Stock of a Vital Regional Asset, " Delaware Valley Regional Planning Commission, April 2012, available at http://www.dvrpc.org/reports/11011.pdf.

- Help Freight Centers to thrive, boosting the region's job market and economy
- Consider land use when planning for future development both within and surrounding Freight Centers

Involving stakeholders such as regional economic and industrial development agencies, as well as county planners within the region, was critical in identifying Freight Centers. Freight Centers are classified as Mega, Major, or Intermediate based on acreage, with one slight adjustment based on employment data:

- 8 Mega Freight Centers
    - At least 1,500 or more acres with any number of jobs, or at least 700 acres with more than 3,000 manufacturing jobs
- 13 Major Freight Centers
    - 700-1,499 acres with any number of jobs, or 250-700 acres with more than 3,000 manufacturing jobs
- 23 Intermediate Freight Centers
    - 250-699 acres with any number of jobs, or under 250 acres with more than 3,000 manufacturing jobs

The Delaware Valley Freight Center Inventory found that Freight Centers in the Delaware Valley serve as important job centers and that they support a variety of industries in the region and offer efficiencies and economies of scale. Also, it found that existing Freight Centers tend to be located in urbanized areas and conform to desirable regional land use patterns that support anti-sprawl strategies and are well located to be served by both the highway and rail system. The report includes action steps for Freight Center stakeholders including:

- Integrate the concept of Freight Centers into regional and county plans
- Create and track Freight Center activity indicators
- Study access into Freight Centers
- Advance Freight Center designation methodology
- Protect Freight Centers through zoning and comprehensive planning
- Encourage re-use of brownfields
- Participate in Freight as a Good Neighbor strategies
- Share services and amenities
- Create branding efforts focused around Freight Centers
- Identify and implement projects needed to improve access to Freight Centers[87]

Philly Freight Finder

DVRPC is consistently collecting and analyzing freight data in order to effectively plan for freight. However, this data has not always been accessible to regional stakeholders. Using data, such as that from *The Delaware Valley Freight Center Inventory*, DVRPC and the Delaware

[87] Ibid.

Valley Goods Movement Task Force developed the Philly Freight Finder as a means of organizing and sharing freight transportation and land use information with partner organizations and the public.

The Philly Freight Finder is a freight mapping and data platform that visually displays freight land uses in the regions of Philadelphia, Camden, and Trenton. Housed on the DVRPC website (http://www.dvrpc.org/webmaps/PhillyFreightFinder/), it is open to the public, and provides a user-friendly platform for investigating freight land uses in the Delaware Valley. The tool gives planners the ability to view the region's entire freight infrastructure on one map. With the ability to view all freight corridors and facilities in one place, planners can work to preserve and enhance freight mobility and avoid land use conflicts. Philly Freight Finder also advances the freight dialog amongst planners, policy makers, and the public and clarifies freight terminology.[88]

Another highlight of Philly Freight Finder is its emphasis on "Freight as a Good Neighbor".[89] DVRPC defined "Freight as a Good Neighbor" strategies as those that "accommodate freight movement, but that also protect the quality of life in adjacent and affected neighborhoods."[90] This important issue of addressing livability issues associated with Freight Centers is showcased on Philly Freight Finder with case studies of "Good Neighbor" strategies. By highlighting these case studies, providing information and education to a broad range of regional stakeholders, and facilitating a dialogue about freight's role in the Delaware Valley, DVRPC is making the most of its regional role to help the Delaware Valley preserve and promote its freight activity as a means of bolstering economic development and meeting broader goals for sustainable development.

Costs and Benefits

DVRPC's strategy of planning for freight involves a significant investment of time and effort. Identifying freight centers required analyzing GIS data, performing field visits, and engaging a variety of stakeholders. While the time and effort attributed to freight planning in the Delaware Valley is great, the economic vitality and environmental sustainability of the manufacturing and freight industry depend on these types of efforts. The 44 Freight Centers identified by the DVRPC consist of over 42,000 acres of freight-related land and nearly 340,000 total jobs, over 66,000 of which are in the manufacturing sector. Roughly 35% of regional manufacturing jobs are located in Freight Centers.

Philly Freight Finder helps to promote the preservation of existing Freight Centers, the redevelopment of brownfield sites to be used as Freight Centers, and Good Neighbor strategies to reduce conflicts. By encouraging the use of existing Freight Centers, DVRPC promotes the efficient use of land and prevents freight sprawl. Additionally, by maintaining freight-intensive land uses in places that can be efficiently served by rail and highways, some of the externalities associated with trucks and trains within residential neighborhoods are avoided. Finally, by bringing together the public sector, the private sector, and community organizations, and

[88] Ted Dahlburg, (Manager, DVRPC Office of Freight and Aviation Planning), in discussion with the authors, June 4, 2013.

[89] Ibid.

[90] Delaware Valley Regional Planning Commission, "DVRPC – PhillyFreightFinder," accessed July 22, 2013, http://www.dvrpc.org/webmaps/PhillyFreightFinder/.

providing tools like Philly Freight Finder, DVRPC has built a foundation for a harmonious relationship between freight stakeholders and the rest of the community.[91]

Lessons Learned

By engaging a wide range of public- and private-sector stakeholders in the Delaware Valley Goods Movement Task Force and working with them to assess regional priorities and understand the freight transportation landscape, DVRPC was able to complete *The Delaware Valley Freight Center Inventory,* which formed the basis for the Philly Freight Finder. The Philly Freight Finder now serves as an information source for public-sector planners and transportation agency staff, a marketing tool for area shippers, carriers, and economic development agencies; , and an information and educational resource for the general public and municipal officials.[92] Freight, because of its diverse stakeholders and logistical complexities, is a difficult concept to understand. With the Philly Freight Finder, DVRPC has created a user-friendly visualization tool that can increase the breadth and depth of the regional conversation about how transportation and land use policies can accommodate freight while contributing to the economic development and sustainability goals of the broader community.

Kansas City, MO

Background

With a population of just over 2.3 million, the Kansas City metropolitan area covers fifteen counties in Missouri and Kansas and is a major intermodal freight transportation hub with access to major highways, an international airport, and the inland waterway system. The region is also served by five of North America's seven Class I freight railroads, making it the second largest freight rail hub in the nation after Chicago.

Issues and Challenges

The amount of intermodal freight moving in North America has increased nearly fivefold since 1980[93]. As one of the nation's largest centers of intermodal freight activity, the Kansas City region has been particularly impacted by this growth, with congestion on area highways as well as truck noise and emissions becoming concerns for the region. Many of the truck trips that contribute to these impacts are involved in drayage moves—relatively short intermediate freight transfers, such as movements from the point of origin to a rail yard, between rail yards, or from an intermodal transfer facility to the final destination—that are part of longer overall trips. Drayage distances have also increased as two major railroads, Kansas City Southern and BNSF have built new intermodal terminals on the outskirts of the urbanized area.[94] While drayage is a necessary part of the goods movement system, there are significant inefficiencies and prevailing

[91] Dahlburg, discussion.
[92] Delaware Valley Regional Planning Commission, "DVRPC – PhillyFreightFinder."
[93] Intermodal Association of America, as cited in: Robert Schiller et al., "Kansas City Cross-town Improvement Project Evaluation: Results and Lessons Learned," November 15, 2012, available at http://docs.trb.org/prp/13-0097.pdf.
[94] Achelpohl, discussion.

drayage practices that often necessitate more than two trip legs (one round trip) for each container moved.[95]

Growth in freight rail traffic has also caused some congestion due to trains blocking at-grade rail crossings, but most of the problem areas have been alleviated with railroad funded grade separation projects.[96]

Solutions

The Kansas City region has implemented the Kansas City Scout (KC Scout), a traveler information and traffic management system, and pilot tested the Cross-town Improvement Project (C-TIP), an information sharing and coordination system to reduce drayage truck VMT and increase operational efficiency.

KC Scout is a traveler information and traffic management system that utilizes cameras, variable message signs, radio, motorist assistance personnel, online applications, and ramp metering to provide traffic/congestion information to motorists, identify and clear stranded vehicles, coordinate activities between emergency responders, and manage the flow of vehicles entering the roadway. Users can get KC Scout information from variable message signs, radio broadcasts, and online, or can register to receive tailored traffic, weather, and air quality updates on their computers or phones. The KC Scout was originally conceived as a tool for commercial dispatchers and drivers. However, trucking companies were concerned about drivers using smartphones and on-board computers while driving, so Scout was launched as a tool for all road users.[97]

The Cross-town Improvement Project, which was funded by FHWA and pilot tested in the Kansas City area in 2010 and 2011, is a bundle of five elements that provide information and facilitate coordination between truckers, rail lines, trucking company dispatchers, and freight facility operators. The primary goal of C-TIP was to reduce congestion by:

- Providing truck drivers with better information about construction and traffic conditions
- Reducing the number of unloaded drayage truck trips by matching trucks dropping off containers at a rail yard or other freight facility with containers waiting to be carried elsewhere
- Facilitating the pooling and shared use of intermodal chassis, the trailers used to transport intermodal containers, to increase efficiency at container pickup and delivery locations

[95] National Cooperative Freight Research Program, "NCFRP Report 11: Truck Drayage Productivity Guide," as cited in: Robert Schiller et al., "Kansas City Cross-town Improvement Project Evaluation: Results and Lessons Learned," November 15, 2012, available at http://docs.trb.org/prp/13-0097.pdf.

[96] Achelpohl, discussion.

[97] Ibid.

C-TIP, as originally conceived, involved five key elements:[98]

1. Real-Time Traffic Monitoring (RTTM) – monitoring and distribution of route- and location-specific travel time and congestion information. Drivers could request travel times and alternate route suggestions prior to and during trips.
2. Dynamic Route Guidance (DRG) – provides truckers with real-time visual routing around congested areas. Travel times are automatically recalculated during the trip based on delay information. The system provides verbal directions for alternate routes with shorter predicted travel time.
3. Intermodal Move Exchange (IMEX) – an online exchange allowing railroads, intermodal facility operators, and truckers to share information about available loads, delivery information, traffic and scheduling
4. Wireless Drayage Updating (WDU) – a wireless communications system allowing truck drivers and dispatchers to quickly exchange time-sensitive shipment information
5. Chassis Utilization Tracking (CUT) – a process to provide truckers and dispatchers information on chassis availability and allocate costs among users

The pilot test involved only the first two of these elements: RTTM and DRG. Because the railroads failed to participate in the operational test, results for the IMEX element were modeled based on historical railroad data for a three-month period in late 2010 through early 2011. FHWA later conducted a drayage optimization test with a Kansas City-based drayage transportation firm that involved elements of IMEX and WDU and allowed dispatchers to track trucks and identify containers released for pickup so that drivers could be connected with available loads.

Costs and Benefits

KC Scout

The Kansas and Missouri Departments of Transportation have estimated that the KC Scout program yields over $8 in benefits for each $1 dollar spent.[99] Annual benefits for the program are estimated at $51.8 million, over $40 million of which is made up of travel time benefits.[100] The system has helped to reduce secondary crashes and improved the efficiency of incident management activities, with a major reduction in the number of incidents lasting over 90 minutes. While the system benefits all road users, freight carriers likely receive significant benefits from improved travel time reliability.

C-TIP

Of the five origin-destination pairs for which the RTTM and DRG were implemented, redirections were offered for truckers on only three of the pairs throughout the study period. The

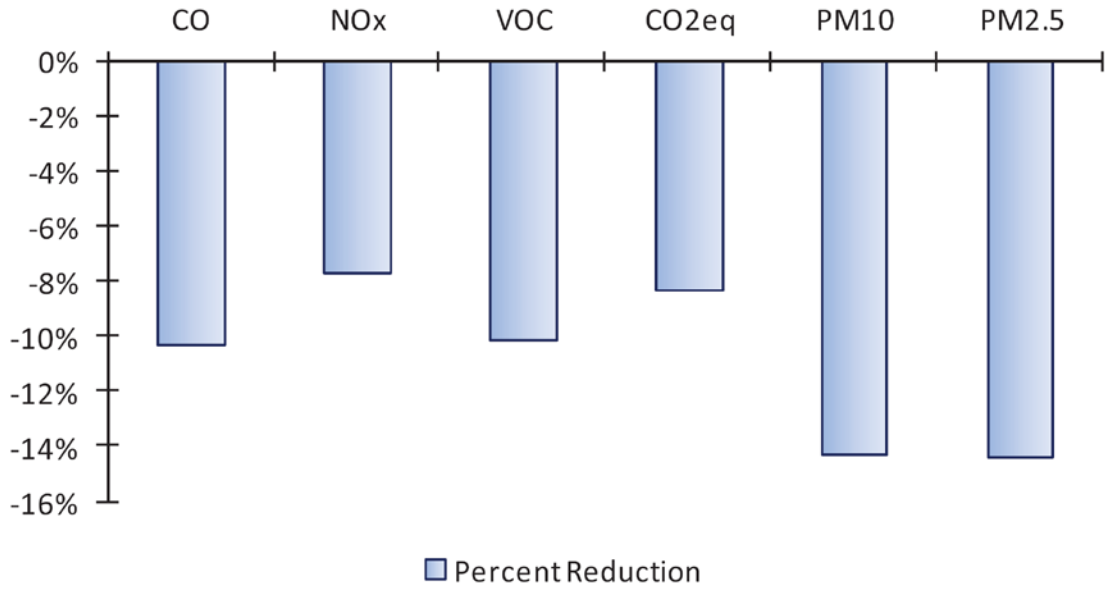
[98] Schiller et al., "Kansas City Cross-town Improvement Project Evaluation."

[99] Kansas DOT and Missouri DOT, "KC Scout Benefit/Cost Study: Summary Overview," n.d., available at http://www.kcscout.net/downloads/Reports/Annual/BenefitCostStudyBrochure.pdf.

[100] Ibid.

travel time savings for truckers who received redirection information averaged 21 percent.[101] Across the three routes the systems generated modest drayage truck emissions reductions as shown in **Figure 2** below:

Figure 2: Drayage Truck Emissions Reductions



Source: Cambridge Systematics Analysis of RTTM and DRG move records.

The evaluation of the IMEX element found that of 1,663 total drayage trips analyzed, approximately 10 percent could potentially be linked to eliminate an empty truck trip. However, in reality, only 28 of these sequential cross-town trips were performed by the same driver. There are a number of reasons why more trips were not matched[102]:

- The IMEX dispatch model assumed that containers could remain at rail yards, all day if necessary, until they can be matched. In practice, however, railroads want containers moved off their property as soon as possible.
- Drayage truck drivers in the Kansas City area are not notified of available containers until they are ready for pickup and drivers do not plan their full day in advance.
- In the Kansas City area, rail terminals are close enough together that the potential time savings of picking up a matched load may not be worth the trouble.
- Freight volumes declined dramatically just prior to the test period due to the recession, resulting in lower demand for cross-town drayage.

The follow-up drayage optimization test showed a small reduction in unloaded truck trips relative to loaded (revenue) trips, which was attributed to the C-TIP load matching system.[103]

[101] Schiller et al., "Kansas City Cross-town Improvement Project Evaluation."
[102] Ibid.
[103] Ibid.

Lessons Learned

Since implementation, KC Scout has provided an effective platform for the integration of a variety of traffic management activities, most recently with the addition of ramp metering. Other communities considering the implementation of a system like KC Scout should work with the trucking industry to ensure that messages and location descriptions provided on electronic signs and via traffic radio broadcasts are easily understood by drivers.

The C-TIP pilot test confirmed the potential benefits of voice-operated real-time route assistance to help truckers avoid congestion and traffic incidents. Although the pilot test also suggests benefits of assisting freight carriers in coordinating and sharing information to reduce supply chain inefficiencies, the firms involved in goods movement, particularly the Class I railroads, were concerned about the potential for information they shared to be used by their competitors. Enabling truckers to more easily find containers to carry at the end of each trip has the potential to increase profit for drivers, reduce congestion and emissions, and cut costs and speed deliveries for carriers. However, carriers would likely be more comfortable with an entirely private sector system that could be held more accountable.[104] It is also likely that C-TIP would have had more of an impact if the pilot test had not been conducted during the recession-related downturn in intermodal freight volumes.

New York City, NY

Background

The New York Metropolitan Area is home to 19.8 million people.[105] From 1830 until the early 1850s, New York ranked as the busiest port in the world. The formation of the Port of New York Authority (later the Port Authority of New York and New Jersey) in 1921 rapidly advanced the transportation infrastructure in the New York Metropolitan Area and lead to the construction of several massive transportation projects including the George Washington Bridge (1931) and the Lincoln Tunnel (1937). Throughout the 20th century, 13 major bridges and more than 400 miles of highways were constructed.

While much of the shipping has shifted to other cities and manufacturing has declined, the Ports of New York and Newark are still the busiest on the East Coast.[106] Additionally, John F. Kennedy and Newark International Airports are an international gateway for air cargo. While financial services and technology form the backbone of the city's economy, supplying the daily needs of millions of residents, retailers, and niche manufacturers requires an efficient freight system.

Issues and Challenges

The challenges in New York City are regional in nature. As an international gateway for air cargo and marine freight, logistics and efficiency are critical to maintaining a vibrant freight economy. New York City does not have the highly developed rail infrastructure of New Jersey,

[104] Achelpohl, discussion.
[105] U.S. Census Bureau, "Metropolitan and Micropolitan Statistical Areas Totals."
[106] George Lankevich, et al., "New York City (New York, United States) – Britannica Online Encyclopedia," accessed July 23, 2013, http://www.britannica.com/EBchecked/topic/412352/New-York-City.

creating a strong reliance on trucks to move cargo through the city streets out to the two main through corridors—I-278 and I-95 (George Washington Bridge, Cross Bronx Expressway).[107] New York City is a series of islands with extremely dense development. This landscape presents a number of challenges for goods movement. Streets are narrow and heavily trafficked and relatively few destinations are equipped with off-street delivery areas. With 8.3 million residents in the city, the dependence on freight for food, clothing, and other necessary goods is immense. Freight deliveries into Manhattan exceed 100,000 trips daily, most of which are bound for wholesale, retail, and food enterprises.[108] More than 430 million tons of freight moved in and out of New York City in 2004, nearly ninety-percent of which traveled by truck. The volume of freight moving in the city is projected to nearly double by 2030.

Most of the cargo deliveries in the city occur during daytime business hours, when traffic is at its peak. Because carriers are faced with very limited parking options, particularly in the Central Business District (CBD), trucks are often left idling, double-parked in traffic lanes while their drivers make deliveries.[109] These double-parked trucks generate a great deal of congestion, along with associated noise and emissions, increase travel times and diminish travel time reliability.[110]

Solutions

PlaNYC 2030, originally released in 2007 and updated in 2011, is a comprehensive plan for the City of New York that focuses on providing sustainable solutions to the challenges of rapid population growth in the city. Two of the 14 initiatives cited in the Transportation Chapter of PlaNYC 2030 involve the improvement of freight movement and the reduction of costs to society, primarily congestion, within New York City:

- Initiative 10: Reduce truck congestion on city streets
- Initiative 11: Improve freight movement

As part of an effort to meet the goals of these initiatives, the city has implemented several strategies.

Paid Commercial Parking

The implementation of paid commercial parking is one important TDM strategy in New York City. In 2000, New York City Department of Transportation (NYCDOT) conducted a pilot program that replaced unpriced commercial loading zones using an escalating price schedule. As part of this effort, NYCDOT replaced single-space parking meters with ticket dispensing "Muni-meters" that allow commercial vehicles to purchase prepaid parking tickets for up to three hours.[111] Results of this pilot in Midtown showed a reduction in average parking duration from 160 minutes to 45 minutes. Only about 25% of the vehicles were parked for more than one hour. Due to the success of this pilot, NYCDOT has incrementally expanded paid commercial parking

[107] Maguire, discussion.
[108] Schaller et al., "Parking Pricing and Curbside Management in New York City".
[109] PLANYC 2030, "Transportation," *PlaNYC 2030* (The City of New York, April 2011), http://nytelecom.vo.llnwd.net/o15/agencies/planyc2030/pdf/planyc_2011_transportation.pdf.
[110] Maguire, discussion.
[111] Marsha Anderson Bomar, et al., "Urban Freight Case Studies: New York", The Federal Highway Administration, November 2009, available at http://ops.fhwa.dot.gov/publications/fhwahop10019/fhwahop10019.pdf.

to cover most commercial parking spaces in Manhattan from 60th Street to 14th Street and in some surrounding areas including Chinatown. Freight stakeholders (shippers, carriers, receivers, unions) have supported paid commercial parking because of its effectiveness in improving curb access and reducing congestion. Current rates for trucks and commercial vehicles making deliveries are $4.00 for the first hour, $5.00 for the second hour, and $6.00 for the third hour.[112]

Off-Hour Delivery

A study of off-hour delivery arrangements is another effort by NYCDOT. Beginning in August 2009, NYCDOT and a consortium of research institutions lead by Rensselaer Polytechnic Institute worked with 8 delivery companies and 25 business locations on a pilot program to encourage businesses to accept off-hour shipments through financial incentives and innovative ideas to aid in deliveries.[113] Two of the most promising of these are "unassisted delivery" and low-noise infrastructure at delivery sites.[114] Unassisted deliveries are those that take place outside of ordinary business hours without the assistance of staff from the receiving establishment, and often involve the use of segregated delivery areas that drivers can access without gaining entrance to the rest of the building. Low-noise delivery infrastructure, including gates and loading docks, reduce the nighttime disturbance to building residents.

THRU Streets

The THRU Streets program is another TDM strategy implemented by the NYCDOT. Congestion due to turning movements in Midtown Manhattan significantly reduces travel time reliability, generates increased emissions, and raises safety concerns associated with vehicle-pedestrian conflicts. In an attempt to reduce congestion and improve safety, NYCDOT designated a series of THRU streets, on which certain parking and turning restrictions are enforced.

The streets designated as THRU streets began as five pairs of opposite direction one-way streets consisting of 36th and 37th, 45th and 46th, 49th and 50th, 53rd and 54th, and 59th and 60th streets bounded by Sixth Avenue to the West and Third Avenue to the East (**Figure 3**). As part of a slight modification to improve the program the THRU Street designation of 59th Street was removed.

Vehicles are restricted from turning off of THRU streets between the hours of 10 a.m. and 6 p.m., which improves the flow of traffic by eliminating the obstructions created by vehicles waiting for pedestrians before making a turn.[115] While the effectiveness of this program has waned as enforcement of parking and turning regulations has declined it has proven an effective way of improving pedestrian safety and vehicle throughput.[116]

[112] "NYC DOT – Parking Rules and Rates," accessed July 23, 2013, http://www.nyc.gov/html/dot/html/motorist/parking-rates.shtml#rates.
[113] Ibid.
[114] Maguire, discussion.
[115] Bomar, et al., "Urban Freight Case Studies: New York."
[116] Maguire, discussion.

Figure 3: New York City THRU Streets

Source: New York City Department of Transportation, *Thru Streets: An Innovative Approach to Managing Midtown Traffic* (2004).

Midtown in Motion

An effort to build upon the THRU Streets program, called Midtown in Motion, began in 2011and uses ITS technology to control traffic flow in Midtown Manhattan. Expanded in 2012, the program currently covers a service area of more than 270 square blocks and uses 210 microwave sensors, 56 traffic video cameras, and 68 E-Z Pass readers. It allows traffic engineers to identify and respond to traffic conditions in real time. Midtown in Motion traffic information can be viewed in real time on NYCDOT's website and on mobile devices.[117] This data can assist carriers in route planning.

Residential Waste Management Plan – Truck to Rail

While shifting inbound goods from truck to rail in New York City is not generally feasible, the city has made progress in reducing the number of residential waste management vehicles on the road through modal shift. Because garbage deliveries to landfills are much less time sensitive than the inbound deliveries to the city, shifting a portion of the garbage leaving the city for landfills from truck to rail has been a cost-effective way of reducing road congestion. To further

[117] Solomonow and Mosquera, "NYC DOT – Press Releases – Announces Expansion of Midtown Congestion Management System, Receives National Transportation Award."

reduce the number of residential waste carrying trucks on city roads, New York City is investing in marine transfer stations to begin to transfer a portion of the waste onto barges.
More than 2,000 city government and 4,000 private trucks are needed to collect residential waste from across the five boroughs of New York City. The New York City Comprehensive Solid Waste Management Plan (SWMP), once fully implemented, will reduce city-collection truck travel by nearly 3 million miles, private long-haul truck travel on city streets by 2.8 million miles, and long-haul truck travel outside the city by 55 million miles.[118]

The plan, implemented in 2006 and involving the City, the Sanitation Commissioner, and Waste Management of New York, is making significant progress. In the 2011 update of PlaNYC 2030, the city reported that approximately 30% of city-collected waste now leaves the city by rail. The city hopes to reach a goal of moving 41 percent of its solid waste by rail, 47 percent by barge, and only 12 percent by truck.[119]

Costs and Benefits

Paid Commercial Parking

There have been infrastructure improvement costs associated with the Paid Commercial Parking program including the installation of muni-meters and new signs. Parking citation revenue is likely to decline as well. However, the city anticipates that the revenue collected from the meters will cover the capital costs and new commercial vehicle parking revenues, and reduced enforcement costs will make up for the decline in revenue from citations.

Other benefits of this program are the reduction in congestion and the associated externalities such as emissions and noise. Results from this program show that occupied curb space has dropped from an average of 140 percent (all spaces were occupied, with double-parking occurring at 40 percent of the locations) to 95 percent. Additionally, average duration of curbside occupancy has decreased from 160 minutes to 45 minutes and only 25 percent of commercial vehicles are occupying spaces for more than an hour.[120] By increasing the turnover of commercial trucks, carriers spend less time circulating neighborhoods to find curbside parking, double-parking is reduced, and congestion is reduced.

Off-Hour Delivery

As part of the Off-Hour Delivery pilot study, GPS devices were placed in the vehicles of project participants. The data from these devices showed that travel speeds for carriers during off-hours average about 8 miles per hour compared to 3 miles per hour during regular hours. A truck traveling 10 miles from customer to customer would save 1.25 hours per tour during off-hour time periods.[121] Overall results from the pilot showed that travel speeds to the first stop improved

[118] Nancy Mann Jackson, "Trash on the Tracks: New York City Leads the Trend of Hauling More Municipal Waste by Rail," Solid Waste Management Plan (SWMP), New York City Department of Sanitation (DSNY), "Waste by Rail Content from Waste360," accessed August 6, 2013, available at http://waste360.com/Collections_And_Transfer/trash_tracks_swmp.

[119] PLANYC 2030, "Solid Waste," April 2011, available at http://nytelecom.vo.llnwd.net/o15/agencies/planyc2030/pdf/planyc_2011_solid_waste.pdf.

[120] Schaller et al., "Parking Pricing and Curbside Management in New York City."

[121] Jose Hoguin-Veras et al., "Integrative Freight Demand Management in the New York Metropolitan Area," as cited in Bruce Schaller et al., "Parking Pricing and Curbside Management in New York City," *Transportation Research Board 90th Annual Meeting (in Review)* (2010).

by up to 75 percent with a decrease in delivery time from 100 minutes to 30 minutes.[122] Other benefits associated with off-hour delivery include a reduction in congestion and its costs to society such as emissions.

One cost associated with shifting to off-hour deliveries is the staff time necessary to receive some of the deliveries. However, if carriers and receivers can work out unassisted delivery arrangements, the staffing costs can be greatly reduced. Another cost of off-hour delivery is that associated with noise, which can be mitigated with quieter doors, gates, and lifts.

THRU Streets

The costs of the THRU Streets Program include new signs, signal upgrades, and costs associated with outreach and education. As a result of the THRU Streets Program, however, carriers began to divert to the THRU streets reducing traffic on "Non-THRU" streets. This has allowed the NYCDOT to enhance loading and unloading zones and create an additional 150 commercial vehicle parking spaces, increasing the revenue from the commercial vehicle parking program.[123] The THRU Streets Program has also reduced congestion and improved travel time reliability. Travel times were reduced following the program's implementation by 24.7 percent, with the number of vehicles per hour increasing from 4,187 to 4,845 vehicles on all of the designated streets. The THRU Streets Program has also been a success in terms of safety, reducing crashes on designated streets by 31 percent.[124]

Midtown in Motion

The total cost for installation and expansion of the Midtown in Motion system was $4.5 million with $1,580,000 coming from the city, $2,320,000 contributed by New York State, and $600,000 provided by the Federal Highway Administration.[125]

The first phase of the program, installed in 2011, showed an overall improvement in travel times on the impacted avenues. Much like the THRU streets program, the resulting increase in travel times and reduction in congestion increases efficiency for freight carriers and reduces emissions.

Residential Waste Management Plan – Truck to Rail

Costs associated with truck to rail transfers of residential waste in New York City included procurement and improvement of six private rail transfer stations in Brooklyn, Queens, and the Bronx. While much of the waste transfer from truck to rail has been completed, more work is necessary to transfer waste to barges including the construction of four marine transfer stations that will export an average of 5,770 tons of waste per day.[126]

Other costs that have not been quantified include the costs of inconveniences to residents living in neighborhoods where the trains carrying waste will travel. Increased transport of residential waste by train will increase the number of trains traveling through some of the residential neighborhoods and may cause odor problems.

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[122] Ibid.
[123] Bomar, et al, Urban Freight Case Studies: New York.
[124] Ibid.
[125] Solomonow and Mosquera, "Press Releases: Announces Expansion of Midtown Congestion Management System, Receives National Transportation Award."
[126] Jackson, "Trash on the Tracks."

However, by reaching a goal of hauling 88 percent of New York City's residential waste by train (41 percent) and barge (47 percent) and only 12 percent of this residential waste by truck, many waste management trucks will be removed from the city streets causing a decrease in congestion, emissions, and noise while increasing safety.

Lessons Learned

Due to the high freight demands and unique characteristics of New York City, the city has adopted a variety of innovative strategies, and is experimenting with others, to smooth the flow of goods while reducing associated costs. In order for these strategies to work and to develop effective new freight TDM methods, the involvement of a variety of stakeholders, including shippers, carriers, receivers, union representatives, residents, and the commercial sector is critical to the planning process, and each strategy needs to be paired with a strong educational component.

Orlando, FL

Background

The first transportation infrastructure in the Orlando Metropolitan Area, a region of 2.2 million people, were rail lines built in the late 1800s to carry citrus fruits to market, which increased the volume of agricultural commodities that were already being transported on the St. Johns River. However, with the development of Disney World in 1971 and the growth of the tourism industry— and later as the economy diversified and the region attracted high tech industries such as software, simulation, and digital media, and biotechnology—highways grew in importance.[127] With the region's rapid economic and population growth there has been a boom in low-density suburban residential development and resulting traffic congestion. With the population expected to double by 2040, over the past decade the region has taken a strategic direction towards maintaining its freight infrastructure and streaming freight movement.

Issues and Challenges

The Orlando Metropolitan Area is one of the world's most popular tourist destinations and welcomes over 500,000 visitors per day. Providing and serving the high demand for consumer goods and other commodity needs for visitors and residents in the region requires an efficient and effective freight and logistics system. Freight travel time reliability is a critical factor. The main commodities consumed in the region are consumer goods, automobiles, construction-related materials, and food products. Many of these commodities need to be imported from other regions since these goods are not manufactured in the Orlando region. In 2010, 201 million tons of freight moved into, out of, within, or through the Central Florida Region (**Figure 4**). According to the Central Florida Regional Freight Study the amount of freight is expected to more than double by 2040, to over 500 million tons per year. About 95% of all freight in the area was moved by truck in 2010 and trucks are predicted to carry a similar share in 2040.[128]

[127] City-Data.com, "Orlando: History – City Built Around Fort, Citrus Industry Spurs Development," accessed July 25, 2013, http://www.city-data.com/us-cities/The-South/Orlando-History.html.

[128] Cambridge Systematics et al., "Future Regional Freight and Goods Flow Profile – Central Florida Regional Freight Study," November 30, 2012, available at http://www.metroplanorlando.com/files/view/regional-freight-study-2013-future-year-commodity-flow-profile.pdf.

In the Orlando Metropolitan Area, short haul trips (less than 300 miles) with both the origin and destination in Florida are the most common types of trips. Truck trips are even shorter within the Downtown Orlando area. Trips in which a partially full truck is making multiple small pickups or multiple small deliveries are the most common. Typically, delivery volumes are twice the size of pickup volumes causing inefficiencies in cargo movements. [129] A significant portion of the Central Florida Region proposed freight network passes through Downtown Orlando. Three through corridors, and one Arterial Stem Route are utilized by trucks for pickup and delivery of goods in the downtown area, but also for routes that pass through the downtown area with no pickups or deliveries.[130]

Figure 4: Central Florida Region

Source: MetroPlan Orlando Freight, Goods and Services Mobility Strategy Plan, 2012.

[129] HDR Engineering, Inc., "Downtown Orlando Transportation Plan", (The City of Orlando Public Works Department, November 2006, available at http://www.cityoforlando.net/transportation/TransportationPlanningDiv/pdf/dtp_docs/DTP1106.pdf.

[130] Ibid.

Solutions

Many studies have addressed characteristics and needs of people traveling in Central Florida. However, until the 2002 MetroPlan Orlando Freight Goods and Services Mobility Strategy Plan (FG&MSP)[131], there was relatively little information about the movement of freight, goods and services in the Orlando area—particularly by truck. The first step in creating the plan was to establish a Committee Freight Mobility Working Group (FMWG), which consisted of 65 stakeholders from both public and private industry.

As a result of recommendations from the FG&MSP, the regional partners are using two primary strategies to manage freight transportation demand in the area. On the land use side, MetroPlan Orlando, the MPO for the Orlando Urban Area, identified locations for freight villages and worked with local jurisdictions to implement supportive zoning ordinances. On the transportation side, the government partners designated a system of truck and truck-restricted routes to focus investment and system improvements.

A study under way now is building upon the original study and expands links to regional, state, national, and international markets. Additionally, the study examines seven counties in Central Florida: Orange, Osceola, Seminole, Lake, Sumter, Volusia, and Brevard. As part of this process, MetroPlan Orlando, along with the Space Coast TPO, Lake-Sumter, MPO, Volusia TPO, the Florida DOT, established the Freight Advisory Council (FAC). The FAC is composed of representatives from the local counties and municipalities, Florida DOT, Port Canaveral, railroad operators, trucking companies, the aviation authorities, and other freight-related industry professionals.

Freight Villages

MetroPlan Orlando first proposed locations for freight villages in their 2030 Long Range Transportation Plan and suggested that local jurisdictions develop a warehousing and logistics (WL) zoning category to ensure appropriate design standards.[132] This zoning designation will provide uniform standards for appropriate development for the needs of freight and freight-related businesses locating in Central Florida. WL zones should include signal timing, geometric design standards, and loading dock requirements. By identifying where freight activities are currently clustered, jurisdictions can use the WL zone to preserve and support current freight activities and prevent potential land use conflicts by ensuring the compatibility of neighboring uses.

Local jurisdictions have been the most important stakeholders in the effort to preserve freight centers and promote the freight village concept.[133] MetroPlan Orlando continues to work with state, county, and municipal governments to highlight the importance of freight intensive land uses to support economic development. The City of Kissimmee has added freight-supportive policies, including clustering warehouses and developing freight staging areas, to its

[131] Wilbur Smith Associates et al., "Freight, Goods and Services Mobility Strategy Plan," Metroplan Orlando, June 2002, available at http://www.metroplanorlando.com/files/view/freight_goods_and_services_mobility_strategy_plan_june_2002.pdf.

[132] MetroPlan Orlando, "2030 Long Range Transportation Plan Overview," 2009, available at http://www.metroplanorlando.com/plans/long-range-transportation-plan/

[133] Alexander Trauger (Transportation Planner, MetroPlan Orlando), in discussion with the authors, May 21, 2013.

Comprehensive Plan. Other larger jurisdictions in the area, such as Orange County, have participated in the National Demonstration Project in Land Market Monitoring organized by the National Center for Smart Growth Research and Education, U.S. Department of Housing and Urban Development, and FHWA This Project incorporates goods movement into land use planning.[134] The City of Orlando has developed an "airport support" zone as part of its *Southeast Sector Plan*[135], which provides infrastructure to support airport activities and the efficient movement of goods to and from the airport.

Truck Routes

A primary goal of the *Downtown Orlando Transportation Plan*[136] is to designate truck routes to facilitate movement of goods through downtown, into and out of downtown, and circulating within downtown. By designating truck routes for movements through downtown, the City Public Works Department was able to maintain truck movement patterns and ensure connectivity for regional and statewide goods movement while limiting the number of routes that trucks could use. This was accomplished by studying the current trends in truck movement and identifying the routes with appropriate road geometries.

Much like routes designated for goods traveling through downtown, truck routes designated for movements into and out of downtown needed to meet certain criteria—such as maintaining truck movement patterns and ensuring efficient connectivity for downtown to the regional and statewide goods movement system—while also limiting the number of routes that trucks could use. The *Downtown Orlando Transportation Plan* identified a core set of roads in the commercial and retail area of downtown that would provide access around downtown to ensure efficient pickups and deliveries.

Finally, truck routes were designated for those trucks making shorter, local deliveries within the downtown area. These routes are designed to get trucks from major local roads to final destinations in the downtown area. The downtown circulation truck routes are designated to ensure access for all downtown establishments while limiting the number of truck routes in both the north/south and east/west direction and ensuring compatibility with the existing road geometries.

Costs and Benefits

There are very few direct costs associated with the preservation of freight intensive land for freight villages and the designation of truck routes. However the development and implementation of design standards, zoning classifications, and truck route designations can create challenging demands on regional and local planning staff. Significant time must be invested in working with private and public sector stakeholders, as well as the public, to collect data and make useful recommendations for policy decisions.

The designation and preservation of freight intensive land uses provides significant economic development benefits to the Orlando Region. Orlando's economy, which depends on goods

[134] Marsha Anderson Bomar et al., "Urban Freight Case Studies: Orlando."
[135] "City of Orlando: Economic Development : City Planning," accessed August 8, 2013, http://www.cityoforlando.net/planning/cityplanning/projectSEPlan.htm.
[136] HDR Engineering, Inc., "Downtown Orlando Transportation Plan: Final Report."

arriving from outside of the region to support its tourism and technology industries, requires balancing the mobility of goods and travelers with livability and environmental concerns. Freight villages encourage the consolidation and clustering of distribution centers near intermodal facilities, which reduces truck VMT, emissions, congestion, and shipping costs, and improves livability for neighboring properties.

Designating specific truck routes in the region not only benefits the efficiency of the freight industry, but also is important to the safety of other transportation system users, particularly cyclists and pedestrians who can more easily avoid routes where they are in close proximity to trucks. The other key benefit of creating a designated truck route network is that it allows for targeted truck-friendly roadway design and pavement maintenance activities, which can create cost savings for the public sector.

Lessons Learned

While the designation of freight villages and truck routes has yet to be completed region-wide, the truck route system designated in the *Downtown Orlando Transportation Plan* is increasing livability in the city. MetroPlan's freight village concept is starting to take root in municipal land use policies and stakeholders have recognized the importance of including freight in their visions for the future. MetroPlan Orlando's success in getting freight planning issues onto the front burner and creating a unified vision for managing freight with input from the public and other freight stakeholders is an example of how MPOs, which serve an advisory role in creating transportation and land use policies, can generate significant benefits for their communities. Currently, MetroPlan Orlando and its planning partners are finalizing the 2013 Freight, Goods, and Services Study. Emphasis continues to focus on the nexus between land use and the transportation system. Results and recommendations are scheduled to be presented mid-September.[137]

Portland, OR

Background

The Portland Metropolitan Area, a region of 2.3 million people that straddles the border between Oregon and Washington State, has a strong history of land use planning. Incorporated in 1851, Portland grew rapidly after the construction of the first transcontinental railroad in 1883, linking Portland with the East Coast. During WWII the city was a shipbuilding and manufacturing center, which required development of industrial zones along the Columbia and Willamette Rivers.[138]

To reduce sprawl and promote sustainable development, Oregon created urban growth boundaries as part of the statewide land use planning program in the early 1970s. Governor Tom McCall, along with a coalition of farmers and environmentalists, worked with the Legislature to require every city and county in the state to develop long-range plans to meet the following state land use goals:

[137] More information about MetroPlan Orlando and its Freight Study initiative can be found at: http://www.metroplanorlando.com/modes/freight/.

[138] City-Data.com, "Portland: History," accessed July 30, 2013, http://www.city-data.com/us-cities/The-West/Portland-History.html.

- Setting urban growth boundaries
- Using urban land wisely
- Protecting natural resources[139]

Since the implementation of the state's long-range planning requirements, Portland has been a leader in planning for controlled growth and environmental sustainability. Portland's urban growth boundary makes the city unique among major metropolitan areas, stemming urban sprawl in the region's constituent counties within Oregon.

The fourth largest port city on the West Coast, Portland is well known for its long history of manufacturing and currently produces electronics, machinery, food products, and transportation equipment.[140] The Portland Metropolitan region is also home to high-technology industries, including the Intel Corporation and the world headquarters of Nike, Inc.

Issues and Challenges

Portland's Urban Growth Boundary (UGB), while important to controlling urban sprawl, preserving agricultural land, and promoting environmental sustainability, creates a unique challenge to the freight industry. Within the UGB, industrial lands are very limited. A 2012 Regional Industrial Site Readiness Report[141] identified a lack of development-ready large lot, industrial sites in the Portland metro region. This report calls for new policies and investments to increase the development-ready supply of industrial sites for manufacturing job growth. This also underscores the importance of preserving the existing industrial sites, especially in the Central East Side of the city where residential and commercial development pressures exist.[142] According to the commodity flow forecast cited in the City of Portland Freight Master Plan, freight tonnage moving in the Portland region will exceed 500 million tons in 2030—more than double 1997 levels. The share of this freight carried by truck is expected to continue increasing over the coming years to nearly 75 percent in 2030. The projected growth in regional traffic volumes on the area's highways over the coming years will significantly worsen congestion levels.

Current city and regional land use policies will continue to increase the density of the Portland area, creating new challenges for delivering goods to consumers and getting locally made goods to buyers outside the area. Portland's role as a gateway and distribution center for domestic and international freight, along with the predicted increase in freight volumes over the coming years, make ensuring efficient goods movement a critical issue. Moreover, as the area's urban population grows, livability issues will exert increasing pressure to lower the externalized costs of freight movement.

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[139] Oregon Metro, "Metro: Urban Growth Boundary," accessed August 1, 2013, http://www.oregonmetro.gov/index.cfm/go/by.web/id=277.

[140] Robert Hillier (City of Portland—Bureau of Transportation), in discussion with the authors, May 16, 2013.

[141] Group Mackenzie et al., "Land Availability," 2012, available at http://www.valueofjobs.com/pdfs/land-availability-study-new.pdf.

[142] Hillier, discussion.

Solutions

Educational Outreach

Portland's Transportation System Plan (the Transportation Element of the Comprehensive Plan)[143] provides preferred courses of action for transportation decisions within the city. An important part of this plan is the Transportation Education component. One of the objectives within the Transportation Education component is to "Implement educational programs that recognize the need for developing and maintaining a multimodal transportation system that supports the movement of freight as well as people." By helping the public and other stakeholders to understand the importance of freight to the viability of the city, certain freight-friendly strategies can be implemented. Portland has succeeded in balancing its economic development, livability, and transportation goals through a combination of education, zoning, and street classification strategies.

Employment Opportunity Subarea

Portland's Employment Opportunity Subarea (EOS) promotes employment and industrial activity in the city's Central Eastside Industrial District. The Central Eastside of Portland is a vital inner-city industrial area. In 2006, the city crafted an amendment to the Central City Plan District that amended the City Zoning Code to create the EOS. The EOS is designed to cultivate the development of a dense urban employment center supporting a diverse industrial base while protecting existing industrial and freight distribution businesses. Maintaining central locations for distribution and freight consolidation companies reduces the overall volume of heavy truck traffic on central city streets and increases the efficiency of the freight delivery system for central city businesses.[144]

Street Classifications

In order to maximize the value of land use policies such as the Central Eastside Industrial District EOS, the City of Portland has strategically classified its streets to ensure the street network supports the land use decisions. The city's Transportation Systems Plan (TSP), part of its Comprehensive Plan, identifies the types of motor vehicle, transit, bicycle, pedestrian, truck, and emergency response uses that should be emphasized on each street and appropriate design guidelines. The TSP also identifies Freight Districts within which transportation and land use policies are designed to facilitate "safe and convenient truck mobility and access in industrial and employment areas serving high levels of truck traffic and to accommodate the needs of intermodal freight movement."[145]

Streets within Freight Districts are intended to provide safe and convenient truck access to industrial facilities. Within Freight Districts, streets are divided into several categories ranging from Regional Truckways—limited access facilities for interregional truck movements—to Local Service Truck Streets—lower volume streets that provide access to individual industrial

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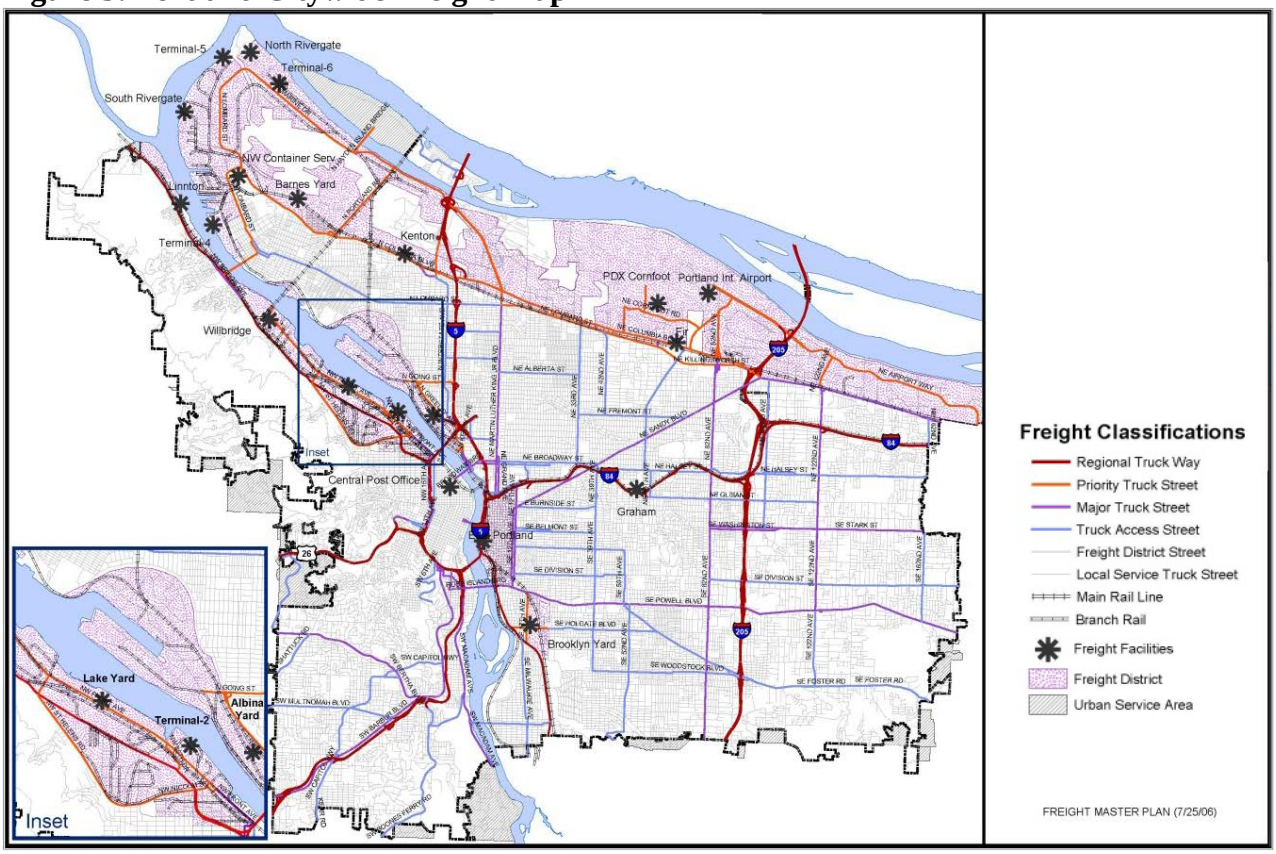
[143] DRI-WEFA and BST Associates, "Commodity Flow Forecast Update and Lower Columbia River Cargo Forecast," Port of Portland, Metro, Oregon Department of Transportation, Port of Vancouver, Regional Transportation Council, July 8, 2002, available at http://www.portofportland.com/PDFPOP/Trade_Trans_Studies_LCR_Crgo_Frcst_Final_Rpt.pdf.

[144] City of Portland Bureau of Transportation, "City of Portland Central City Sustainable Freight Strategy," October 2012, available at http://www.portlandoregon.gov/transportation/article/406590.

[145] Portland Bureau of Transportation, "Transportation System Plan," City of Portland, OR, November 2011, available at http://www.portlandoregon.gov/transportation/52495.

parcels.[146] All of the streets within Freight Districts are to be designed to accommodate all truck-types and over-dimensional loads, as practicable.

Figure 5: Portland Citywide Freight Map



Source: City of Portland, *Freight Master Plan* (2011).

Planning for the street classification system required significant public outreach. The Portland Freight Committee was formed as an advisory group to the Bureau of Transportation and City Council and includes citizen volunteers and public agency representatives from the local, state, and federal level. Implementation of street classifications and the associated enforcement required a great deal of coordination across city departments.

Costs and Benefits

Implementing strategies such as the EOS and the city's street classification system involves a significant investment of time and effort. The development of design standards, zoning classifications, and the classification of streets requires extensive data collection, public outreach, and stakeholder coordination to ensure that recommendations are implementable. When determining street classifications, freight-friendly design standards such as high bridge clearances, weight limits, and turning radii should be considered. Upgrading streets to meet the needs of truck traffic can be expensive but is more affordable if freight-friendly upgrades are implemented during reconstruction, or when other design changes are being made.

[146] Ibid.

Like many cities, Portland's economy is dependent on the ability of its roads and highways to adequately serve its freight needs. Planning measures implemented to improve freight efficiency lower business costs, reduce congestion, and lower emissions while maintaining the viability of industrial jobs in the urban core.

Lessons Learned

Portland's land use and transportation policies have helped the city to maintain its industrial job and economic base without sacrificing its livability. Implementing these policies and ensuring their success, however, has required a great deal of stakeholder outreach. The City of Portland has recognized the importance of partnerships with the business community, other local governments, and community interests to achieve environmentally sustainable solutions that support economic development and a strong employment base. Working with these partners, Portland's experience demonstrates how cities can use their regulatory authority over land use and transportation infrastructure to shape growth and cultivate economic development in a responsible way that benefits a broad range of stakeholders.

Conclusion

The goals of this study have been to identify the costs associated with urban goods movement, the cost-effectiveness of various freight TDM strategies, and implementation issues associated with each. **Table 12**, below, displays the external and private cost impacts and level of difficulty of implementation for each of the freight TDM strategies. The impact classifications and levels of difficulty were assessed qualitatively based on information gathered from relevant literature, surveys conducted, and interviews performed. More detail on the implementation challenges for each TDM strategy, as well as their costs and benefits, is found in the discussion that follows.

Table 12: Freight TDM Strategy Impacts and Implementation Difficulty

TDM Strategy	External Costs					Private Costs		Difficulty to Implement
	Congestion	Health	Safety	Noise	Livability	Shipper & Receiver Costs	Carrier Costs	
Anti-idling Policies	0	+	0	+	+	0	+	Low
Designation of Truck Routes	+	+	+	+	+	+	≈	Medium
Modal Shift	≈	≈	≈	≈	≈	≈	≈	High
Off-Peak Pickup and Delivery	+	+	+	-	≈	≈	+	Medium
Restrictions on Nighttime Delivery	-	-	≈	+	≈	≈	-	Medium
ITS Solutions	+	+	0	0	+	+	+	Low
Land Use Strategies	+	+	+	+	+	+	+	Medium /High
Parking Policies	+	+	+	+	+	+	+	Low
Planning Information Strategies	+	+	+	+	+	+	+	Low

Beneficial Impact	+	Detrimental Impact	-	No Impact	0	Dependent upon other variables	≈

Anti-idling Policies

The negative impacts associated with truck idling are widely understood and policies to reduce idling have been adopted by state, county, and local governments throughout the U.S.. However,

it is important to carefully craft these policies to make sure that they are enforceable, contain reasonable exceptions, and target landowners and/or vehicle owners in addition to drivers. In many cases, drivers do not own their vehicles and thus are unable to invest in auxiliary power units (APUs) or other anti-idling technologies. Penalizing vehicle owners for idling violations could create an incentive for them to make investments in their vehicles that will reduce emissions and increase driver comfort. Similarly, holding landowners liable for vehicles idling on their property creates a greater incentive for self-policing of delivery trucks and may reduce public enforcement costs. Anti-idling rules for trucks are generally supported by the public and often have support from industry stakeholders, as well, because idling wastes fuel and increases engine wear.

Designation of Truck Routes

Establishing or reconfiguring truck routes, as long as there is adequate enforcement, is another way to reduce urban freight impacts relatively quickly. Cities across the U.S. have designated truck routes to reduce truck traffic and associated impacts near schools, residences, and other sensitive areas. When proposed truck routes are located in industrial areas, opposition is likely to be low. However, when proposed truck routes pass through residential areas, public opposition can be intense. Cities can generate carrier support for new truck routes by ensuring that network is linked across jurisdictional boundaries, implementing truck-friendly signal timing, and ensuring adequate overhead clearance and turning radii on designated routes.

Modal Shift

As a method of reducing the negative impacts of urban freight transportation, modal shift from truck to rail is the one of the least likely to be effective and most difficult to implement. Trucking is generally more flexible, faster, and more cost-effective than rail for shorter shipments and few cities have sufficient rail infrastructure to accommodate a large scale shift of freight from truck to rail. In addition, success in promoting more rail freight may result in more local truck traffic as rail freight is carried by truck between rail yards, origins, and destinations, or moved by truck to another rail facility. While shifting freight from truck to rail for long distance moves is economically feasible and provides clear environmental benefits, more urban rail freight often leads to more urban truck freight. Even in cases where a low-volume rail line is available that can be used for through freight in an urban area, residents and communities along the rail line are nearly certain to oppose increasing rail traffic. Given the potential costs, unintended consequences, and likely negative public reaction, strategies by the public sector to effect a modal shift from truck to rail are not generally advisable.

Off-Peak Pickup and Delivery

Incentive and promotional programs for off-peak pickup and delivery can be effective at reducing congestion and associated emissions while lowering costs for carriers. The benefits from these types of programs are likely highest in the most congested regions, such as the New York and Los Angeles areas, where they are currently in place. Trucking companies and drivers are usually happy to make pickups and deliveries during off-peak hours to avoid congested roadways but shippers and receivers often cannot accommodate nighttime and weekend activity. Shippers/receivers need to be incentivized or persuaded of the value of off-peak pickup and delivery in order to implement off-peak programs. Residents who live near freight facilities, however, are often vehemently opposed to new or expanded nighttime freight activities. Cities

considering efforts to promote off-peak pickup and delivery should work closely with residents near freight routes and facilities to reduce their exposure to noise from nighttime freight activities, as well as facility lights and other disturbances.

Restrictions on Nighttime Delivery

Residents often seek to prohibit nighttime truck traffic and loading/unloading activity in order to reduce nighttime noise. However, in congested regions, such restrictions impede efficient freight movement because deliveries that would otherwise occur at night will be shifted to peak periods. While the bans reduce nighttime noise and vibration that disturb residents, their impact on peak period regional congestion more than negates their local benefits. Local governments that have or are considering nighttime delivery bans should consider other ways to reduce nighttime noise impacts, such as by designating truck routes or mandating quieter equipment at delivery locations.

Intelligent Transportation Systems (ITS)

While there are safety concerns related to the use of mobile apps by drivers, dynamic messaging signs, audio information, and the use of mobile apps by drivers when parked can all improve transportation system efficiency, lowering costs and emissions. ITS strategies represent a relatively low-cost alternative to large-scale infrastructure projects and often have wide appeal. Strategies such as variable message signs and traffic congestion applications are already widespread for use by the general public. Working with freight carriers or private application developers to get public information to carriers more effectively can help to reduce congestion with little additional expenditure. Other more advanced freight-specific ITS solutions, such as online platforms to match empty trucks with available loads, are promising; but because they often involve the sharing of confidential proprietary information they are probably best led by the private sector.

Land Use Strategies

Isolating freight from other land uses and locating freight intensive uses near key transportation infrastructure is generally well received by residents and businesses. Maintaining freight land uses in central areas, however, can be difficult due to development pressures for residential or commercial uses. Additionally, rezoning areas for industrial purposes can receive significant opposition from businesses and residents looking to promote commercial and residential purposes. Emphasizing the jobs, economic development, and transportation benefits of these industrial areas, can make creating and preserving them more palatable. Preserving clusters of industrial land in urban areas, particularly parcels with unique attributes, such as accessibility by rail or waterway, can help maintain a robust, resilient urban economy and reduce regional truck VMT.

Parking Policies

By increasing the availability of truck parking near urban delivery locations and limiting the use of spaces to trucks actively engaged in loading and unloading, cities can reduce illegal truck parking and associated congestion while improving freight transportation efficiency. Implementing parking policies, such as paid commercial parking, is relatively inexpensive and often well received by carriers because it increases turnover of vehicles in loading zones and reduces downtown congestion, making their businesses more efficient. Since many carriers

already pay large sums of money in parking violations, paid commercial parking often creates cost savings by increasing the amount of available parking space. Adjusting parking policies is one of the quickest and lowest cost ways to improve transportation system efficiency and reduce societal costs associated with freight transportation.

Planning Information Strategies

Efforts to compile information on freight-generating land uses, key freight corridors, and local freight transportation policies are relatively low cost and, by informing local and regional transportation and land use policymaking, can generate a wide variety of benefits. While the effects of efforts to compile and share land use and transportation information may not be felt in the short term, they can help cities and regions avoid planning and regulatory decisions that generate unintended negative consequences.

Cities and regions are facing increasing congestion, growing roadway construction and maintenance costs, and concerns about livability and sustainability issues. While many cities have had success in reducing congestion by promoting transit use, biking, walking, flexible work hours, and other strategies focused on personal transportation decisions, there has been less of a focus on freight. However, freight TDM strategies are the low-hanging fruit in many urban areas. Many of them are low-cost, relatively easy to implement, ways to increase economic and environmental sustainability that can garner the support of both industry and residents. Today, more cities are looking towards freight TDM strategies as part of the solution to their environmental and economic challenges. As the urban transportation challenges facing cities continue to grow, low-cost strategies that channel freight transportation demand to reduce impacts on residents and increase the efficiency of existing highway and road infrastructure are likely to become much more common.

Appendix A – Methodology

This study was divided into the following four tasks:

1. Conduct a literature review to estimate the full costs for freight moved by truck and train, including costs to society.
2. Identify transportation demand management strategies to reduce the negative impacts of freight transportation in urban areas and survey implementers.
3. Conduct follow-up interviews, develop case studies of example strategies, and evaluate the effectiveness of the strategies identified in task 2.
4. Prepare a final report.

A project advisory committee assisted the project team in refining the scope of the project, developing survey and interview questions, identifying interviewees, and in reviewing draft documents. Members of the project advisory committee included:

- Kurt Paulsen, Assistant Professor, Department of Urban and Regional Planning, University of Wisconsin-Madison
- Kathy Leotta, Washington State Department of Transportation, Public Transportation Division
- Rod Clark, Wisconsin Department of Transportation, Chief – Bureau of Transit, Local Roads, Rail and Harbors, retired

Task 1: Literature search to estimate and allocate the costs of freight transportation by truck and rail.

Because the vast majority of freight tonnage moving within the U.S. is hauled by truck and rail modes, between which there is significant potential for modal shift, this study focused on these modes. Air cargo, pipeline, and inland waterway transportation, though critical to the nation's freight system, are less susceptible to modal shift for most commodities. Using relevant published literature costs for highway and rail modes were determined for shipping costs as well as costs related to congestion, noise and vibration, safety, air pollution, and pavement damage.

This task attempted to answer the following questions:

1. What are the costs of transporting freight by highway and railroad in urban areas?
2. How are these costs allocated to shippers, taxpayers, and society?

While livability was not directly addressed in this task it is important to note that when considering costs it is important to keep in mind the environmental justice issues associated with freight transportation. Due to lower property values attributed to the adverse impacts of truck and rail transportation, many vulnerable low-income populations live in close proximity to freight facilities and are most impacted by their environmental impacts.

The chapter details the internal and external costs associated with freight transportation by truck and rail. Internal has been defined as the costs to the shippers, carriers, and receivers. External

costs have been defined as the costs to society (congestion, noise and vibration, safety, air pollution, and pavement damage).

Task 2: Identify strategies to reduce the impacts of heavy truck traffic on urban areas and conduct an initial survey to assess challenges and effectiveness.
Task 2 identified demand management strategies in use by state and local governments to reduce the environmental, fiscal, and livability impacts of goods movement in urban environments. anti-idling policies, designation of truck routes, truck to rail modal shift, restricted or incentivized delivery hours, Intelligent Transportation Systems (ITS), land use strategies, and parking policies were identified through the literature search as strategies that have been successfully implemented in local communities within the U.S. and that could be transferrable to other communities.

Using the online survey tool, SurveyMonkey, the project team surveyed 23 state governments, local governments, and Metropolitan Planning Organizations (MPO) to determine: their motivations for considering and implementing freight TDM policies as well as the costs and benefits associated with them, and challenges to implementation. Each respondent was asked a series questions related to their organization's experience regarding freight TDM strategies.

Task 3: Evaluate the effectiveness of strategies identified in Task 2 and develop case studies.
Upon receipt and analysis of the survey results the team conducted follow-up interviews with 10 transportation planners and policy implementers from MPOs and local governments in order to gain a deeper understanding of why their communities adopted these strategies, implementation challenges, and strategy effectiveness. The team then developed six case studies of freight TDM strategies based on information gathered during the interviews, the surveys conducted in Task 2, and through a review of available literature. Interviewees reviewed draft case studies and provided comments as well as additional information, where necessary.

Task 4: Prepare final report with discussion and case studies of transportation demand management strategies to reduce the negative impacts of urban goods movement on society.
This report describes the costs, benefits, barriers to implementation, and effectiveness of various freight TDM strategies and provides case studies of strategy implementation.

Appendix B - Survey

Managing Urban Freight Demand

PAGE 1

Many urban areas are struggling with the the question of how to facilitate freight transportation and economic development while reducing the negative impacts associated with truck and rail traffic. The solution of expanding highways and roads is often cost-prohibitive or may create more problems than it solves. However, there are a number of freight transportation demand management (TDM) strategies that do not involve expanding roadway capacity that may often present the most cost-effective solutions to urban freight challenges.

Freight TDM includes the use of incentives/disincentives, regulations, market devices, and investments in supportive infrastructure to increase freight mobility and reduce the negative impacts of freight transportation in urban areas by shifting freight routes, modes, pickup/delivery times, or operational characteristics.

The State Smart Transportation Initiative (SSTI) is currently working on a project to understand how state, local, and regional governments are using freight TDM strategies to improve urban freight transportation and lessen its negative impacts on their communities. We are also interested in the opportunities and barriers that they have faced in implementation. As a transportation professional, your insight will help us understand how communities are balancing the challenges posed by freight transportation with the need for economic development.

If there is someone else at your organization more familiar with these efforts, please pass along the link to this survey to them. The survey will take 5-10 minutes to complete.

1. Name:

2. Organization:

3. Email address:

4. What are your organization's primary interests regarding urban freight transportation? (check all that apply)

- ☐ Reducing noise/vibration
- ☐ Improving safety
- ☐ Reducing traffic congestion
- ☐ Reducing emissions/pollution
- ☐ Reducing pavement damage
- ☐ Promoting environmental justice
- ☐ Improving freight mobility
- ☐ Reducing shipping costs

Other (please specify)

5. How much interest has there been in your organization in considering/pursuing urban freight TDM strategies?

- ● None
- ● Very little interest
- ● Moderate interest
- ● Strong interest

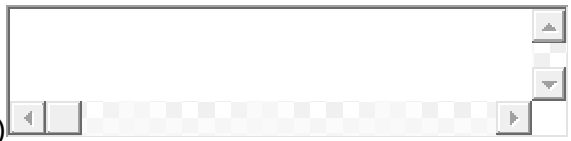
6. Why do you think your organization is not more interested in investigating the potential use of these types of strategies?

- ☐ No problems related to urban freight movement in our area
- ☐ Not enough knowledge about problems related to freight movement
- ☐ Lack of public interest/concern
- ☐ Uncertainty about the effectiveness of freight TDM measures
- ☐ Lack of financial resources

Other (please specify)

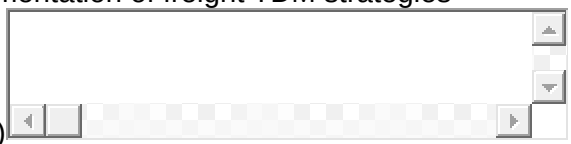
7. Has your organization considered any of the following strategies: (check all that apply)

- ☐ Restricted pickup/delivery hours
- ☐ Funding or financing for new or upgraded railroad infrastructure to promote modal shift
- ☐ Route restrictions
- ☐ Parking pricing or road tolling
- ☐ Anti-idling policies
- ☐ Truck-only lanes (tolled or free)
- ☐ Dynamic message signs or mobile applications to convey congestion or parking information to truck drivers or dispatchers
- ☐ Changing land use policies to cluster freight-intensive land uses (distribution centers, ports, etc.)
- ☐ None

Other (please specify) 

8. Which, if any actions has your organization undertaken in pursuit of urban freight TDM strategies (check all that apply)?

- ☐ Research on possible options
- ☐ Discussions at public hearings or committee meetings
- ☐ Inclusion of freight TDM recommendations in plans or policy documents
- ☐ Specific planning, engineering, or financial analyses of freight TDM strategies
- ☐ Funding or implementation of freight TDM strategies

Other (please specify) 

9. Please identify which, if any, of these strategies were implemented.

- ☐ Restricting pickup/delivery hours
- ☐ Funding or financing for new or upgraded railroad infrastructure to promote modal shift (truck to rail)
- ☐ Route restrictions
- ☐ Parking pricing or road tolling
- ☐ Anti-idling policies
- ☐ Truck-only lanes (tolled or free)
- ☐ Dynamic message signs or mobile applications to convey congestion or parking information to truck drivers or dispatchers
- ☐ Changing land use policies to cluster freight-intensive land uses (distribution centers, ports, etc.)
- ☐ None

Other (please specify)

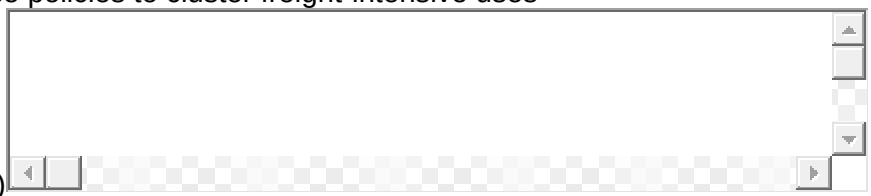
10. What issues (costs/benefits) were most critical in the decisions about whether to adopt these strategies? Please describe.

11. What stakeholder groups were most resistant to implementation of these strategies? Why?

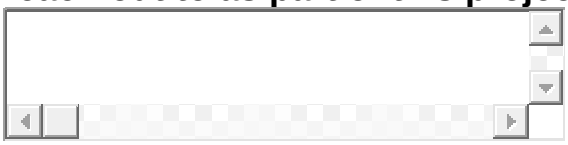
12. What stakeholder groups were most supportive of these strategies? Why?

13. If you could implement any demand management strategy or set of strategies to improve freight mobility or reduce the negative impacts of urban freight transportation on your community, which of the following would you do?

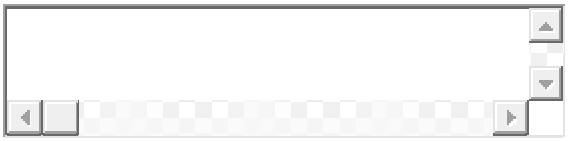
- ☐ Restricting pickup/delivery hours
- ☐ Funding or financing for new or upgraded railroad infrastructure to promote modal shift
- ☐ Route restrictions
- ☐ Parking pricing or road tolling
- ☐ Anti-idling policies
- ☐ Truck-only lanes (tolled or free)
- ☐ Dynamic message signs or mobile applications to convey information to drivers or dispatche
- ☐ Changing land use policies to cluster freight-intensive uses

Other (please specify) 

14. Can you suggest any other people/organizations that we should reach out to as part of this project?



15. Additional Comments?



Thanks for taking the time to fill out this survey. We will be conducting interviews over the next 2 months and will be using our results from the survey and interviews to guide us as we develop our final report, which will be available on our website (www.ssti.us) in September.

Appendix C – Selected Survey Results

The authors selected the following survey questions and answers for display in this appendix based on two characteristics:

1) There were sufficient responses to the questions to lend value to the discussion
2) They could be graphically displayed for easy analysis

4. What are your organizations' primary interests regarding urban freight transportation? (check all that apply)

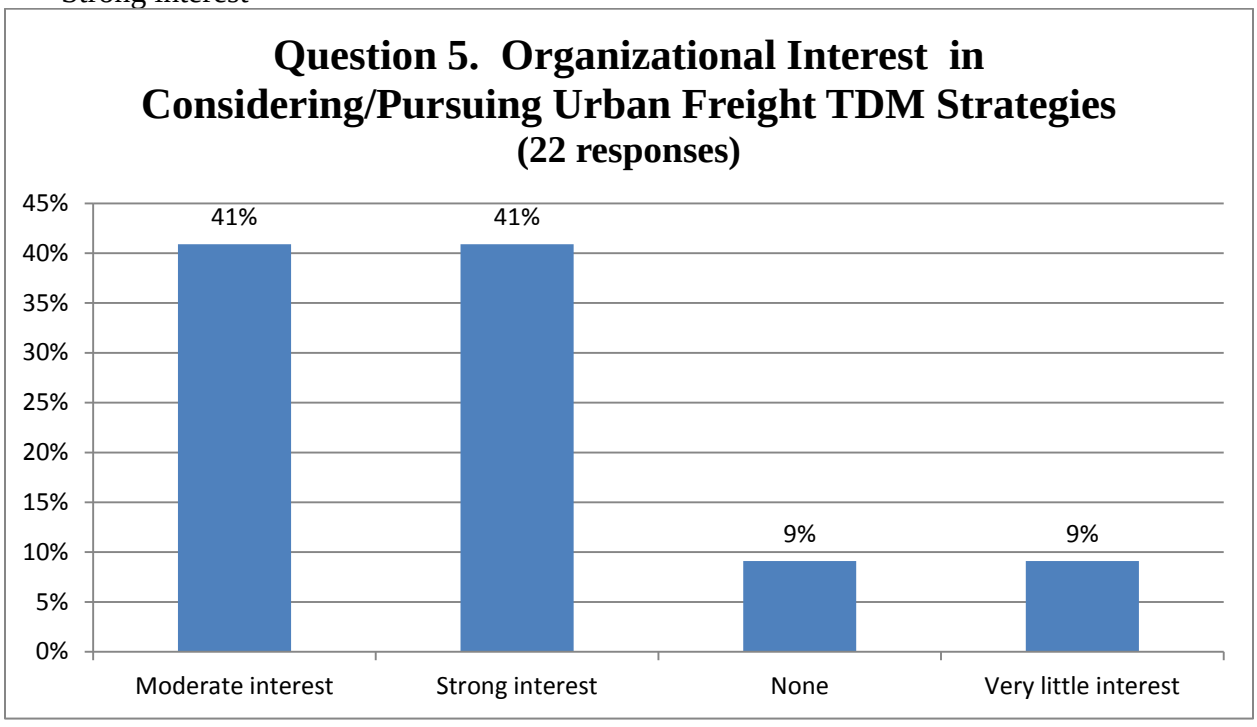
- ☐ Reducing noise/vibration
- ☐ Improving safety
- ☐ Reducing traffic congestion
- ☐ Reducing emissions/pollution
- ☐ Reducing pavement damage
- ☐ Promoting environmental justice
- ☐ Improving freight mobility
- ☐ Reducing shipping costs

Additional Responses:

- Job retention and job creation. Reducing bridge damage.
- Increasing the amount of freight into and out of our region.
- State/regional Economic competitiveness
- Making informed decisions about multi-modal management decisions affecting current and future trips. Maintain and improve urban freight mobility. Future growth in rail volumes (freight and passenger) will impact street crossing congestion and response time for emergency vehicles.
- Monitor Travel Times, Reliability of trip time
- Promoting economic development (2)
- Helping states, MPOs and local gov't understand freight transportation and their role in it
- Retaining Short Line RRs and carload freight into urban core
- As a city government, our organization is responsible for all the issues referenced above. Reducing shipping costs is indirectly achieved by improving the overall conditions for freight movement.

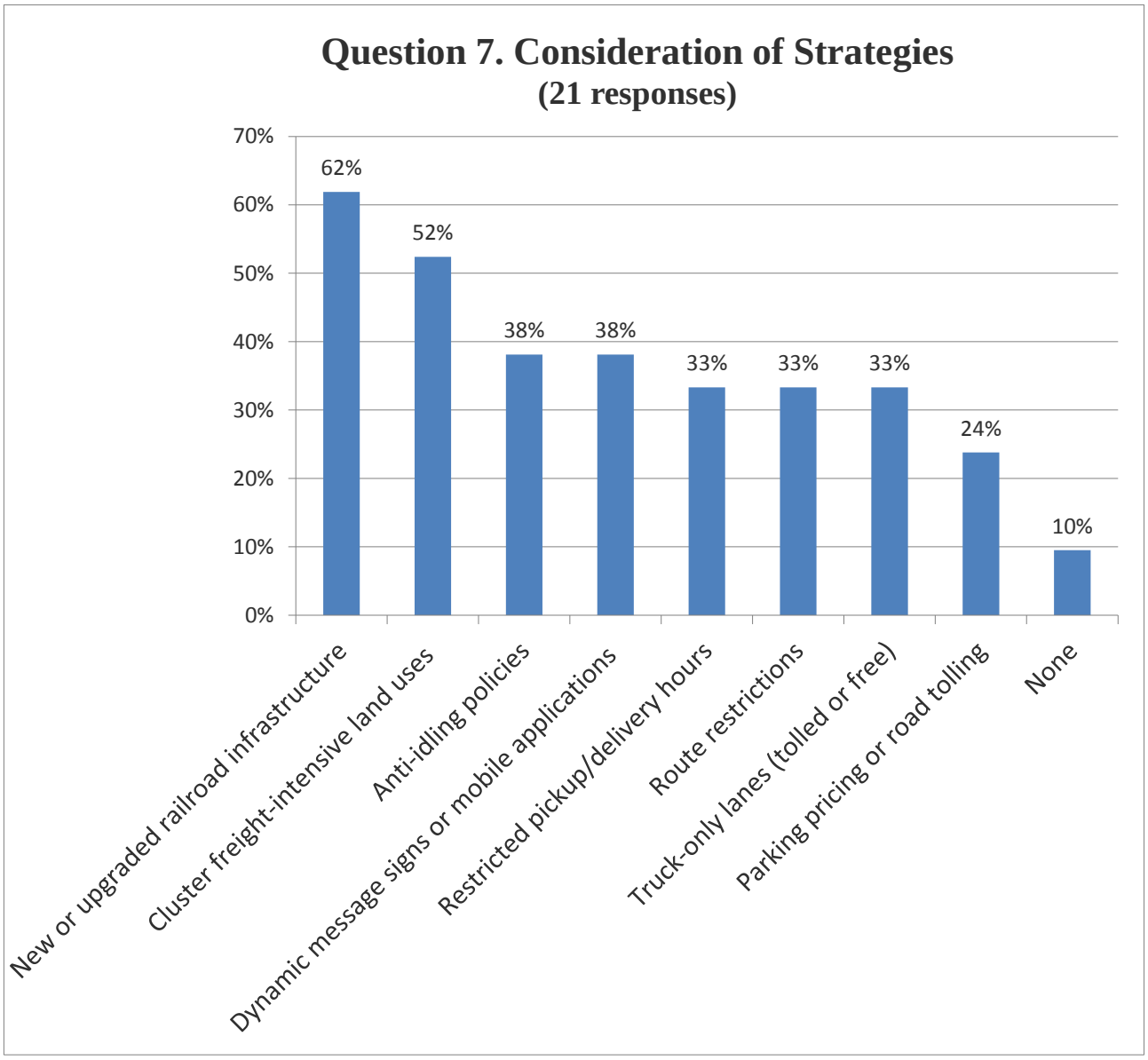
5. How much interest has there been in your organization in considering/pursuing urban freight TDM strategies?

- None
- Very little interest
- Moderate interest
- Strong interest



7. Has your organization considered any of the following strategies: (check all that apply)

- ☐ Restricted pickup/delivery hours
- ☐ Funding or financing for new or upgraded railroad infrastructure to promote modal shift
- ☐ Route restrictions
- ☐ Parking pricing or road tolling
- ☐ Anti-idling policies
- ☐ Truck-only lanes (tolled or free)
- ☐ Dynamic message signs or mobile applications to convey congestion or parking information to truck drivers or dispatchers
- ☐ Changing land use policies to cluster freight-intensive land uses (distribution centers, ports, etc.)
- ☐ None

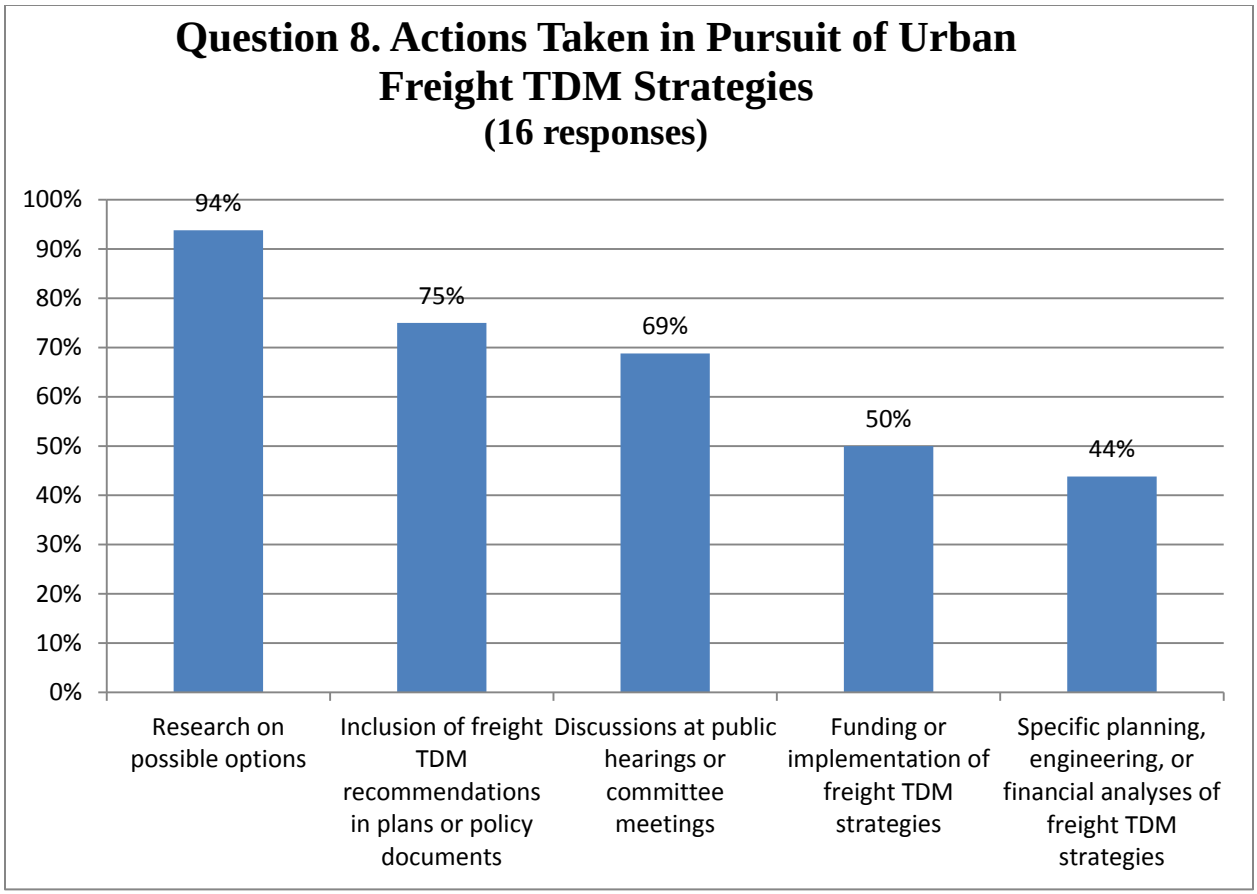


Additional Responses:

- Identification of National Highway System connectors.
- Truck parking on the urban fringe with ITS
- Creating "freight friendly" corridors; freight destination wayfinding; freight "relief routes" providing improved access to ports, manufacturing areas, intermodal terminals.
- Trade Data Exchange, Cross-Town Improvement Project
- Many of these strategies have been included in a FHWA freight and land use guidebook.
- Creating incentives for increasing rail modal share, Advocating for Industrial Rail Access Program and port access for rail
- All of these strategies have been considered to some degree within the City.

8. Which, if any actions has your organization undertaken in pursuit of urban freight TDM strategies (check all that apply)?

- ☐ Research on possible options
- ☐ Discussions at public hearings or committee meetings
- ☐ Inclusion of freight TDM recommendations in plans or policy documents
- ☐ Specific planning, engineering, or financial analyses of freight TDM strategies
- ☐ Funding or implementation of freight TDM strategies

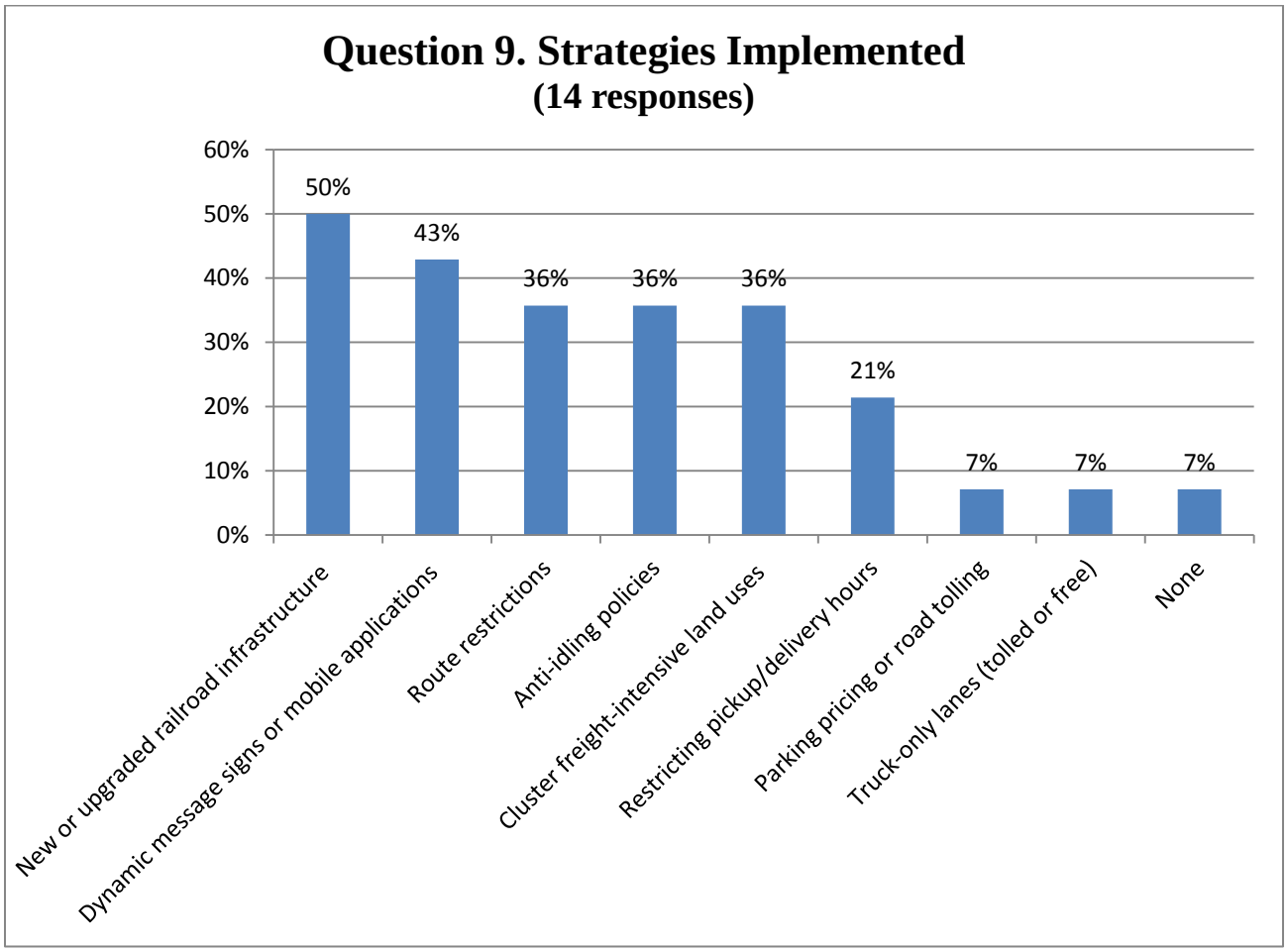


Additional Responses:

- In process of adopting regional freight plan.
- Developed guidebook and 1 day workshop
- Lobbying at legislative and state DOT level as well as at MPO
- The City of Portland adopted a Freight Master Plan which sets the policy direction for freight transportation planning based on three core themes: Mobility, Livability, and Economy. The City of Portland has recently prepared a Sustainable Freight Strategy which recommends many TDM-based actions: truck parking and loading, street design best practices, last-mile solutions, centralized freight distribution districts, off-hour delivery, electric-hybrid delivery vehicles, multi-modal freight strategies (rail, barge, ship).

9. Please identify which, if any, of these strategies were implemented.

- ☐ Restricting pickup/delivery hours
- ☐ Funding or financing for new or upgraded railroad infrastructure to promote modal shift (truck to rail)
- ☐ Route restrictions
- ☐ Parking pricing or road tolling
- ☐ Anti-idling policies
- ☐ Truck-only lanes (tolled or free)
- ☐ Dynamic message signs or mobile applications to convey congestion or parking information to truck drivers or dispatchers
- ☐ Changing land use policies to cluster freight-intensive land uses (distribution centers, ports, etc.)
- ☐ None



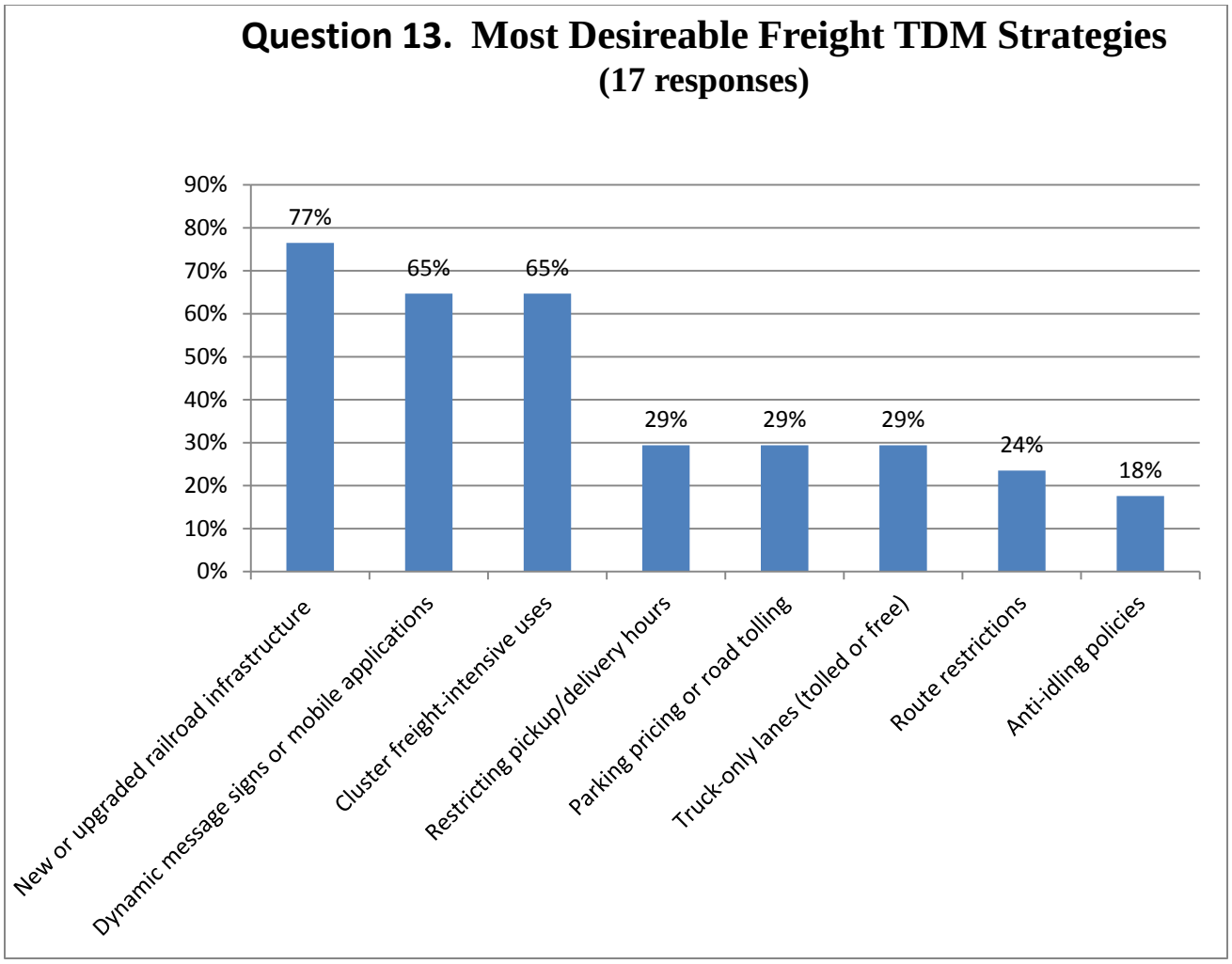
Additional Responses:

- Diesel locomotive retrofit.
- Revising the number of curbside delivery zones. Encouraging off-street delivery. Revising the length of commercial vehicle load zones.
- Note that the region has pre-existing pickup/delivery hour restrictions; route restrictions; rail infrastructure improvement plans (CREATE); and road tolling. None of these, however, are a direct result of our most recent comprehensive plan.

- Addressing freight in plans and programs, keeping the issue at the forefront
- Trade Data Exchange Cross-Town Improvement Program
- Our efforts to move Boston MPO to freight planning were poorly received and supported
- Truck route restrictions are implemented in local streets in various parts of the city by posting "no truck" signs based on street designation.

13. If you could implement any demand management strategy or set of strategies to improve freight mobility or reduce the negative impacts of urban freight transportation on your community, which of the following would you do?

- ☐ Restricting pickup/delivery hours
- ☐ Funding or financing for new or upgraded railroad infrastructure to promote modal shift
- ☐ Route restrictions
- ☐ Parking pricing or road tolling
- ☐ Anti-idling policies
- ☐ Truck-only lanes (tolled or free)
- ☐ Dynamic message signs or mobile applications to convey information to drivers or dispatchers
- ☐ Changing land use policies to cluster freight-intensive uses



Additional Responses:

- The clustering of the facilities is important--and often times means preserving the existing clustering.
- Increase efficiency of the infrastructure to move freight more competitively.
- Additional funding for the CREATE program would certainly be welcome. Other policies will be studied but at this time, no further recommendations can be said to be supported.
- Use Smart Freight for Smart Growth.
- Freight loading zone management in downtown Chicago. Promote clean, quiet trucks. Exempt such trucks from some of the regulations that reduce freight system efficiencies.
- Land use policy changes and strategic freight planning including modal shift enhancement programs

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