Seattle Department of Transportation

SUSTAINABLE FREIGHT OPPORTUNITIES APPENDIX F

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SUSTAINABLE FREIGHT OPPORTUNITIES

Sustainable freight is about more than just the environmental impacts generated by operations and transport of goods, it's also about the creation and maintenance of economic vitality and the generation, consumption and transportation of energy sources that fuel the movement of goods and people.

Sustainable freight practices consider three main drivers:

- The Environment
- The Community
- The Economy

Freight is a low margin industry and is slow to take on new practices or technologies, unless they are imposed by regulation or are more efficient. Practices must consider the company's financial bottom line before they will be adopted. In this case, the macro and micro economics are inextricably intertwined and a prerequisite to achieving the environmental and community benefits. Addressing sustainable freight practices in these three areas results in a "win" for businesses, consumers, residents, and the environment. This paper overviews trends in the freight industry as they relate to sustainability.

In describing trends, this analysis focuses on three major components of freight activity in Seattle:

- Imports/Exports
- Deliveries to/from/between businesses and industries
- Deliveries to consumers (primarily e-Commerce)

The paper then explores case studies in the areas of fuel, warehousing facilities and delivery that illuminate several sustainable practices in these areas.

The Seattle Climate Action Plan indicates that freight represents a significant share of Seattle's GHG emissions, because freight, regardless of mode, moves almost exclusively by diesel engines. It states that transportation represents the largest source of citywide emissions, 40% of which are from cars and trucks and nearly half of that from heavy- and medium-duty trucks involved in the movement of freight.[1] Due to the impact of diesel emissions, the 2030 vision is that "significant progress has been made in transition of diesel vehicles to next generation alternative fuels."

Using more fuel increases carbon emissions and costs the goods movement industry more money. Conversely, using cleaner fuels, such as natural gas and electricity, reduces both emissions and operating costs.

High-cube warehouse facilities[2] encourage redevelopment and consolidation of existing antiquated warehouse facilities and could reduce the number and length of trips between facilities and to consumers. This is also supported by the Climate Action Plan which has a vision for 2030 to "continue efforts to preserve Seattle's industrial lands which provide local jobs and have efficient access to deep water port, rail lines and highways."

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[1] p. 75-6

[2] High-cube warehouses are multi-storied warehouse facilities where automated stacking technologies allow the same processes to take place with significantly less floor area.

It also proposes by 2015 to improve the permitting processes to promote the most sustainable buildings. Applying sustainable building and operations practices to the freight industry reduces energy and water consumption, as well as emissions, landfill waste, and urban storm water runoff.[3]

Finally, the idling associated with congestion increases fuel usage and emissions. Several programs that seek to spread truck travel to other times of day are discussed.

[3]Green building is the practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's life-cycle from siting to design, construction, operation, maintenance, renovation and deconstruction. This practice expands and complements the classical building design concerns of economy, utility, durability, and comfort. Green building is also known as a sustainable or high performance building.(http://www.epa.gov/greenbuilding/pubs/about.htm)

OVERVIEW

Over the past seven years, dynamic changes in logistics and supply chains have occurred as industries have struggled to survive the most devastating economic downturn since the Great Depression. At the run-up to what has come to be known as the Great Recession, trade throughput was at an all-time high and all cargo forecasts indicated that the growth would continue. Concerned communities near growing ports, industrial uses, and rail yards began demanding more protection from the impacts of congestion, emissions, and noise. Numerous key programs and changes to the industry began taking shape just before the economy fell, including clean truck programs and emissions monitoring at several ports, transloading, e-commerce, and warehouse automation.

At the same time, oil prices were on the rise but new discoveries of natural gas in North America were finding their way into the market, thus providing a significantly cheaper energy source for manufacturing. Since 2011, there has been a steady growth in energy-intensive industries, such as steel manufacturing and chemical production due to the availability and relatively low-cost of natural gas. Before the abundance of natural gas, most steel and many chemicals were being produced overseas and then shipped to the US due to the cost of energy, i.e. petroleum-based fuels and coal. Both the production and the shipment of steel contributed significantly to greenhouse gas emissions. Re-shoring of these two industries has been happening for the past few years because of natural gas availability.

Natural gas is having profound impacts on transportation. Natural gas powered trucks provide significant operating cost reductions, as well as significant air quality benefits. While there are costs to upgrade or purchase natural gas fleet vehicles above traditional diesel, the gap between the cost of purchasing natural gas versus diesel trucks continues to decrease as demand increases. Whereas natural gas trucks in 2007 were approximately $100,000[4] more than diesel trucks, that cost has decreased to as low as $40,000. Retrofitting a diesel truck into a dual-fueled natural gas based system costs approximately $25,000. Both the US Environmental Protection Agency and US Department of Energy have been providing grant funds to off-set the equipment cost. Several larger companies are voluntarily moving in this direction as described later in this report. Smaller companies may face challenges with the upfront capital costs, although these conversions may still occur as fleets are replaced.

These changes are affecting Seattle. Seattle has already converted its refuse fleet and airport taxis to CNG.[5] Southern California's Omnitek Engineering has been selected by the Puget Sound Clean Air Agency to demonstrate its diesel-to-natural gas engine conversion technology for drayage trucks serving the Port of Seattle.[6]

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[4]White Paper on Best Available Control Technology and Liquefied Natural Gas Fueled Trucks, Port of Long Beach, 2007. http://www.polb.com/civica/filebank/blobdload.asp?BlobID=4841

[5]http://www.greenfleetmagazine.com/channel/natural-gas/news/story/2008/09/cng-refuse-trucks-fuel-station-to-come-to-seattle.aspx

[6]http://www.fleetsandfuels.com/fuels/cng/2013/07/omnitek-with-asg-for-seattle-port/

SHIP OPERATIONS

In general, throughput at the Ports of Seattle and Tacoma has not rebounded as quickly as other key west Coast ports, notably, Los Angeles and Long Beach. Three key factors contributing to this phenomenon include fleet conversion to larger vessels, shipping alliances, and the growth in transloading and value-added services. Specifically, the Ports have been losing business to Metro Vancouver and Prince Rupert Ports which have benefitted from major investments in rail and other infrastructure by the Canadian government.[7] In recognition of the challenges confronting them and a bid to remain competitive, the Ports of Seattle and Tacoma recently announced their decision to combine their container terminal operations.[8]

Fleet conversion was anticipated due to significant growth in trade from 2000-2006. Vessel operating companies began ordering larger ships, known as the New Panamax and the Triple E classes, and retiring smaller vessels, and even during the recession, most had few options but to honor their purchases as the ships were already under construction. What is most interesting is the rate of scrapping of relatively young vessels (less than 20 years)[9]. The push for efficiency gains from fuel consumption and the related environmental benefits prompted the industry to convert much more quickly than previously anticipated.

This quick conversion created significant impacts to ports, including surges of goods as a large vessel offloads in one day the same amount that a terminal typically once handled over the course of two to three days. The larger vessels also created winners and losers as marine terminals with berths capable of accommodating the larger ships won more cargo, while those that could not, lost cargo.

West Coast ports also are adjusting to the reality that carriers, through alliances and vessel-sharing arrangements, are concentrating their vessel calls at fewer ports and terminals. Shipping lines seek density. Shipping alliances had a drastic impact on the Port of Seattle two years ago when it lost a bid for the Grand Alliance to the Port of Tacoma. Pushing more freight through fewer ports allows the carriers to use the capacity of their big ships more effectively and achieve the economies of scale inherent in the mega-ships. The cost savings are compelling. Compared to a Panamax vessel with a capacity of 4,800 20-foot equivalent units (TEU), an 8,000-TEU ship offers a 47 percent lower slot cost, and a 14,000-TEU ship has a 60 percent lower slot cost.[10] This new reality creates winners and losers among ports and marine terminals and gateways. This trickles down through the supply chain, resulting in long truck queues at the gates and more deliveries to warehouses in a condensed timeframe.

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[7]http://kuow.org/post/tacoma-seattle-ports-join-forces-take-canada
[8]http://www.bizjournals.com/seattle/news/2014/10/07/in-historic-decision-ports-of-seattle-and-tacoma.html
[9]Danish Ship Finance, http://www.shipfinance.dk/en/SHIPPING-RESEARCH/~/media/Shipping-Market-Review/Shipping-Market-Review---April-2013.ashx
[10]Mongelluzo, Bill, Journal of Commerce, Strong infrastructure draws big ships to Pacific ports, July 7, 2014, http://www.joc.com/port-news/strong-infrastructure-draws-big-ships-pacific-ports_20140707.html

In order to remain competitive, Seattle and the Greater Seattle Region must improve intermodal capabilities, such as creating logistics supportive land uses. The Los Angeles region currently has over 2 billion square feet in warehouse space, which is one reason why it has been ebbing away at the other West Coast ports' shares. The warehouse availability in Southern California is nearing saturation and, with significant pressure from the South Coast Air Quality Management District to curb growth of new high-tech warehouse facilities, another region may soon have an opportunity to accommodate new demand. In addition, the demand for same-day delivery of consumer products driven by "the Amazon effect" also creates opportunities in terms of more high-tech, smaller, strategically placed warehouse facilities within close proximity to major population bases, such as Seattle, rather than large, consolidated high-cube warehouses located in just a few locations throughout the country. The Amazon effect is changing the location, configuration, and operation of retail warehousing and distribution. This is an opportunity for major urban markets near major ports to attract these high-tech facilities.

SUPPLY CHAIN EFFICIENCIES

Aside from the consolidation of vessel operations, the Great Recession prompted several other changes in the supply chain. These changes included more efficient packing, re-packing, and shipping practices. These changes not only helped shippers survive a near economic disaster, but they have resulted in economic efficiency gains through smarter logistics, conversion to more cost-effective warehouse operations, and less fuel consumption.

Within the first year of the drastic economic downturn, companies began investigating every opportunity to reduce the costs of doing business. Beneficial Cargo Owners (BCO), such as Walmart and Target, as well as the world's largest shipping companies, UPS and FedEx, began working with suppliers and shippers to implement packaging methods aimed at fully utilizing as much space as possible in ocean-going and domestic containers, as well as on cargo planes and local delivery trucks. This led to them working with suppliers to maximize shipping space by minimizing and/or reconfiguring packaging. Along those same lines, the BCOs also reduced cargo weight through packaging reductions. Minor per package weight reductions created significant overall shipping cost savings. Additionally, the major BCOs also looked more closely at consolidation, sortation, and dissemination of goods.

The 2002 Pacific Maritime Association (PMA) Lockout of West Coast labor (ILWU) had resulted in what is commonly known in the industry as the "four corners" approach. Whereas major BCOs, such as Walmart, had previously relied on a couple of major distribution centers (DCs) located on the east and west coasts, they altered their practice by creating major DCs in the four corners of the country to better manage future labor disputes.

The Ports of Seattle and Tacoma were beneficiaries of this move as shippers diversified their Port portfolios many of which previously might have been exclusively run through the Ports of LA and Long Beach. Just as importantly, the Great Recession prompted more efficient consolidation and distribution of goods via transloading, including value-added servicing of goods prior to final distribution. Regions with significant warehouse space were the winners of this industry shift. As mid-size BCOs began to capitalize on this practice, regions with large amounts of available warehousing space and workers have benefitted. In the Greater Seattle area, most of this growth has occurred in suburban areas, such as Kent.

In addition, warehousing is also becoming more efficient due to new technology and the consolidation of multiple facilities. Technology, such as bar coding and radio-frequency identification (RFID), coupled with automated warehouse inventory and sortation practices, have resulted in significant efficiency gains and cost savings. Not only can these systems better manage inventory, but they can also store more goods under one roof, improve safety, and reduce the number of automobile trips and parking demand. On the downside, these new facilities require fewer unskilled workers to drive forklifts and manage inventory. However, they create some high-tech jobs to operate and maintain the automated systems. Amazon, headquartered in Seattle, The Kroger Company, and Highland Fairview provide excellent examples of this next generation of warehousing technology.

Furthermore, energy consumption has played an equally important role in the economic vitality of the industry. Trucks serving Seattle have access

to alternative fueling facilities, including a recent installation of a public liquefied natural gas (LNG) fueling station located 26 miles outside of Seattle, and several public compressed natural gas (CNG) and propane stations that can accommodate all vehicle types, including heavy duty trucks.

For the past 10 years, there has been a steady conversion to the use of alternative fuels for transportation. Initially, the size of engines and tanks, as well as the range and fueling availability prohibited the trucking industry from taking advantage of this low-cost fuel. More recently, technology and fueling availability have begun to dismantle the barriers to purchasing natural gas powered Class 8 trucks. Natural gas is not only cleaner than diesel and gasoline, but it is also substantially less expensive due to recent discoveries and new extraction practices in the United States.

Cleaner fuel trucks provide a variety of public benefits (improved air quality, reduced reliance on imported petroleum, etc.), but cost savings are driving the decision for companies to convert. The cost to purchase natural gas trucks still represents a barrier to entry, however. Natural gas trucks cost between $40,000 and $50,000 more than a diesel truck primarily because of the large carbon-fiber fuel tanks that are required to store compressed or liquefied natural gas.[11] In large fleets, that premium could add millions of dollars to equipment cost. In addition, natural gas requires more space to store the equivalent of petroleum-based fuels adding weight and reducing the amount of space for carrying goods.

There are several programs which that support retrofit of older diesel engines. Three Ports in Washington formed the Northwest Ports Clean Air Strategy with the goal of having all trucks to the Port having emissions equivalent to 2007 or newer engines by 2017. The EPA Smartway Transport Partnership is making upgrade kits available to all truckers on I-5. And the West Coast Collaborative recently installed diesel oxidation catalysts on construction equipment and trucks that significantly reduce emissions.[12]

These benefits and challenges are also being faced by ocean-going vessel and railroad operators who, in addition to looking for cost savings, are also being required to meet new emissions standards. For example, vessels operating in U.S. regulated waters are converting to natural gas or dual-fuel engines to reduce costs while meeting emissions targets. U.S. railroads are also exploring alternative fuel options, for similar reasons. Lower fuel prices make freight movement less expensive, and states that can facilitate clean fuel fleets can gain a competitive advantage. Blu. just constructed a new LNG public truck fueling facility in Sumner, WA near Tacoma and is planning one in Kent WA near Seattle, and a Tacoma-based trucking fleet, Interstate Distributors Co., recently ordered 10 LNG trucks that will be using the new facility.

Policies such as the EPA's SmartWay Transport Partnership are also encouraging shippers to turn to cleaner technologies. Since 2004, SmartWay has been instrumental in saving its partners $16.8 billion in fuel costs. SmartWay incentives, coupled with incentives provided by states and private utility companies, are making it possible for manufacturers to invest in technology development, for trucking companies to purchase natural gas vehicles, and for natural gas fuel providers to construct the fueling infrastructure.

As more and more shippers join SmartWay, the demand for cleaner transport will continue to

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[11]Ramsey, Mike, Wall Street Journal, Truckers Tap Into Gas Boom Operators of U.S. Truck Fleets Are Accelerating a Shift to Natural Gas Fueled Vehicles, October 29, 2013, http://online.wsj.com/news/articles/SB10001424052702304200804579165780477330844

[12]Seattle Climate Action Plan, p. 76-9.

grow. Already, major shippers such as Walmart, Home Depot, Krogers, IKEA, Best Buy, Canon, HP, Tyson, and Walgreens (to name a few) are SmartWay members, and many of them are requiring the cleanest transport for both their own fleets and those of their contractors. Many shipping companies, including UPS and FedEx, are leading the charge.

The industry's focus on reducing energy consumption has benefitted not only the bottom line, but more importantly, for the communities most heavily impacted by trade. It has created major environmental benefits from the reduction in emissions. The larger vessels are resulting in fewer emissions, but beyond that, companies are also turning to renewable fuels and natural gas to power facilities and transport goods.

In addition to cleaner fuels for trucks, other alternative delivery vehicles are also being tested by large and small delivery companies. For example, UPS, FedEx, and DHL have been testing small, electric delivery vehicles. Amazon, who is seriously testing drones, has submitted an official request to the FAA to utilize drones. Even bicycle delivery services, like Postmates.com and local restaurants/sandwich shops are emerging, although the market for these types of technologies and services are limited.

These new options provide cleaner, more sustainable delivery options. As mentioned by Amazon in its letter to the FAA, 80 percent of the packages that they ship weigh less than five pounds. While drones and bicycle delivery will continue to develop, the efficiencies gained through new routing technology points to the smaller, electric delivery vehicles appear to have the most utility of these emerging technologies in the short term.

http://www.zerohedge.com/sites/default/files/images/user5/imageroot/2014/11/amazon%20drone.jpg

E-COMMERCE

The advent of e-commerce changed business as usual for the retail industry, prompted most notably by Seattle's own Amazon. Started in 1994, the online business focused mainly on the sale of books, but has since changed the way that the world shops. E-commerce impacts not only typical retail, but it's also beginning to have a real impact on the grocery industry.

The brick-and-mortar establishments, such as Walmart and Macy's, appeared to sit back and warily watch what consumers wanted as Amazon pushed more and more into the forefront. As Amazon began to perfect its return processes and reduce its delivery times, its brick-and-mortar contenders soon realized that they would need to adjust in order to retain their customers. Walmart began shipping online, and also making in-store pick-ups available. Macy's began using its department stores as online fulfillment centers. For instance, the department store chain has converted more than half its 840 physical stores to be able to fulfill online orders. This move has allowed it to keep the majority of its inventory of popular items on store shelves and in front of customers, rather than stocking them in faraway warehouses.

But a significant reduction in impulse shopping created by consumers' ability to find the best deals online, drive to the store selling it for the lowest price, and then leave has resulted in significant losses in foot traffic at brick-and-mortar stores, That trend is likely to continue. This is why retailers, such as Home Depot, have cut back on new store openings in favor of shifting that investment toward online operations. Meanwhile, Sears, The Gap, JC Penney, and others have closed hundreds of stores over the past couple of years. Such closings could accelerate as leases for big retailers, which typically last between 10 and 25 years, are not renewed. Only 44 million square feet of retail space opened in the 54 largest U.S. markets last year, down 87 percent from 325 million in 2006, according to CoStar Group, Inc., a real-estate research firm.[13] There will continue

"In 2013, Macy's expanded its fulfillment network to include 200 more department stores, bringing the total number of stores in its fulfillment network to 500. Each day, employees at these 500 stores receive a list of goods ordered by customers living near that particular store. The associates round up the ordered items and bring them to a specific station in the store to prepare them to be packaged and tagged for delivery. On a typical day, a Macy's store ships 50-60 orders, and on a one-day sale day, 75-100 orders."

Integrated Solutions for Retailers, December 19, 2013

[13]Banjo, Shelly and Drew Fitzgerald, Wall Street Journal, Stores Confront New World of Reduced Shopper Traffic E-Commerce Not Only Siphons Off Sales, but Changes Shopping Habits, January 16, 2014, http://online.wsj.com/news/articles/SB10001424052702304419104579325100372435802

to be more of this as the growth and demand for easy and convenient shopping and merchandise returns continue.

One of the biggest unknowns for city planners is the true impact of e-commerce on land use and infrastructure. Macy's was never envisioned as an e-commerce distributor that would go out to local neighborhoods. How does this impact traffic patterns? How will the closure of hundreds of thousands of square feet of retail space impact the built environment? Some initial research indicates that e-commerce will actually reduce overall trips.[14] But, clearly, the trip generation rates of years passed will change for these dual-purpose retail store fronts with a likely result being fewer auto trips and more short truck trips, with some of these trips being completed with smaller trucks.

These changing consumer demands and behaviors will require communities to closely re-evaluate land use plans and zoning as retail stores close and the need for e-commerce facilities increases. As a result, there will be less demand for retail/commercial space and more demand for warehousing, albeit, a new type of warehousing. These facilities may include retail space or areas for customer pick-up and returns. An example of this in Seattle, is the Comcast facility on SR-99. Customers can pick up orders at the store but more frequently will have the product shipped to their home. In order to preempt long-term vacancies of large commercial space, planners should recognize the changes, begin talking with real estate developers and commercial realtors, and identify future needs.

[14]Cao, Xinyu (Jason), Frank Douma, Fay Cleveland, and Zhiyi Xu, The Interactions between E-Shopping and Store Shopping: A Case Study of the Twin Cities Final Report, Humphrey Institute of Public Affairs, University of Minnesota, August 2010, The Intelligent Transportation Systems InstituteCenter for Transportation Studies http://conservancy.umn.edu/bitstream/11299/101340/1/CTS%2010-12.pdf

CASE STUDIES

In order to highlight some of the key points raised in the introduction, the following three case studies will focus on the latest trends. The objective of these case studies is to stimulate and inform policy discussions as part of the Freight Master Plan. These cases provide information that could help Seattle achieve freight sustainability goals of increasing environmental protection and economic vitality.

Case Studies:

1. **Natural Gas and Renewables**
   a. Kroger's sustainable waste practices and their link to transportation: donations, anaerobic digester, composting, recycling
   b. Kroger's and UPS' alternative fuel transportation

2. **Warehousing: The Next Generation**
   a. Highland Fairview, SKECHERS Facility, Moreno Valley CA
   b. Kroger's: automation
   c. The Amazon effect on distribution practices, size, location, and automation of warehouses/DCs. Seattle just happens to be the home of Amazon's Corporate Headquarters in the Duwamish area. Amazon currently operates three fulfillment centers in the Greater Seattle region located in the cities of Bellevue, Dupont, and Sumner, with a new sortation facility in Kent.

3. **Off Peak Truck Operations**
   a. PierPass: Ports of Long Beach/Los Angeles
   b. New York City Off-Peak Delivery Demonstration Project
   c. Guidelines for Off-Peak Delivery from London

THE THREE PILLARS OF SUSTAINABILITY: ENERGY + ECONOMICS + COMMUNITY

The City of Seattle's Climate Action Plan (Plan) provides many goals and strategies for reducing greenhouse gas (GHG) emissions. Interestingly, the Plan includes the quote to the right. While the City may have limited regulatory power to address truck technology, there are specific actions that the City could take to encourage faster implementation of cleaner, more efficient technologies.

For example, two of the strategies recommended in the Plan are being encouraged through both programs at the federal, state and regional levels:

1. Support programs which help heavy duty truck owners and operators transition to more efficient vehicles and cleaner fuels.
2. Explore ways to use Seattle waste to produce alternative fuels, such as liquid natural gas from anaerobic digesters.

Examples include the Northwest Port's Clean Air Strategy and grant funding through the federal Congestion Mitigation and Air Quality program for assisting the industry in purchasing trucks that met Port requirements for 1994 or newer trucks, as well as the Department of Energy grants for alternative fueled vehicles, such as Kroger's new LNG trucks that will be serving QFC and Fred Meyer stores. Kroger has a long-term vision of generating its own source of natural gas for these trucks, as will be discussed in this report.

"Emissions from freight transportation, which make up 18% of road transportation GHG emissions as of 2008, are not a primary focus of the Climate Action Plan because the main strategies for reducing freight emissions are related to vehicle fuel and technology improvements, which the City has limited ability to influence. That said, many of the strategies recommended in this section will have some impact on freight emissions..."

CASE STUDY 1: KROGER

The following case study highlights what private companies are doing to be more sustainable, both environmentally and economically. Public agencies can encourage others to follow suit by both educating private companies about new technology, operating procedures, and available financial incentives, as well as implementing policies that support and foster changes. This can come from understanding what works, the benefits, and lessons learned from others. One key example would be the anaerobic digester, a goal directly out of Seattle's Climate Action Plan. Kroger is the first of its kind to have an anaerobic digester constructed at its main distribution and manufacturing facility in Southern California. The digester intakes otherwise unusable perishable foods to create natural gas that powers their facilities, with a future vision of fueling their natural gas trucks.

OVERVIEW

The Kroger Company, founded in 1883 in Cincinnati, Ohio, is the country's largest supermarket chain, and the second-largest general retailer (after Walmart). Kroger employs more than 375,000 workers and operates 2,640 grocery stores in 34 states, including 16 QFC and 3 Fred Meyer stores in the city of Seattle that are served by a distribution center located approximately 30 miles south in Puyallup, WA. Kroger is also a large food manufacturer and owns and operates 37 manufacturing plants, and also owns and operates 1,240 retail fuel centers and 786 convenience stores. Kroger's passion for sustainability makes it a national leader and a positive impact on the communities in which it operates.

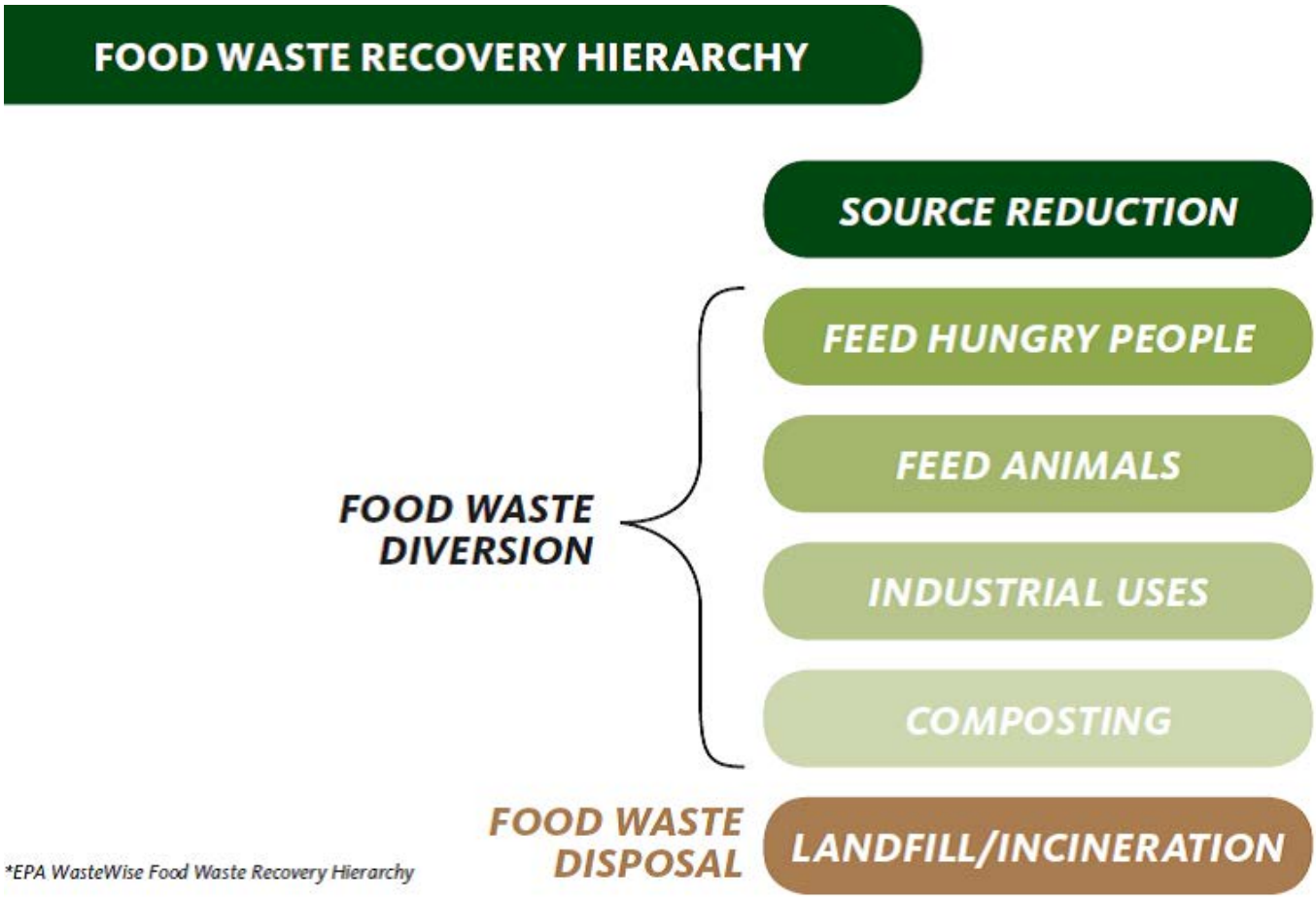
SUSTAINABILITY

Kroger's notable goals for sustainability focus on reducing waste, emissions, water consumption, and inefficiencies through the development and implementation of new processes, technological advances, and operating parameters. Some examples include the installation of an anaerobic digester in Southern California, use of alternative fuels, generation of renewable energy, and its coordination with local food banks and charities to ensure maximum donation of foods before considering alternatives, such as anaerobic digestion, composting or landfill. Kroger is also a founding member of Feeding America, member of the United States Environmental Protection Agency's (EPA's) SmartWay and Waste Wise programs.

ZERO WASTE

Kroger joined the EPA's Waste Wise Program and adopted the EPA's "zero waste" definition as part of its Company-wide sustainability efforts in 2012. The program allows members to benchmark, measure and communicate efforts in a more consistent and cohesive way by tracking individual waste streams and progress over time. This allows members to identify even more opportunities to reduce waste. Kroger has established a goal to meet and exceed the EPA's Zero Waste threshold of 90 percent. To that end, in 2013, Kroger implemented an enterprise-wide waste diversion initiative in all of its grocery stores. This initiative focuses on donations to local food banks, composting and animal feed for food products that cannot be donated, and finally, anaerobic digestion. Kroger is on target to meet its goal of 70 percent of zero waste by 2015. Aside from diverting reusable material from landfills, this program is also reducing overall truck miles traveled.

Figure 2: EPA WasteWise Food Waste Recovery Hierarchy



http://www.epa.gov/waste/conserve/pubs/food-guide.pdf

Donate

Kroger's number one community goal is to "support organizations that bring food and hope to our hungry neighbors".[15] By donating, Kroger eliminates long-haul truck trips to landfills and green recycling facilities. In Seattle, the main landfill operated by WasteManagement, Seattle's provider, is located in East Wenachee – a one-way trip of about 150 miles from Seattle.

Recognizing both the incredible need to feed the hungry and an opportunity to reduce waste and costs, Kroger is eliminating waste and improving the quality of life through the creation of Perishable Donations Partnership (PDP), a company-wide program that donates food to Feeding America food banks with the capacity to safely handle and distribute fresh food. In 2013, the PDP program expanded to 2,300 stores resulting in 50 million pounds of perishable food and 23 million pounds of other items being donated to local food banks instead of processed as waste. This donation is equivalent to 200 million meals which otherwise would have ended up in landfills. Through its relationship with Feeding America, Kroger worked with more than

[15]Kroger, Improving Today to Protect Tomorrow 2014 Sustainability Report, http://sustainability.kroger.com/1-Kroger_30043_CSR14.pdf

100 local food banks – something it's been doing for more than 30 years. The company continues to be one of the top donors to Feeding America.

Not only does this program reduce truck trips to distant landfills, but it also reduces "returns" to major food manufacturers that are typically located several hundred miles away. Many of the food manufacturers have agreed to provide the same credit for donated food that they would for returned, unusable items. Del Monte, Kellogg's and Bush's Beans are leading examples of those that are willing to increase the amount of donations. This in turn results in fewer truck trips to return items, and fewer trips to deliver the returned food items to a landfill.

Compost/Recycle

In 2008, Kroger became one of the first major grocery chains to implement a food scrap composting program in 24 Ohio stores. In its first four months, more than 650 tons of food waste were diverted from landfills and instead composted.

The Ohio Environmental Protection Agency (Ohio EPA) initiated the conversation with the grocery industry in 2007. The idea was further discussed by the Environmental Task Force created by the Ohio Grocers Foundation (OGF), who received a grant from the Ohio Department of Natural Resources (ODNR) to develop a supermarket manual to help grocers plan and implement food waste composting programs.

Kroger was one of the first companies to conduct a waste audit, which revealed that nearly 60 percent of the waste at its stores consisted of compostable material. Kroger then committed 24 of its Ohio stores to participate in a four-month pilot program designed to determine logistical and economic feasibility. Store managers monitored the efficiency of separating compostable wastes from packaging both in terms of time and contamination. Departments selected to participate in the project used containers with clearly marked signage and lined with compostable bags. In many stores this included produce, floral, deli, bakery and dairy.

The cost of transporting waste was also studied and compared to disposal costs to the local landfill versus shipping organics up to 40 miles west to the nearest permitted compost facility. The study determined that it would be economically feasible to divert food scraps to compost facilities despite the relatively low landfill tipping fees at the time. The demand for composting is increasing throughout the country, and as it continues to grow, Kroger and others are hopeful that new composting facilities will be developed in closer proximity.

The start-up of the pilot project did encounter challenges, similar to any other program that requires behavioral change. Kroger addressed this challenge by designating an employee in every store to champion the program by motivating and assisting coworkers. Once they understood the impacts, employees quickly embraced the program. Kroger educated employees via a training video filmed at one of its participating stores and the composting facility to communicate the purpose of the program. The video is now a training requirement for all employees.

The project, which started with 24 stores, has proven so successful that, as of last year, 97 percent (2,300 stores) of all Kroger-owned stores were participating. Perishable foods and flowers that are not suitable for donation are collected from the deli, meat and flower departments and are picked up by local companies for composting.

Composting may not seem to have much of a "freight" aspect since its demands on the transportation network are similar to traditional landfill. However, these steps tell the story of how Kroger began to think bigger – what if we could locally recycle, compost and generate our own energy source?

Anaerobic Digester

The anaerobic digester took the recycling and composting ideas a huge step forward. It not only significantly reduces fleet vehicle miles of travel (VMT) and costs, but it also produces valuable products: commercial grade compost and natural gas. The Kroger Recovery System, the first of its kind anaerobic digester for grocery uses, converted 46,500 tons of food waste to create 3.5 million kWh of renewable energy at Kroger's Ralphs/Food 4 Less Distribution Center in Compton, CA in 2013.

Prior to the installation of this system, approximately 300 Ralphs and Food 4 Less grocery stores in Southern California each produced 150 tons of food waste, which would be trucked to a distribution center in Compton, CA for consolidation and shipment to a composter 100 miles away. Kroger estimates that the system is helping it to avoid about 500,000 truck VMT a year on congested Southern California freeways. Not only is this resulting in a significant congestion and emissions reduction for the region, but it is also saving Kroger money that it used to pay contractors to move the waste from store, to consolidation center, to composter or landfill.[16]

The system, designed by Feed Resource Recovery, allows Kroger to turn a waste stream into an energy resource for the 49-acre logistics center, which includes a creamery and corporate offices for Ralphs and Food 4 Less, along with a 650,000 square-foot distribution center.

Kroger has plans for installing this technology in the Pacific Northwest in the future. The facility recycles spoiled food via anaerobic digestion, a naturally occurring process, and transforms this otherwise waste into renewable biogas. In 2013, 46,500 tons of food waste was processed. This biogas is then turned into power for onsite operations. The process is carried out in an enclosed, oxygen-free environment, which

Figure 3: Kroger's Anaerobic Digester

[16]Bardelline, Jonathan, How Kroger turned food waste into warehouse-powering energy, GreenBiz.com, August 9, 2013, http://www.greenbiz.com/news/2013/08/09/kroger-fuels-warehouse-food-waste

means the process takes up less space and generates no odors.

In 2013, the system saved Kroger approximately $4.5 million and reduced carbon emissions by 90,000 tons. Thinking bigger than just fueling its distribution center, Kroger has been working with Clean Energy Fuels to investigate future opportunities for fueling its trucks with the natural gas produced from the anaerobic digester. As a first step, Kroger recently purchased LNG trucks.

Kroger and Natural Gas Trucks

"This is the first step in Kroger's effort to transition our fleet to alternative fuels," said Kevin Dougherty, Kroger's group vice president and chief supply chain officer. "Converting to LNG trucks will allow us to reinvest savings into lower prices for our customers while also benefitting the environment."[17] This is a message that makes sense to private companies, and a message that Seattle could echo, particularly as renewable natural gas (through landfill and dairy farm capture systems, as well as anaerobic digestion) becomes more of a reality.

The trucks will make deliveries to about 50 Fred Meyer and QFC stores as far south as Corvallis, OR and as far north as Longview, WA., averaging approximately 175 miles per day, six days a week, 52 weeks a year. They are expected to reduce greenhouse gas emissions by approximately 755 metric tons per year, which equates to removing approximately 159 passenger cars from the road annually. The fleet will be fueled at a new, private LNG fueling station at Kroger's Clackamas Distribution Center, which will be designed and engineered by Clean Energy Fuels Corp.

Figure 4: Heavy-Duty Truck Natural Gas Comparisons

Natural Gas Fuel

CNG	LNG
• Gas is Compressed	• Gas is Cooled to -260° F
• Gas from Pipeline	• Gas is Trucked in
• Compressed On-site, Stored in Tanks	• Stored in On-Site Cryogenic Tanks
• Shorter Ranges	• Longer Ranges Than CNG and Less Than Diesel
• Requires More Tanks	• Lighter Weights
• Heavier Weight	• Shorter Length Tractor
• Longer Length Tractor	

[17]Kroger Company Release, May 6, 2014

"These trucks are nearly identical to our diesel fleet, which allows us to have minimal impact on operations and still achieve the same caliber and standard of performance," said Matt Hoffman, Kroger regional logistics director, based in Portland. "They are truly the prototype truck of the future – the safest, cleanest and quietest way… to deliver product to the stores."

The shift to LNG trucks began as Kroger investigated fleet fueling efficiencies through the development of an Alternative Fuel White Paper. Key questions to answer included: Will alternative fuels work for Kroger's heavy-duty Class 8, on-road trucks? If so, which alternatives will meet all of the operational parameters, including range and truck configuration, as well as economic and environmental goals?

Kroger considered three alternative fueling sources: natural gas, electric, and hybrid electric fuel cells. The technology for electric and hybrid electric fuel cells has not developed enough to provide the necessary range for Kroger's operations. In addition, the cost of these technologies is much more expensive, as are hydrogen fueling facilities. Due to cost and range, natural gas was selected for further consideration.

Kroger compared and contrasted liquefied versus compressed natural gas based on the following parameters:

- 34 Distribution Centers
- 1,200 Owned Tractor Fleet, 1,800 Third Party
- 24/7/363 Operations
- High Miles, Local Delivery, Hub and Spoke
- Tight Behind Store Space for Deliveries
- Heavily Regulated On-Road Applications

Since Kroger serves grocery stores in urban areas that often have constraints, such as turning radius and restricted access to loading docks, the vehicle requirements for CNG and LNG were closely analyzed prior to purchasing the first natural gas trucks.

Figure 5: Ideal Kroger Truck Platform

- ✓ 168" Maximum Wheelbase
- ✓ 15,900 lbs. Maximum Dry Weight
- ✓ 1150 ft./lbs. Minimum Torque
- ✓ 400 HP
- ✓ 350 Mile Range
- ✓ No Reduction in Swing Clearance
- ✓ No Decrease in End User Performance
- ✓ Minimal Impact to Existing Operations
- ✓ MUST BE SAFE

CNG requires more storage space than LNG, thus the fuel tanks are larger and weigh more. Kroger has a limitation of 168 inches of wheelbase, which leaves less than 20 inches behind the cab. As shown in Figure 5: , behind-the-cab mounted CNG tanks are not a viable solution for Kroger.

Side mounted CNG and LNG tanks were investigated as shown in Figure 6, below. One CNG and two LNG configurations met the operating parameters and were further studied for consideration.

Figure 6: Class 8 Truck Length Constraints for Behind the Cab Fuel Tanks

Length Constraints: Behind the Cab

168" Wheelbase = >20" Behind the Cab Clearance

Behind The Cab Systems

System DGE	Qty of Tanks	Fuel Type	Cylinder Size	Cylinder Width w/ Clearance
~~45~~	~~3~~	~~CNG~~	~~16" x 80"~~	~~23.5"~~
~~60~~	~~4~~	~~CNG~~	~~16" x 80"~~	~~23.5"~~
~~75~~	~~5~~	~~CNG~~	~~16" x 80"~~	~~23.5"~~
~~52~~	~~2~~	~~CNG~~	~~21" x 86"~~	~~28.5"~~
~~80~~	~~3~~	~~CNG~~	~~21" x 86"~~	~~28.5"~~
~~105~~	~~4~~	~~CNG~~	~~21" x 86"~~	~~28.5"~~

*Need an Additional 7.5" Clearance for the Tank Housing Unit

Figure 7: Class 8 Truck Length Constraints for Side Mounted Fuel Tanks

Length Constraints: Side Mounted

168" Wheelbase = >86" Frame Rail Clearance

Side Mounted Systems				
System DGE	Qty of Tanks	Fuel Type	Cylinder Size	Cylinder Length w/ Clearance*
28	1	CNG	25" x 61"	71"
~~80~~	~~2~~	~~CNG~~	~~25" x 80"~~	~~90"~~
~~88~~	~~2~~	~~CNG~~	~~25" x 90"~~	~~100"~~
~~80~~	~~2~~	~~CNG~~	~~26" x 80"~~	~~90"~~
~~92~~	~~2~~	~~CNG~~	~~26" x 90"~~	~~100"~~
~~63~~	~~1~~	~~CNG~~	~~26" x 120"~~	~~130"~~
70	1	LNG	26" x 76"	86"
140	2	LNG	26" x 76"	86"
~~88~~	~~1~~	~~LNG~~	~~26" x 90"~~	~~100"~~
~~176~~	~~2~~	~~LNG~~	~~26" x 90"~~	~~100"~~

*Need an Additional 10-12" Clearance to Access Tanks for Maintenance

Figure 8: Class 8 Truck Operating Range Comparison

Minimum 350 Mile Range

System DGE	Qty of Tanks	Fuel Type	Type of System	Cylinder Size	Cylinder Length w/ Clearance	System Range
~~28~~	~~1~~	~~CNG~~	~~SM~~	~~25" x 61"~~	~~71"~~	~~140~~
70	1	LNG	SM	26" x 76"	86"	350
140	2	LNG	SM	26" x 76"	86"	700

The last two remaining factors included range and weight. The remaining CNG option could not meet the required 350-mile range necessary for Kroger's operations. With a range of only 140 miles, it fell short, thus making LNG the clear winner.

Natural gas fuel costs up to $1.50 less per gallon than gasoline or diesel, depending on local market conditions, according to Clean Energy Fuel. The use of natural gas fuel not only reduces operating costs for vehicles, but also reduces greenhouse gas emissions up to 30 percent in light-duty vehicles and 23 in medium- to heavy-duty vehicles, the company said, noting that nearly all natural gas consumed in North America is produced domestically.[18]

The cost and availability of natural gas from an extraction standpoint is becoming very attractive to the trucking industry, but even more encouraging is the real capability to fuel their fleets with renewable natural gas generated by recycling their own waste. WasteManagement in California is currently using methane captured from its landfills to fuel its fleet, and one of Kroger's dairy farms is currently capturing methane generated from cow manure to fuel its dairy delivery trucks. The cost savings alone are enough to make the industry take notice, and the GHG and waste reduction benefits create a true opportunity for the City to investigate. Could there be a City-supported organic waste collection program for use in an anaerobic digester? Could such a program generate fuel for city fleets? The lessons being learned from Kroger's California installation are valuable for others considering this technology.

[18]Green Retail Decisions, Kroger, Cardenas Markets Add Natural Gas Trucks to Fleets, May 8, 2014, http://www.greenretaildecisions.com/news/2014/05/08/kroger-cardenas-markets-add-natural-gas-trucks-to-fleets

CASE STUDY 2: UPS ALTERNATIVE FUEL INITIATIVES

Founded in 1907 in Seattle, UPS has long been a proponent of efficiency, and since about the 1930s, a pioneer in testing different technologies such as electric vehicles. As a SmartWay participant, UPS continues to test a number of alternative local and over-the-road truck technologies in order to reduce its impacts on the environment. The company continues to test electric bike and electric golf cart technologies in Europe; natural gas, electric-hybrid, and hydrogen delivery vans in the US; and LNG for long-haul trucking. Beginning in the 1980s, UPS began testing medium-sized delivery trucks that operated on natural gas. Now, 30 years later, the company has committed to deploying 1,000 natural gas delivery vehicles. Increasing the miles driven with these vehicles provides incremental increases in emissions efficiency. Just as importantly, it increases the amount of information flowing in from their "rolling laboratory" of non-conventional vehicles, including the "cargo cruiser" electric assist bicycle delivery vehicle in use in Dortmund, Germany, and the Ducati "Free Duck" in use in Italy. Both vehicles can access narrow streets that would take a typical delivery truck much too long to pass through. These vehicles have a maximum operating speed of 15 mph and a range of 21 miles. These vehicles are most effective in parts of Europe where the streets are too narrow and the parking too limited for the larger trucks to get through. The vehicles make multiple sprints of deliveries, reloading from a big truck used as a mini hub. UPS is considering them in interested US cities with similar operating restrictions, such as historic sections of Boston, New Orleans, and Key West.

Also being tested in the Netherlands, UPS deployed four Mercedes P80-E fully electric trucks in April 2014. These vehicles, as well as the other aforementioned technologies, joined

Figure 9: UPS "Ducati Free Duck"

UPS' rolling laboratory of vehicles to track vehicle performance, including range, fuel consumption, and emissions. UPS shares this information with manufacturers who use the data to make technological advancements.

To date, natural gas technology has been the most successful in the US, due in part to more than thirty years of testing. This is particularly true for long-haul trucking. LNG-configured heavy-duty tractors combine strong pulling power and long range so they compete operationally with comparable diesel-powered tractors while offering a lower emission profile and cost less to operate.

The challenge with natural gas is fueling infrastructure and equipment cost in comparison to standard diesel trucks. Creating a critical mass of natural gas users, which results in lower equipment and infrastructure prices. It's a fine balance between equipment and infrastructure as operators need available fueling stations, while fueling stations require demand to survive. For these reasons, UPS is making substantial financial and operational investments in LNG vehicles and

infrastructure in the United States. Bigger LNG fleets enable manufacturers to achieve economies of scale. They also make it economically viable for companies to build fueling and maintenance stations. As natural gas-fueled commercial transportation becomes more widely affordable, it will help the country lower its greenhouse gas emissions, especially as technology to prevent methane release during fueling improves.

UPS already plays an important role in the nation's longest LNG corridor, known as the Interstate Clean Transportation Corridor (ICTC). This corridor stretches from the West Coast to the Rocky Mountains and into the Southwest. UPS built a station along the ICTC in 2010 and has deployed 114 LNG tractors in the region. In the Southeastern United States, UPS is rapidly building up a substantial presence in LNG-fueled commercial transportation. It employs a hub-and-spoke strategy within the ICTC region, which means that their long-haul tractors return each evening to a base near an LNG fueling station. In 2013, UPS completed two new fueling stations in the state of Tennessee and plans to complete another 11 new stations throughout the United States in 2014. UPS also purchased 156 new LNG vehicles, bringing the total to 249 vehicles at the end of the year as it closes in on its plan to have over 1,000 LNG vehicles in operation by the end of 2014. UPS intends that all new tractors purchased for its Domestic Small Package operations in 2014 will be LNG or CNG.

Figure 10: UPS "Cargo Cruiser" Electric Bicycle Delivery

Just as importantly, it increases the amount of information flowing in from their "rolling laboratory" of non-conventional vehicles, including the "cargo cruiser" electric assist bicycle delivery vehicle. This vehicle has a maximum operating speed of 15 mph and a range of 21 miles. It is being tested for short-hauls in Germany, but due to its limited speed and range, the future use in the US is unknown.

UPS is rapidly expanding its use of liquefied natural gas and propane as vehicle fuels because of the positive results they showed as part of its rolling laboratory. In 2013, UPS was operating 3,142 and logged 55 million miles in those vehicles during the year. Since 2000, UPS alternative fuel and advanced technology fleet logged more than 350 million miles, resulting in the avoidance of 34.5 million gallons of conventional gasoline and diesel (a savings of over 700 million pounds of carbon dioxide), with a goal to reach 1 billion miles in 2017.[19]

The following summarizes UPS' alternative fueled fleet in the US (operates an additional 1,059 outside of the US).[20]

TOTAL Alternative Fuel Vehicles: 2,378

- Compressed Natural Gas (CNG) Vehicles: 1,001
- Liquefied Natural Gas (LNG) Vehicles: 727
- LNG fueling facilities: 13
- Electric Vehicles: 102
- Propane Vehicles: 28
- Hydraulic Hybrid Vehicles: 41
- Composite Body Diesel: 400

[19]UPS Corporate Sustainability Report, 2013 http://sustainability.ups.com/media/UPS-2013-Corporate-Sustainability-Report.pdf
[20]Testimony of Jim Bruce, Senior Vice President, UPS Corporate Public Affairs to the United States Joint Economic Committee Hearing on "The Economic Impact of Increased Natural Gas Production", 216 Hart Senate Office Building, June 24,2014

The following are criteria UPS has for adopting and deploying alternative fuel technologies:

- Safe
- Reliable fueling infrastructure
- Predictable supply of vehicles and parts
- Results in measurable improvement in emissions, fuel savings and/or environmental benefit
- Economically viable in terms of initial purchase price, maintenance costs and reliability and adapted to UPS fleet use characteristics

The criteria above explain why most of UPS' alternative fueled fleet consists of natural gas technology. Natural gas is more reliable, has a more reliable fueling infrastructure, has more vehicle options, and is more economical than other alternative fuel technologies they studied, including electric and compressed natural gas. However, UPS aims to change this by continuing to create market demand for cleaner technologies through continuing investment in testing options.

UPS continues to test all alternatives as reflected in some highlights, below:

- UPS has a rolling laboratory for alternative fuels development. The rolling laboratory tests prototypes on the road. Because natural gas has been in use in heavy-duty vehicles for the past 30 years, natural gas technology is ahead of electric, fuel cell, and other alternatives. The company works with manufacturers of all types of technologies, the EPA and other government agencies to pilot projects before new vehicles are ready for commercial deployment.
- In 2013, UPS reached a new milestone of logging more than 55 million miles using alternative fuels and advanced technology vehicles.
- Goal for 2017: log 1 billion miles with alternative fuel fleet

CASE STUDY 3: WAREHOUSE AUTOMATION

THE PORT OF SEATTLE AND INDUSTRIAL LAND

Warehousing and industrial uses, including the Port of Seattle, create significant benefits in terms of jobs and economic vitality for Seattle, but these uses also generate significant health and environmental impacts. Through a variety of efforts, including several outlined in the Climate Change Action Plan, Seattle offers the lowest carbon footprint of any other US port. Over the next 25 years, the Port of Seattle intends to:

1) Meet all increased energy needs through conservation and renewable sources.
2) Reduce air pollutants and carbon emissions, specifically:
    a. Reduce air pollutant emissions by 50% from 2005 levels.
    b. Reduce carbon emissions from all port operations by 50% compared to 2005 levels, and
    c. Reduce aircraft-related carbon emissions at Sea-Tac by 25%.
3) Anchor Puget Sound urban-industrial land use to prevent sprawl to less developed areas by protecting existing industrial land clustered in Manufacturing and Industrial Centers.

The last goal above directly relates to the next case study. Due to limited available land near the Port of Seattle, particularly for large warehouse sites, meeting this goal requires an understanding of what the industry needs – allowable building heights, cleared and very level sites, and access. In addition, although not specifically stated in the Plan, it's important to Seattle that these new facilities strive for the highest efficiencies, particularly with energy usage. The following case study will outline not only how new construction can reduce congestion, but also how it can reduce the carbon footprint of freight operations in Seattle.

WAREHOUSE EFFICIENCIES

As part of the trend toward greener warehouses, businesses are seeking not only energy savings, but also more efficient materials handling. Automated storage and retrieval systems (AS/RS, the robotic handling system, and warehouse management systems (WMS), the warehouse handling system, help achieve significant efficiencies by maximizing storage space while reducing operating costs. The WMS has the added benefit of increasing the speed of delivery and deployment of goods, which reduces truck queues and idling, particularly during peak seasons or immediately following a supply chain disruption.

Flexible, hybrid AS/RS designs use one or more cranes in an aisle that only need be as wide as the largest commodities – a significant space savings in comparison with forklift operated facilities. Automated racking systems can store products single deep, double deep, or up to 12 loads deep in the rack structure. AS/RS systems can be customized based on the warehouse's inventory mix of high, intermediate, and slow moving products to minimize the cubic space required for storage and handling. Unmanned rack entry vehicles quickly, smoothly, and accurately transport pallets and containers in and out of the storage rack, resulting in faster throughput. These systems benefit small and large warehouses, alike. Although the following example focuses on a very large scale warehouse, it demonstrates the ability of systems like this to perform a vast amount of work in a very small space – a potential opportunity for Seattle.

Automated systems also deliver the following environmental benefits:

- **Less land usage:** A warehouse with an AS/RS uses up to 40 percent less space than a conventional warehouse to store the same number of products.
- **Less energy consumption:** Automated warehouses require less lighting and cooling; regenerative braking on storage/retrieval machines produce energy for assisting with powering the system; the warehouse maintenance system controls all product flows and optimizes product movements.
- **Less product waste:** Automated warehouses reduce product damage caused by human error; require less shrink wrapping to secure pallets; improve accuracy of fulfillment through technology like RFID
- **Reduced maintenance:** Maintenance costs for AS/RS are lower than for forklift operations; automated facilities require less space resulting in facility leasing savings
- **Safety benefits:** Automated facilities have fewer workers moving goods, thus resulting in fewer injuries that are typically inherent in warehouses, such as back and neck injuries and forklift accidents.

HIGHLAND FAIRVIEW: A VISION FOR SUSTAINABLE GOODS MOVEMENT

On December 28, 2012, SKECHERS received LEED (Leadership in Energy and Environmental Design) Gold certification for its North American distribution center in Rancho Belago, California from the U.S. [21]Green Building Council. SKECHERS and developer Highland Fairview, who designed and constructed the cutting edge warehouse facility, shared a vision of attaining the highest environmental standards for the 1.82 million-square-foot SKECHERS facility. Not only did Highland Fairview and SKECHERS build the largest LEED Gold certified building in the United States to have received this honor, but they pioneered the way forward for the logistics and supply chain industry through a combination of significant energy and water consumption savings, waste reduction, truck trip reductions, and emissions reductions.

The official groundbreaking ceremony for the SKECHERS distribution center took place in March 2010 and the building opened for operation in November 2011. A summary of the facility dimensions and LEED features is included in the following.

BUILDING DIMENSIONS

- **Building Area:** 1,820,000 square feet
- **Building Length:** Approx. 2,850 linear feet
- **Building Width:** Approx. 650 linear feet
- **Building Height:** Varies 45 – 66 feet

BUILDING AND SITE FEATURES

- **Parking and Loading Docks:** The facility provides 715 automobile parking spaces, including two electric vehicle spaces with charging stations, as well as 37 spaces designated for alternative fueled vehicles and carpools. The number of vehicle parking spaces complies with the City's zoning code. The developer requested that fewer spaces be provided due to projected demand. The high-tech automation and the facility's 24/7 operations equate to less demand for parking. Currently, the employee parking lot is under-utilized. Typical parking demand is approximately 450 spaces resulting in unnecessary paving.

[21]LEED certification for commercial buildings involves a scorecard that evaluates several categories: sustainability, water efficiency, energy and atmosphere, materials and resources, indoor environmental quality, and innovation.

The facility offers 254 dock doors with over 200 cross-dock opportunities and 306 truck parking spaces. This facility operates as both a national and regional distribution and warehouse center. This facility receives goods directly from the Ports of Long Beach and Los Angeles in marine containers, cross-docks them into 53' over-the-road containers for shipment via truck or train throughout the country, and also stores some goods and fulfills orders within the greater Southern California region directly.

This represents a significant change from Sketcher's previous operations which consisted of six warehouses of up to 1.5 miles apart where one warehouse would receive, break the goods up and wrap them for movement to another warehouse where they would be handled up to two more times before being shipped. This prior practice cost SKECHERS $1 million annually to shrink wrap inter-warehouse moves and generated 58 percent more truck trips.

- **Power, Lighting, and Cooling:** Highland Fairview developed the facility with enough solar panels on the roof to supply 100 percent of the power necessary to operate SKECHERS' corporate office, which is also part of the facility. The extensive use of parabolic skylights to increase natural lighting greatly reduces the need for facility lighting during the day. The lighting operates as needed, regulated by motion sensors.

  The roof has been designed as a "cool roof" and consists of a single-ply poly membrane to deflect heat absorption, and the ventilation system utilizes outside air drawn through louvers facing the prevailing winds, supplemented by energy efficient heating and cooling systems.

Figure 11: Rendering of SKETCHERS Facility

- **Water Usage:** The facility reuses gray water for irrigation, exclusively utilizes drought tolerant native plant species for landscape, and utilizes the latest technology for drip irrigation.

- **Green building Certification:** Project is in process for certification under the U.S. Green Building Councils LEED's program for "Green Buildings."

- **Visual Screening:** The facility was designed with image in mind. This facility is SKECHERS' corporate office in addition to being a major warehouse and distribution center. This facility is also near a major community-serving retail area. Community concerns about the visual appearance of the facility resulted in solid wall around the employee and truck parking areas ensure full screening from local streets.

- **Security:** Facility is fully secured and certified as a Free Trade Zone

LEED GOLD CERTIFICATION ELEMENTS

- **Water Useage:** The facility's drip irrigation and drought resistant landscape, reclamation efforts (the image above shows a holding pond), as well as installation of low water fixtures within the building were recognized by LEED. The facility recycles water via an on-site system. Furthermore, stormwater runoff is captured in natural infiltration basins and treated.
- **Recycling:** The facility recycled an extensive amount of construction materials used in the construction of the building and site. The facility shreds and compacts all recyclable cardboard and materials on site, and encourages recycling of all recyclable materials on site.
- **Reduced "Heat Island" Effect:** The white "cool roof" and light colored paving reduce heat absorption and global warming effects.
- **Energy Efficiency:** The use of natural light and cooling, coupled with energy efficient mechanical heating and cooling systems greatly reduce energy consumption, and the solar panels generate enough electricity to power the Corporate Office.
- **Environmentally Friendly Materials Use:** Low emitting VOC materials, such as glues, adhesives, paints etc., were incorporated into the building construction

From an operations and cost savings perspective, the new SKECHERS facility consolidated six warehouse facilities consisting of interior ceiling heights of up to 32 feet and totaling approximately 2 million square feet, into one 1.8 million square-foot facility with internal ceiling heights of 45-66 feet. Whereas SKECHERS was incurring significant costs from shipping between its facilities, the new facility reduced those costs by approximately $2 million per year. The consolidation is estimated to have reduced truck and auto trips generated by SKECHERS' operations by 58 percent – a significant improvement in traffic operations and emissions reductions for the community and the region.. This reduction was in part from eliminating inter-warehouse truck trips, and in part from moving the facility closer to where their employees live.

Figure 12: SKETCHERS Automated Warehouse in Moreno Valley, CA

Beyond all of these features, the SKECHERS facility utilizes an automated system from Japan-based Daifuku Co. The $100 million AS/RS, nearly half of the facilities overall $250 million price tag, enables SKECHERS to move as many as 20,000 pairs of shoes in an hour as compared to approximately 7,000 pairs per hour in its previous six locations combined. The speed, efficiency, and accuracy of the AS/RS tripled the previous shipping capacity. In its previous operations of a network of warehouses, SKECHERS' workers handled items three times between arrival and shipment to stores. Workers moved goods by forklift and by truck between warehouses before shipping to the final destination, whereas,today, all of those processes occur under the same roof.

KROGER: WAREHOUSE AUTOMATION

In the early 2000's, Kroger began working with a systems integrator (Witron Integrated Logistics[22]) to create a new automated warehouse design for its grocery distribution centers. Kroger's system can receive, sort and shelve full pallets, break them down, and repackage them into store-ready mixed pallets organized according to their location within the destination with very little human intervention. Goods are only touched by workers when lift truck operators unload pallets at the receiving dock and load them at the shipping dock for store deliveries.

The system uses:

- automatic pallet exchange and depalletizing machines
- a 10-crane unit load automated storage and retrieval system (AS/RS) with approximately 21,000 pallet positions for reserve storage
- a 32-aisle mini-load AS/RS with nearly 400,000 tray positions for temporary storage of cartons prior to order fulfillment
- transfer vehicles that deliver pallets from the system induction area in receiving to a pallet exchange station and from the conveyor system to the AS/RS crane selected for storage
- a unique system that automatically builds mixed pallets in the sequence they will be stocked on shelves in a specific store aisle; the system uses a separate mini-load system for buffer storage, a custom-designed palletizer to place the cartons on the right spot on the pallet, and an automatic stretch wrapper

In 2009, Kroger processed approximately 110,000 cases per day with a peak capacity of 160,000 cases in its newly designed facility in Arizona. Since then, Kroger has built two additional automated distribution centers in Colorado and Southern California.

Kroger set out to re-engineer the way it distributes product to its stores, creating a distribution system for the 21st century. Most in the grocery industry believe that it's important to place distribution and support facilities close to retail outlets. Kroger decided to take a closer look at this assumption. Kroger began to tackle SKU (stock keeping unit) proliferation in order to manage the amount of real estate necessary to handle large numbers of SKUs. Second, Kroger began investigating ways to efficiently build a mixed case pallet for individual stores. The automation played a key role by allowing the AS/RS (automated storage and retrieval system) to automatically build a pallet of mixed SKUs without damaging the products, maximizing the cube of a truck, and delivering an aisle-aligned pallet to the store based on the planogram for that store. The AS/RS system was designed to take into account constraints such as crushability to prevent cans of soup from being placed on top of Japanese noodles on the pallet.

After Kroger identified supply chain goals and priorities, as well as operational challenges that

[22]Trebilcock, Bob, automation in command, MODERN MATERIALS HANDLING, May 2009

it needed to address, it incorporated a number of familiar automated materials handling technologies:

- unit load automated storage and retrieval system (AS/RS) for full pallet storage
- automated depalletizer that removes a layer of cartons and orients them for putaway in a mini-load AS/RS
- automated palletizer and stretch wrapper.

Completed pallets are automatically stretch-wrapped, and uniquely join to build aisle-aligned pallets. The case order machine, for instance, takes cases from the mini-load and places them in a buffer storage system that then delivers them in sequence to the palletizer, which uses a unique series of arms to maneuver a carton into the right position on a pallet before delivering the finished pallet to an automatic stretch wrapper. What's special about this solution is the way the software coordinates pulling the pallets out of the AS/RS, dictates how much product needs to be placed in a mini-load tray, and sequences the delivery of the cartons to the palletizer.

From the supplier to the store, pallets are only touched on the inbound and outbound moves. These systems result in fewer injuries, fewer distribution errors and returns, optimized use of truck space, and increased efficiencies. By optimizing truck space, more goods can be moved per truck resulting in fewer truck trips.

CASE STUDY 4: AMAZON AND ITS IMPACTS ON E-COMMERCE

How Amazon continues to change the game for retailers is still to be seen. From kicking off free shipping during Christmas, regardless of costs, to aiming for same-day shipments, Amazon's impact on e-commerce provides an excellent example of the direction that the industry is headed.

Amazon has tremendous influence on its industry. In recent news, Walmart announced that it plans to offer same-day shipment of online orders in select markets. In the view of Jim Tompkins, president of Tompkins International and one of the sharpest observers of our industry, it's going to have a profound impact on retail distribution and retailers in general. "Retail is at a crossroads," Tompkins says. "The reality is that Amazon is so big that they are now mandating what the customer satisfaction requirements are for everyone, even if you don't think that you compete with Amazon." As examples of how Amazon is redefining the retail game, Tompkins points out that most shoppers expect free shipping, free returns, and delivery in two days or less.

Unlike many other major companies, such as SKECHERS who recently consolidated six regional distribution centers into one major distribution center, Amazon is building more individual warehouses closer to markets in order to deliver goods to consumers more quickly – within a day or two in major markets. These two ways of doing business may seem counter to one another, but in fact, they work well together. Major manufacturers, such as SKECHERS, sell both wholesale and retail. Amazon fills the customer needs of "same day" by purchasing from SKECHERS' wholesale customers, such as Macy's In the Seattle region, Amazon recently added a new sortation facility.

In 2004, 38 percent of Amazon's fulfillment capacity was less than 200 miles from a major metropolitan area, whereas today, 79 percent of its distribution centers are within 200 miles of a major metro area.

System-wide, Amazon is in the process of adding 15 or more "sortation" centers. These facilities are typical located within 30 miles of a major metropolitan center. Sortation centers not only make shipping more efficient, but they facilitate Sunday delivery. Amazon sends prepared customer packages to sortation centers, sorts them and then ships them to individual post offices for faster delivery, including on Sundays, by the US Postal Service. Amazon began rolling out Sunday deliveries in 2013 and, quite recently, upon opening the new 313,000 square-foot sortation facility in Kent, Washington, began Sunday deliveries in the City of Seattle in July 2014.[23]

Sunday deliveries are being made possible by an unprecedented move – postal delivery service on Sundays. Amazon and the USPS have teamed up

[23]Greene, Jay, *Amazon launches Sunday delivery from Kent warehouse*, Seattle Times, July 20, 2014, http://seattletimes.com/html/businesstechnology/2024114127_amazonkentxml.html

to implement the service in major US markets. The rollout offers yet another way to entice consumers to utilize e-commerce. Amazon has also introduced on-line grocery shopping through AmazonFresh, accompanied with a new technology for easy online ordering that involves a wand that allows you to scan, say or type in grocery items and then beam them to your online grocery list. Kroger recently purchased a grocery chain in the south with over 200 stores equipped with a similar e-commerce platform aimed at competing with AmazonFresh.

The retail industry is paying attention. Four key elements that they need to consider according to Jim Tompkins include:

- Price: Can you beat Amazon on price?
- Selection: Can you offer more selection?
- Experience: Can you beat them on experience? (Amazon invented this type of retailing)
- Convenience: How fast and conveniently can you get product to a customer?

But in this ever-changing market, another competitor may yet change the playing field as it has done so many times before: Google. Google's Shopping Express service intends to go head-to-head with Amazon in competition for the "last mile deliveries". While traditional retailers continue to experience flat sales growth, Amazon again experienced outlandish growth in the last quarter as its sales rose 23 percent. Google wants in on the action and, unlike retailers like Walmart and Macy's, they have the technological know-how and financial capability to possibly do it.

AmazonFresh recently began filling same day orders based on inventory stored in its warehouses in limited markets, including Seattle, with grocery chains as its new target. However, AmazonFresh's refill ordering for everyday essentials targets many non-grocery items, such as diapers.

In 2013, Google launched Shopping Express in San Francisco and Silicon Valley and expanded into New York and Los Angeles markets in early 2014. This service competes with Amazon's same day service, Amazon Fresh, in the San Francisco Bay Area and West Los Angeles.[24]

So what makes Shopping Express different than AmazonFresh? First, it relies upon partnerships with traditional retailers. Second, it relies on contracts with courier. And third, Google utilizes a hub-and-spoke type of system where all items from retailers are taken to a warehouse operated by Google and then packed into a vehicle for delivery during a specified time window to the customer.

There is no available data describing how the routing and delivery occurs but, based on Google's technological capabilities, some speculate that warehouses are small and strategically placed throughout a region in a zone system to allow for quick fulfillment of orders. Further speculation indicates that this type of warehouses operation may operate similar to a "cross-dock" facility where inventory is quickly moved from one vehicle to another, overnight storage is minimal, and space requirements are far less than an Amazon distribution facility.

In short, the combination of couriers and low cost order consolidation warehouses would allow Google Shopping Express to not only compete in same day delivery, but operate more cost-effectively. This is something for Seattle to watch. Google could help traditional retailers remain profitable – a key point that cities and regions should continue to monitor in order to anticipate, monitor and prevent long-term vacancies of retail storefronts.

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[24]Banker, Steve, *Amazon Grows Rapidly, Traditional Retailers Struggle, Should Brick and Mortar Retailers Partner with Google?*, Forbes, August 25, 2014, http://www.forbes.com/sites/stevebanker/2014/08/25/amazon-grows-rapidly-traditional-retailers-struggle-should-brick-and-mortar-retailers-partner-with-google/

CASE STUDY 5: OFF-PEAK FREIGHT DELIVERY

Off-hours deliveries seek to shift truck activity out of the peak traffic periods and hence reduce congestion and emissions. Despite obvious advantages in terms of avoiding congestion, few examples of off-hours delivery programs exist. This is due to the supply chain - off-hours deliveries require off-hours truck drivers and receivers. Constraints on the trucking side include federal hours of service requirements, shift premium pay for unionized drivers, and possible efficiency losses associated with spreading shipments out across more hours of the day. Constraints on receivers include having to open receiving facilities early and to operate loading terminals more hours of the day, shift premium pay for terminal workers, and local zoning codes that prohibit after hours truck activities in residential neighborhoods.

There is only one permanent off-hours program in the US, the PierPass program at the Los Angeles/Long Beach ports. It was implemented due to the extreme congestion and very high volume of good flowing through the Port, circumstances that do not exist in other US metropolitan areas. It has resulted in reduced congestion, energy consumption, and emissions and thus demonstrates the potential benefits of such programs. However, these benefits have not been fully utilized due to the receiver constraints. Often times, truck drivers will pick up during peak hours and wait until the PierPass off-peak hours begin to drop the cargo off at the ports. Until receivers have an incentive to incur the additional costs, and local residents can be protected from the noise, off-peak delivery will continue on only a limited basis.

A New York City demonstration was the first and only in-city program. In the New York City test, receiver constraints were found to be the most difficult to overcome. It has resulted in reduced congestion, energy consumption and emissions and thus demonstrates the potential benefits of such programs.

Off-hours delivery may have potential as a voluntary regulation. The public sector could offer incentives such as recognition (green certification for receivers) or tax breaks to promote off-hours deliveries in areas where residents would not be affected (e.g., commercial zones). Shippers might be incentivized to purchase and use quieter trucks and handling equipment in exchange for being able to deliver off-hours, as in the PIEK program in the Netherlands. In that program, Dutch law set down strict limits for nighttime noise rather than banning freight activity altogether. Due to the high demand for Port facilities there, the noise restrictions have led to identification of quieter equipment solutions to most portions of Port activity. In Seattle, additional financial support would likely be needed in order to keep the Port competitive.

PIERPASS: PORTS OF LONG BEACH/LOS ANGELES

PierPASS began at the Ports of Los Angeles and Long Beach in July 2005 in the midst of unprecedented growth in truck traffic resulting from significant trade activity at the Ports of Long Beach/Los Angeles. Due to political pressure caused by community concerns over trucks clogging up the I-710 Freeway, terminal operators at both ports joined forces to develop and implement an off-peak gate incentive program aimed at shifting trucks to off-peak hours.

PierPASS assesses a Traffic Mitigation Fee (TMF) on most containers (exceptions include

intermodal containers destined for a rail yard) moved in and out of the San Pedro Bay ports. The current fee of $66.50 per 20-foot container and $133 per 40-foot container is assessed between the hours of 3 AM and 6 PM, Monday through Friday. The TMF helps fund the additional cost of longshore labor necessary to operate the terminals during off-peak periods. To date, the PierPASS program has shifted an estimated 30-40 percent of truck traffic at the marine terminal gates to evenings and weekends.

A few significant barriers that inhibit off-peak gate operations include longshore labor costs (especially for overtime pay), longshore labor minimum hour guarantees, longshore labor minimum size of labor work units, operating hours of warehouses, distribution centers, manufacturers, and other entities which must also be available to process cargo during off-peak hours.

In spite of these challenges, PierPASS has reduced truck congestion in and around the ports by successfully shifting a significant amount of eligible cargo to the evening (approximately 40 percent). However, shifting truck traffic at the ports has generated changes and unintended consequences along the entire supply chain, most notably, the impacts of the program on the trucking community.

One of the most significant unintended consequences has been the measures that truckers have taken to avoid paying the TMF. The trucking industry operates on very thin margins. Truckers that are either picking up an export or dropping off an import from/to a facility that only operates during peak hours must then decide to pay PierPASS or wait for the off-peak gate to open. Particularly for independent truck drivers, finding a place to park and wait is a challenge. The closest truck stop to the ports is located approximately 50 miles east in Ontario, CA. Truckers are driving to Ontario, parking and waiting for either warehouses to open so that they can deliver or for the off-peak gates to open so that they can pick up the container. The true efficacy of PierPASS has been the reduction in congestion in and around the ports. The unintended consequences include time and monetary costs incurred by the trucking industry, as well as a possible increase in vehicle miles traveled and related emissions.

NEW YORK: OFF-PEAK DELIVERIES

In 2003, New York City contracted with Rensselaer Polytechnic Institute to investigate the potential for delivering goods to businesses in Manhattan between the hours of 7 PM and 6 AM. The study was expanded in 2005 to include Brooklyn. Moving goods and passengers is complex in urban areas that experience severe congestion and have significant physical constraints. The costs incurred by carriers due to parking citations and other violations in New York City, as well as the time and idling costs associated with being stuck in traffic, result in costs of as much as 30 percent, according to FedEx. Other New York City area business representatives reported that moving a shipment from the container terminals in New Jersey to Manhattan, a straight line distance of 1.5 miles, costs as much as sending a shipment from Connecticut to Ohio, a difference of 500 miles.[25]

The research for this Off-Hours Delivery project focused on: (a) identifying policies and initiatives that would be effective in inducing a shift to off-peak deliveries; (b) assessing the overall effectiveness of such initiatives; and, (c) fully understanding the implications to shippers, receivers and carriers.

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[25]Holguin-Veras, Jose, POTENTIAL FOR OFF-PEAK FREIGHT DELIVERIES TO CONGESTED URBAN AREAS (TIRC Project C-02-15), Rensselaer Polytechnic Institute, December 21, 2006

The study only considered policies and programs based on voluntary participation of the industry. The study focused on the following key objectives:

- Define the set of policies and programs that would induce a shift in deliveries to off-peak hours (referred to here as off-peak delivery initiatives)
- Quantify the effectiveness of these initiatives
- Quantify extra costs to stakeholders so that compensation schemes could be implemented, should off-peak deliveries be found to be economically beneficial to society at large
- Conduct the analyses using advanced statistical and econometric techniques to minimize the risk of biased results

The Study process involved:

1. Identifying the key stakeholders, including shippers, warehouses, receivers and carriers
2. Documenting geographic patterns of economic activities using economic datasets that contain a breakdown of businesses and employment at the ZIP code level to define the sampling areas for receivers
3. Outreach Activities: in-depth interviews, an on-line survey, and a focus group to gauge stakeholders' willingness and ability to employ off-peak deliveries
4. Stakeholder interviews: 2 trucking companies, 4 trucking/warehouse companies, 3 shippers, 4 shipper/trucking/warehouse companies, 2 receivers, and 2 lobbyists

Based on the outreach, not surprisingly, all respondents that operated trucks preferred off-peak hours, citing less congestion, fewer parking conflicts, and an increase in worker productivity. Conversely, receivers that were closed for business during the off-peak hours cited concerns related to labor costs, security concerns, and unwillingness of employees to work nights.

The study found that the restaurant industry tends to operate during off-peak hours and have staff available to accept deliveries. The study also found that off-peak deliveries offer the most cost saving for longer trips.

New York City Off-Peak Delivery Policies Considered

For Receivers:
(R1) tax deductions
(R2) lower shipping costs

For Carriers:
(C1) a request from receivers
(C2) a request from receivers together with parking availability during the off-peak hours
(C3) a request from receivers and security clearances at bridges and tunnels
(C4) a request from receivers and toll savings to carriers doing OPD
(C5) a request from receivers and financial rewards for each mile the carrier traveled during the off-peak (C6) a request from receivers and an off-peak delivery permit that enables trucks to double park during off-peak hours
(C7) the creation of a (neutral) company to do the last leg of delivery to the congested areas
(C8) the creation of a staging area in Brooklyn to allow trucks to travel to Brooklyn during the off-peak hours, spend the night at the staging area and then deliver to consignees during day hours

The effectiveness of the two scenarios targeting receivers (R1 and R2 above) was based on the likelihood of receivers to: (1) commit to do a given percentage of off-peak deliveries if they receive a tax deduction for one employee assigned to off-peak hours work; and (2) commit to do off-peak deliveries if delivery costs were less during the off-peak hours. These tax incentives are currently provided by the City of New York.

Similarly, the most effective scenarios targeting carriers were C1, C3, C and C6, above. The receiver was key in the success. Convincing the carriers is much easier since off-peak delivery greatly reduces uncertainties, travel time, and parking penalties.

In conclusion, several of these incentives have proven successful, especially the employee tax incentive for receivers and the cost and time savings for carriers. New York and Brooklyn have shifted a meaningful portion *of truck traffic to off-peak hours, particularly led by the restaurant industry where a tax deduction of $10,000 is anticipated to result in 20 percent industry participation in off-peak delivery service.

LONDON: OFF-PEAK DELIVERIES

Seattle, like many cities, has rules in place that prohibit night-time deliveries, particularly near residential areas. In order to pursue a program like the one in New York City, London provides guidance that is useful in considering such a program. The London Quiet Delivery Scheme guidelines are included in their entirety below.

How to introduce a Quiet Deliveries Scheme
Menu of Measures for Retailers and Freight Operators
(based on Transport for London's code of practice for quieter out-of-hours deliveries)

General guidance – activities mainly within your control
Think about the potential noise impact of any out-of-hours activity on local residents, and review the likely sources and consider how to address these by:

- Using newer and quieter delivery vehicles and equipment, where possible.
- Making sure all equipment – both on the vehicle and at the delivery point – is in good working order and maintained or modernized to minimize noise when in operation.
- Ensuring all staff involved in delivery activity are briefed and trained appropriately, in accordance with the code of practice.
- Ensuring all suppliers and carriers receive copies of the code and are aware of its importance.

General guidance – activities that you will need to collaborate on

- Liaising with your local Borough/District Council and contacting the Environmental Health Officer (responsible for noise issues) to explain the plans to manage night-time delivery and servicing activity. This needs to happen in partnership with your key customer/retailer.
- Liaising with your local Borough/District Council and contacting the Planning Department to identify and help address any variations to planning conditions required and the process for carrying this out. This needs to happen in partnership with your key customer/retailer.
- Liaising with clients, colleagues, other local businesses, suppliers and carriers to minimize the likelihood of more than one vehicle arriving at the same time.

Ensure all drivers/deliveries/loading/unloading personnel follow the guidance below:

The Delivery Point

- Ensure delivery bay doors, gates and shutters are well maintained to minimize noise when opening and closing .
- Switch off any external tannoy systems.
- Avoid using external bells at delivery points.
- Switch off the radio when delivery point doors are open.
- Ensure the delivery point and surrounding areas are clear of obstructions so vehicles can maneuver easily.
- Keep doors other than the delivery point closed to ensure noise does not escape.

- Where possible, prepare all empty handling units, salvage and returns behind closed doors. Check they are in the correct condition and position and at the right height before taking them out. This will minimize outdoor activity and unnecessary noise.
- Think about how to minimize contact between hard surfaces, particularly metal on metal, during the unloading/loading processes. For example, use rubber matting and buffering material on doors.
- Service any delivery equipment in advance to minimize noise.
- Make sure the delivery point is ready for the vehicle before it arrives – gates and doors should be open to avoid the vehicle idling.
- Make sure the driver knows the precise location of your delivery point and is aware of any local access issues.
- Ensure staff do not shout or whistle to get the attention of the driver.

The Driver

- Plan ahead to ensure you know the location of the delivery point and the appropriate access route.
- Adjust or restrict routings for evening/night-time deliveries to avoid housing areas.
- If early for your delivery slot, do not wait near residential property and switch off the engine.
- As you approach the site and maneuver your vehicle into position, remain aware of the effect noise levels can have on local residents.
- Do not sound your horn.
- Reversing alarms should be switched off or modified for white noise, if not subject to health and safety requirements or localized risk assessment issues (e.g. proximity to a cycle route). Use a qualified banksman instead, if available.
- Engines should be switched off immediately when not maneuvering, however, try to minimize start-ups and avoid over-revving.
- Refrigeration equipment should be switched off in advance of arrival at premises.
- If the radio is on, ensure the cab windows are closed and switch the radio off before opening the door.
- Minimize the frequency of opening and closing vehicle doors, and do so quietly.
- Allow extra time if needed to unload as quietly as possible. Take particular care to minimize rattle from metal-on-metal contact when moving roll cages.
- Where practical, notify staff at the delivery point in advance of arrival to ensure they are ready for you.
- Be aware of how far your voice can carry when talking outside at night.
- If opening a gate/cellar flap/roller shutter door to gain access, do so gently and as little as possible.
- Lower flaps on tail-lifts carefully and quietly.
- Do not whistle or shout to get the attention of store employees.
- When moving gates, locks and load restraint bars ensure they are placed gently in their resting position/ stowage point – do not drop or drag them on the ground.
- When safe to do so, use sidelights rather than headlights while off-road and maneuvering, to minimize light intrusion.
- Minimize excessive air brake noise.

CONCLUSIONS AND RECOMMENDATIONS

ALTERNATIVE FUELS

The US and the world continue to move towards cleaner transportation technologies. Seattle continues to support these efforts by working with Puget Sound Clean Air Agency to identify opportunities to work together towards new technology. As the region moves towards a low to zero emission goal, good examples from the Ports of Los Angeles and Long Beach can be found for moving the industry. Below are some opportunities for Seattle:

1. A Technology Advancement Program with seed money jointly provided by the air resource district, EPA, and the City to test new technology. Seattle could coordinate with the Port and local stakeholders to explore means to aid the freight industry's use of cleaner technologies.

Fueling station development, which could be hydrogen, liquefied or compressed natural gas would improve the air quality as well as the economic sustainability of freight. The Ports of Los Angeles and Long Beach offer the best example of requiring and supporting the development and testing of alternative-fueled trucks, including battery-electric, hydrogen fuel cell, and both liquefied and compressed natural gas.

Presently, hydrogen fuel technology does not meet the range needs of the freight industry. In as much hydrogen fueling stations almost exclusively support passenger vehicles, but as technology improves, opportunities for hydrogen fuel cell trucks may become feasible. Hydrogen fuel stations typically cost approximately $2 million to develop. California in 2013, approved $200 million to fund the construction of 100 hydrogen fueling stations. In anticipation of future hydrogen truck opportunities, Seattle could coordinate with hydrogen fuel station developers to ensure future access for trucks could be accommodated at the new stations.

Development of one or more public natural gas fueling stations could be a partnership between the City and one of the providers (such as Blu or Clean Energy). The partnership would require the City to potentially off-set the initial lack of demand – if any.

1. Develop guidelines for the development of hydrogen fueling stations, and seek opportunities for the City to encourage or support the inclusion of truck access
2. Study the needs and opportunities for development of alternative fueling stations within the City. Develop station development guidelines that consider both the potential demand and all potential environmental effects
3. Develop an implementation plan that supports increased use of alternative fueled trucks

WAREHOUSING

Seattle has an opportunity to capture warehousing that supports same-day delivery of consumer product. The development of new high-tech, smaller, strategically placed warehouse facilities within close proximity to major population bases, such as Seattle, continues to grow. Capturing a piece of this market could reduce overall vehicle miles traveled in the Seattle area, improve economic efficiency for the industry, and result in reuse of vacant or underutilized industrial land. Recommendations for investigating this opportunity include:

1. Identify vacant industrial land and unoccupied warehouse and industrial buildings in Seattle

2. Investigate the opportunities for redeveloping these sites based on the most current industry warehouse space demands (area, height, loading docks, access, etc) by preparing a study that collects available commercial real estate information, investigates sites, and develops a business development strategy for capturing this opportunity

OFF-PEAK TRUCK OPERATIONS

Off-peak truck operations offer a real solution to discouraging trucks on regional freeways during peak hours, but the ability to implement these operations has been limited to seaports and a few major cities. The success of these programs has been based on significant coordination across the supply chain. Deliveries require off-hours truck drivers and receivers. Constraints on the trucking side include federal hours of service requirements, shift premium pay for unionized drivers, and possible efficiency losses associated with spreading shipments out across more hours of the day. Constraints on receivers include having to open receiving facilities early and to operate loading terminals more hours of the day, shift premium pay for terminal workers, and local zoning codes that prohibit after hours truck activities in residential neighborhoods.

The following recommendations could lead to a successful off-peak freight operations program:

1. Identify all existing City regulations that impact, restrict or prohibit off-peak truck operations
2. Follow up with stakeholders who expressed an interest in off-peak delivery. Identify others.
3. Further investigate their operational needs and work with them to develop potential off-peak solutions
4. Develop off-peak delivery guidelines, if needed, to address potential impacts of an off-peak delivery program (i.e., noise, light, vibration)
5. Explore potential industry incentives to encourage off-peak operations, such as tax incentives to employers who hire a third shift at a warehouse