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The Good Haul

Innovations That Improve Freight Transportation *and* Protect the Environment

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Innovations That Improve Freight Transportation *and* Improve the Environment

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Cover photos (clockwise from top right): Nippon Yusen K.K. and Nippon Oil Corporation's solar power-assisted vessel, the MV Auriga Leader, courtesy NYK Line; truck stop electrification, courtesy Jennifer Witherspoon; Norfolk Southern's battery-powered switching locomotive, courtesy of Norfolk Southern Corporation.

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Executive summary

Solar powered ships. High-tech GPS truck tolling systems. Advanced diesel-electric engines. These are just a few of the technologies that the freight sector is using to reduce the pollution that comes from moving goods.

Trade is the lifeblood of the global economy, but it comes at a high price for the environment and local communities. Moving freight creates traffic congestion, greenhouse gas emissions, toxic air pollution and noise in local communities. Without thoughtful infrastructure and operations improvements, projected increases in trade threaten to make these problems worse and place greater strains on the nation's aging infrastructure. By 2020, 90.1 million tons of freight per day are expected to move throughout the United States, a 70% increase from 2002.[1]

Generally, freight transportation—how to keep it functioning well and how to reduce its environmental and community impacts—has received little policy attention domestically or internationally. This has begun to change as trade becomes more international, infrastructure ages, and environmental damages worsen.

This report addresses the three principle freight modes: trucking, rail and ships. It focuses on real-world, innovative solutions that reduce pollution and increase freight transportation efficiency. While most of these solutions are in place somewhere in the world, they have not been widely adopted in the United States.

We focus on a handful of exemplary projects; there are many more that hold promise, such as on-dock rail initiatives and various technologies still in research stages. We discuss ten categories of innovative projects that are working right now to improve freight transport while reducing its environmental impacts:

- Port and corridor cleanup plans
- Shoreside power
- Ship cleanup
- Coastal shipping
- Rail yard and port cargo handling equipment
- Diesel engine emissions reductions and incentives
- Truck tolling
- Truck stop electrification
- Logistics
- On-the-horizon technologies for rail, port and maritime

Each case study is evaluated based on environmental benefits, co-benefits and economic benefits. We also touch on funding sources. For the purpose of this report, we define co-benefits as any health, quality of life or time-saving benefit that goes beyond emissions reductions or cost savings.

Widespread adoption of the solutions outlined in this report would help create a modern freight system that is cleaner and more efficient, supports a strong economy and creates stable jobs.

Introduction

The U.S. freight sector faces a serious challenge in the coming years. By 2020, 90.1 million tons of freight per day are expected to move throughout the United States, a 70% increase from 2002.[1] Goods now travel faster, farther and for less cost per unit than a decade ago. In addition to using a wider web of global trade, many businesses have adopted the strategy of "Just in Time" shipping, keeping inventory at a minimum, saving valuable warehouse space and increasing investment returns. This strategy places greater demand on energy-intensive transportation to meet tight delivery schedules.[2] One result has been a decrease in vehicle load size, meaning more vehicle trips and greater system congestion and emissions.[3]

Expected trade increases will place greater strains on our highway, rail and waterway systems and test their safety. The domestic trucking sector loses an estimated $8 billion per year as a result of clogged roads, and projected increases will likely worsen congestion and increase the risk of accidents. The average U.S. bridge is 43 years old; 47% of locks are functionally obsolete; and major investments are necessary to keep aging roads safe for both people and goods.[4] On top of concerns about the system's safety and capacity, the freight sector must address its environmental and societal impacts.

The environmental and social costs of freight

Transportation accounts for a third of global energy consumption, and freight movement represents nearly a quarter of the transportation sector, or approximately 8% of total global carbon dioxide emissions.[5] The freight sector's greenhouse gas emissions have increased 58% since 1990. This increase is double that of passenger travel (27%), which has significantly more environmental regulations aimed at improving vehicle efficiency, lowering emissions and mandating cleaner fuels.[6]

Freight is also a major source of health-threatening air pollutants, including diesel soot, sulfur and the major components of ground-level ozone or smog. These pollutants are linked to premature death, asthma, lung cancer, low birth weight and cardiovascular illness. The U.S. Environmental Protection Agency (EPA) classifies pollution from diesel engines—the most common engines used in freight—as a toxic air contaminant responsible for 20,000 premature deaths annually.[7]

In California—where the Ports of Los Angeles and Long Beach handle more than 45% of U.S. ship-borne freight—the California Air Resources Board estimates that the health costs from freight-related air pollution in 2005 amounted to more than $19.5 billion. Freight-related pollution was responsible for about 2,400 premature deaths, 2,000 respiratory-related hospital admissions, 62,000 asthma and lower respiratory cases, 360,000 lost work days, and 1.1 million lost school days. The agency estimated that every dollar spent on reducing freight-related pollution would produce long-term health and productivity benefits between $3 and $8.[8]

Pollutants from freight movement affect neighborhoods along busy corridors and near ports.[9] These neighborhoods are often made up of low-income residents. Noise and vibrations from trucks and equipment keep residents up at night, affecting sleep patterns and school performance.[10] Levels of cancer and other health problems are also higher in these communities.

The West Oakland community abuts the Port of Oakland, the fourth largest port in the United States.[11] West Oakland residents inhale three times as much diesel particulate matter as residents of the entire San Francisco Bay Area, and it is estimated that 71% of cancer risk from diesel particulate matter originates from port-related activities.[12] The community's life expectancy is ten years lower than residents of other Oakland communities. In Southern California, where operations from the Ports of Los Angeles and Long Beach, as well as truck traffic along I-710, disproportionately affect low-income residents, a study revealed that women had a 128% and 91% higher risk of premature delivery (prior to 30 weeks) due to exposure from nitrogen oxides and particulate matter, respectively.[13] These are only some of the health consequences that these communities must bear.

Trucks, trains and ships: inside freight modes

Each of the major freight modes—trucks, trains and ships—has advantages and disadvantages. Trucking is the most flexible, and more than 80% of U.S. cities and towns are served exclusively by trucks. In 2006, trucks moved 61% of all freight in the U.S. by weight.[14] They are often indispensable for the "last mile" of a product's journey from factory to storefront. However, trucks are also the most fuel-intensive freight mode, emitting tons of greenhouse gases and unhealthful pollutants.

Rail freight is three times more fuel efficient than trucking and is a flexible and efficient way to move bulk commodities long distances since containers can easily move from ship to rail to truck.[15] Although rail is considerably more fuel efficient, increases in tonnage typically require additional diesel fuel, which reduces the magnitude of the environmental benefits. Moreover, older rail locomotives and a great deal of rail yard equipment are highly polluting. Rail yard sites create noise and pollution in surrounding neighborhoods.

The increase in international trade over the past decades has placed a high premium on ocean-going vessels. Every year ships make more than 10,000 visits to U.S. ports, and West Coast ports are expected to experience a 138% increase in container traffic by 2035.[16] Maritime shipping is efficient in terms of goods moved per mile. However, ships use heavily polluting bunker fuel. Also, the sector has few regulations, partly because the majority of ships serving U.S. ports are foreign flagged. Such ships are governed primarily by an international regulatory system, leaving the United States with limited ability to independently regulate the sector's emissions.

Each mode of moving freight requires infrastructure, facilities and related ground equipment that add to greenhouse gas emissions, unhealthful pollution and congestion. Most of this equipment uses highly polluting fuels—either bunker fuel or high sulfur diesel fuel—and the turnover to new and cleaner engines is slow. The concentration of freight at various facilities also contributes to congestion, especially in metropolitan areas. By delaying shipments and slowing mobility overall, congestion affects not just the environment, but also the local economy.


Port of Long Beach

West Coast ports are expected to see a 138% increase in container traffic by 2035, worsening congestion.

What's in this report: case studies of best practices

Several players within the freight movement sector have taken steps to reduce greenhouse gases and other pollutants. This report aims to showcase these leaders, highlighting innovative programs that are environmentally, economically and socially effective but not yet universally adopted.

This report addresses the three principle freight modes: trucking, rail and maritime. Air freight will not be addressed as 60% of air cargo travels in the belly of passenger planes, and policies and regulations vary in this area. Within and overlapping these modes are intermodal components, such as port and corridor facilities, cargo handling equipment and supply chain innovations that improve door-to-door logistics.

The United States needs national programs and policies to make our freight system more effective now and in the future. This report provides examples of real-world freight transportation innovations that can help the economy, create and support good jobs, and reduce environmental impacts.

U.S. freight regulations

Generally, freight transportation—how to keep it functioning well and how to reduce its environmental and community impacts—has received little policy attention domestically or internationally. That has begun to change as trade has become more international, as older infrastructure has reached the end of its functioning life, and as environmental impacts have increased.

Federal transportation laws

In response to the 1990 Clean Air Act amendments, Congress adopted the Intermodal Surface Transportation Efficiency Act (ISTEA) in 1991, which contained the Congestion Mitigation and

Six common criteria pollutants

EPA sets standards for six "criteria" pollutants that are known to affect local air quality and public health.[17]

1. **Carbon monoxide (CO):** A gas created when the carbon in fuel is not completely burned. Health impacts include cardiovascular, nervous and respiratory system problems.
2. **Nitrogen oxides (NO_x):** Nitrogen oxides are a group of reactive gasses. While EPA's National Ambient Air Quality Standard is designed to protect against exposure to the entire group of nitrogen oxides, EPA sets standards for nitrogen dioxide (NO_2). Nitrogen oxides come from combustion. Inhalation can lead to asthma and respiratory illness, and they combine with other pollutants to create ozone and particulate matter.
3. **Lead:** Lead emissions come from industrial sources, and to a lesser extent from motor vehicles. Exposure can harm the kidneys and the nervous, immune, reproductive, developmental and cardiovascular systems.
4. **Sulfur dioxide (SO_2):** This highly reactive gas comes from power plants, industrial facilities and diesel fuel used in locomotives, ships and non-road engines. Short-term exposure can cause serious respiratory problems.
5. **Particulate matter (PM):** Made up of dust, soil, metals, acids and organic compounds, these particles are found near dusty areas, in forest fire smoke, and in diesel fuel exhaust. $PM_{2.5}$ is less than 2.5 micrometers (an average human hair is 70 micrometers), whereas PM_{10} is between 2.5 and 10 micrometers. Both lead to heart and lung problems. $PM_{2.5}$ from diesel soot is especially toxic.
6. **Ozone (O_3):** Ozone is created when nitrogen oxides (NO_x) react with volatile organic compounds from engine combustion. At ground level, ozone combines with sunlight to create smog, which impacts visibility and can cause respiratory diseases.

Greenhouse gases

These pollutants trap the sun's heat within the Earth's atmosphere. The increased burning of fossil fuels since the Industrial Revolution has exacerbated the natural carbon cycle and led to a warming of the Earth's climate. Climate change will lead to new rainfall patterns, an increase in catastrophic weather events, sea level rise, and a range of impacts on wildlife, plants and humans.[18] The most important manmade greenhouse gases include:

- **Carbon dioxide (CO_2):** This gas is emitted through the burning of fossil fuels and naturally through the carbon cycle.
- **Methane:** This gas is more potent than carbon dioxide and is emitted from a variety of sources, including agricultural practices and the transport of coal, natural gas and oil.
- **Nitrous oxide:** This gas is created from agriculture sources, sewage treatment and fossil fuel combustion. Nitrous oxide is also produced naturally.
- **Fluorinated gases:** These gases are produced through industrial processes, including semiconductor processing and electrical transmission. Usually emitted in small amounts, these gases are very potent and are called High Global Warming Potential gases based on their impact on the atmosphere.

Air Quality (CMAQ) Improvement Program. CMAQ provided $6 billion for surface transportation and other projects to improve air quality and reduce congestion. CMAQ was reauthorized in 2005 under the Safe, Accountable, Flexible, and Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU). SAFETEA-LU's CMAQ program authorized more than $8.6 billion from 2005 to 2009 for local and state agencies to invest in projects that reduce air pollution from transportation-related sources.[19]

Though CMAQ is a start, SAFETEA-LU has few freight movement provisions and lacks comprehensive freight movement language. Efforts at regulating greenhouse gas emissions and air pollution from freight transportation vary from state to state. State and national programs that have successfully reduced pollution remain only voluntary.

Federal regulations

Several promising steps have been taken to clean up locomotive, marine and heavy-duty truck engines and fuel. In December 2000, EPA announced its plan to mandate ultra-low sulfur diesel (ULSD) fuel. ULSD reduces sulfur compounds that contribute to acid rain, and allows pollution control devices to function effectively, reducing nitrogen oxides and diesel particulate matter. EPA required ULSD to have a sulfur content of 15 parts per million by weight (ppmw) for on-road vehicles by mid-2006, down from the former 500 ppmw maximum standard. In 2007, EPA also began a slow phase-in of ULSD for non-road vehicles.

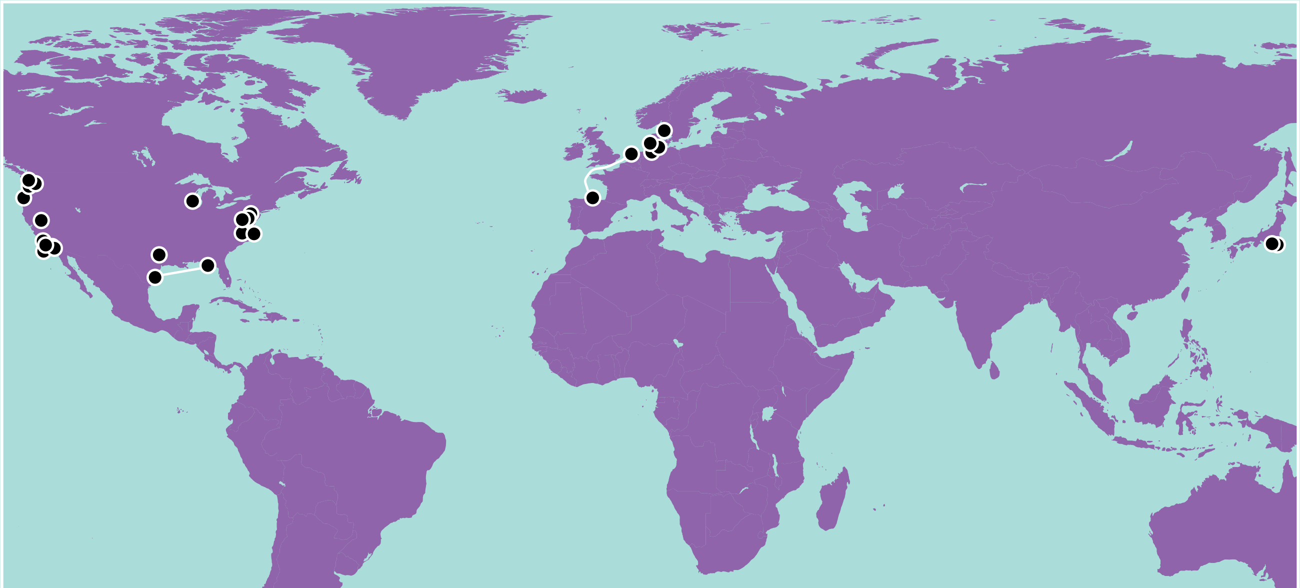
In addition to the ULSD requirements, EPA enacted heavy-duty highway engine regulations in 2001, which were phased in from 2007 to 2010. The rules place stricter regulations on particulate matter, nitrogen oxides and non-methane hydrocarbons and are intended to reduce emissions by 95%.[20,21]

In March 2008, EPA adopted strong emissions limits for locomotive and marine engines. The regulation follows three strategies: it sets more stringent emissions standards for remanufactured locomotive and marine engines; creates standards, phased-in starting in 2009, for newly rebuilt locomotive and marine engines; and sets standards for new marine and locomotives diesel engines beginning in 2014 and 2015, respectively. The new engine standards are based on advanced engine technology that requires ULSD fuel, which will be available nationwide by 2012 for off-road engines.[22]

California regulations

California was an early champion of ULSD standards for diesel fuel, limiting the sulfur content to 500 ppmw beginning in 1993. The standards were amended in 2003 to align with EPA on-road diesel fuel requirements of 15 ppmw. Unlike the federal requirement, the California requirement applied to both on-road and off-road engines, starting in mid-2006.[23]

California has also pioneered regulations for bunker fuel from ocean-going vessels, requiring the use of low sulfur marine distillates within 24 nautical miles (28 miles) of the coastline in main and auxiliary engines. The regulation, applying to both international and domestic vessels, was enacted in July 2008, and will be phased in between 2009 and 2012. By 2012, the rule will reduce sulfur dioxide by 95% and nitrogen oxides by 6%.[24] The International Maritime Organization (IMO), the United Nations agency concerned with the prevention of marine pollution from ships, also adopted more stringent sulfur regulations, and the United States and Canada are set to vote on expanded Sulfur Emissions Control Areas (two currently exist in the Baltic Sea and the North Sea) in March 2010.[25,26] Like EPA's and California's ULSD regulations, these are promising steps but there is room for further reductions and voluntary actions.



Map of case studies

1. Port and corridor cleanup plans

Case study #1: Chicago Region Environmental and Transportation Efficiency (CREATE) Program (Chicago, Illinois)
Case study #2: The Ports of Los Angeles and Long Beach (Los Angeles/Long Beach, California)
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CHAPTER 9

Logistics

Inefficiencies in freight operations contribute to congestion at freight transportation hubs and lead to idling engines and wasted fuel from trucks and trains carrying half-full or empty containers. A typical long-haul truck drives empty for more than 14,000 miles each year, consuming 2,400 gallons of diesel and emitting more than 26.4 tons of carbon dioxide.[1] Smarter supply chain management and logistics can make companies more efficient by optimizing total tons-per-mile performance. These initiatives help reduce total trips, which reduces greenhouse gas emissions, improves air quality and relieves congestion.

Companies can employ a broad suite of strategies to streamline their supply chain and reduce emissions, including route optimization, employee and driver training programs, and contract specifications. Companies are finding that adopting new technologies and employing simpler measures to improve performance benefits the environment, reduces fuel costs and improves customer service. Smarter logistics benefit the environment and the company's bottom line.

Some companies have incorporated several of the logistics concepts described below into comprehensive programs as part of strategies to reduce carbon footprints and meet internal company greenhouse gas and fuel consumption reduction goals.

LOGISTICS CASE STUDY #1

Technological solutions and route optimization

Several devices and other options are available to reduce idling, improve aerodynamics and determine the best route to deliver goods. Some companies have designed vehicles that combine several of these technologies to maximize the benefits. Each technology has varying emissions and greenhouse gas benefits, depending on how much the vehicle is used and the accompanying weather and road conditions.

The following summarizes the technological solutions available to reduce emissions and make the transport of goods more efficient:

- **Idle reduction:** With varying weather conditions and driver comfort needs, simply turning off a vehicle to eliminate idling is often not an option. Instead of running the engine for hours, trucks can be equipped with an auxiliary power unit (APU), a small engine mounted externally on the cab that provides power. There are also automatic engine idle systems that drivers can program to start and stop the truck engine.[2]

- **Vehicle aerodynamics:** Aerodynamic drag from wind resistance decreases fuel efficiency, especially for vehicles that travel long distances. Higher speeds and longer distances mean greater losses. Roof fairings, cab extenders, side fairings and other devices can be installed to streamline the profile of the tractor. For the trailer, reducing the gap between the trailer and the cab, as well as installing side skirts, are options that improve aerodynamics.[3]

Advanced vehicle aerodynamics, like rear fairings and side skirts, as well as other technological solutions improve fuel economy and save money."

- **Tire options:** Improperly inflated tires increase rolling resistance and waste fuel. Automatic tire inflation systems monitor and continually adjust the level of pressurized air in the tires, even while the truck is on the road.[4] Another option to decrease rolling resistance is to use single wide-based tires. A single wide-base tire and wheels are lighter than the typical two standard tires and wheels.[5]
- **Route optimization:** Computerized routing, scheduling software and global positioning systems (GPS) allow drivers to determine the most efficient routes, minimize the chances of getting lost, keep track of pickup and delivery schedules, and find out about adverse weather or traffic conditions. These technologies reduce unnecessary idling at loading docks and in traffic, and often reduce the distance driven, all of which result in fuel savings.[6]
- **Advanced vehicles:** Several companies are using vehicles that incorporate GPS and routing technology software, alternative fuels and other fuel saving technologies on an experimental basis. Many of these projects have yet to be deployed on a fleet-wide level.[7]

Environmental benefits

- **Idle reduction:** APU systems and the amount of emissions they produce vary. Battery-electric APUs are the cleanest, followed by diesel-electric hybrid APUs.[8] Diesel-powered APUs are the dirtiest, though their emissions can be reduced if installed on a 2007 or newer vehicle, and the APU is either retrofitted with a particulate matter control device or the APU exhaust is rerouted through the truck's particulate trap retrofit system.[9] The systems also prevent additional wear-and-tear on the engine, reducing vehicle maintenance costs.[10]
- **Vehicle aerodynamics:** Compared to a classic profile tractor, a streamlined profile tractor with aerodynamic devices can improve fuel economy by up to 15%, saving up to 2,430 gallons of fuel annually and eliminating more than 5.5 tons of greenhouse gas emissions.[11]
- **Tire options:** Automatic tire inflation systems can improve fuel economy by 1% and reduce greenhouse gas emissions by 1.1 tons annually. Properly inflated tires also have a longer

life, which reduces overall tire expenditures and improves vehicle safety. Single wide-base tires can reduce more than 4.4 tons of greenhouse gas emissions a year and result in fuel savings of 2% to 5%.[12]

- **Route optimization:** Route optimization technologies vary widely, so it is difficult to determine precise emissions benefits. However, a simple 5% idling reduction through improved routing and loading practices could save 100 gallons of fuel and reduce greenhouse gases by 1.1 tons per year.[13] Ryder Trucking, for example, offers RydeSmart, a GPS fleet location, tracking and vehicle performance management system. The system allows Ryder to refine route design, detect engine inefficiencies and measure driver performance and vehicle efficiency by monitoring speed, hard breaking and idling. RydeSmart uses Teletrac software and PanaStream's instructional service. This collaboration has reduced fuel consumption between 10% and 15% per truck per day.[14]

- **Advanced vehicles:** These vehicles often use advanced engines, such as electric or hybrid-electric, and alternative fuels such as biodiesel as part of their overall strategy to reduce emissions and fuel costs. The fuel used largely determines the emissions benefits, with the additional GPS system, aerodynamic devices and other technologies only adding to the emissions benefits. For example, DHL, the global freight and mail carrier, recently began the SmartTruck project, which uses dynamic route planning and live traffic data. So far, SmartTruck has achieved the hoped-for 6% reduction in fuel consumption and carbon dioxide emissions. DHL also has incorporated hybrid diesel-electric vehicles into its fleet. The company expects to use up to 20% less fuel and produce 20% fewer carbon dioxide emissions.[15]

LOGISTICS CASE STUDY #2

Eco-driving

The emissions benefits of driving a new or well-maintained used truck are often negated by driving style or by a driver not knowing how to properly operate on-board technology. Training programs that teach drivers how to maximize fuel economy and use advanced technology systems are an important part of improving logistics and reducing emissions. Changes in personal driving habits and behaviors can be challenging to achieve, but company policies, combined with on-the-ground educational programs, can help with the transition, often for a low cost.

- **Training programs:** Driving techniques to maximize fuel efficiency include reducing speed, minimizing or eliminating hard braking and reducing air-conditioning use. Volvo Trucks North America, for example, launched their Fuelwatch Initiative beginning in 2009. One of the major components of the initiative is to provide Volvo customers with Performance Guides on how to best operate their vehicles. These guides help customers keep up with scheduled maintenance. Each of

Wikimedia Commons

Driving behavior can be an impediment to fuel reductions; small changes to driver habits can make a big difference for a small cost.

Volvo's five sales regions have driver trainers, who work with fleets on the best ways to increase fuel economy.[16]

- **Company policies:** Improved company practices include initiatives that limit idling, have loading specifications, require routine vehicle and tire maintenance, and allow for flexible loading and receiving schedules. One company that has actively changed its policies to improve fuel economy is EA Logistics. EA Logistics is a Bensenville, Illinois–based domestic and international freight forwarder with services that include trucking, air freight, ocean freight and warehousing. EA Logistics also has five of its own vehicles. Some of the measures include enforcing an anti-idling policy both at their own loading dock and for all of their drivers. They also train drivers on eco-driving, tire pressure monitoring and methods to consolidate loads and reduce packaging. EA Logistics also requires that drivers drive at or under 60 mph.[17]

Environmental benefits

Some estimates suggest that driver training and monitoring programs can improve fuel economy by at least 5% per year and eliminate 8.82 tons of carbon dioxide emissions annually.[18]

LOGISTICS CASE STUDY #3

Contract specifications

Many freight transport companies subcontract their vehicles or work with a variety of vendors to deliver goods. Contract specifications that encourage or require external parties to employ the practices listed in Case Studies 1 and 2 in this chapter represent a huge opportunity not only to reduce emissions, but to educate others on how to improve a company's fuel economy and bottom line. Companies that already employ certain fuel-saving practices can be given a competitive advantage over those that do not, further encouraging companies to find ways to become more environmentally friendly.

- EA Logistics is one company that actively works with vendors to adopt responsible prac-tices in their operations. For example, EA Logistics worked with one of its shippers to

Technologies alone won't reduce emissions; partnerships are crucial.

reduce the air in their packaging, allowing more cargo to fit on the truck trailer. Since hauling full loads saves fuel and increases company profit, EA Logistics has integrated maximization of load capacity into its business model.[19]

- Subcontracting is a major part of DHL's operations profile. DHL has begun negotiations with its subcontractors to improve efficiencies and reduce emissions, at the lowest costs, wherever feasible.[20]
- Ryder Truck's RydeSmart service is written into all of its new contracts, and the company is working with existing customers to amend their contracts to include RydeSmart.[21]

Environmental benefits

All of these initiatives do have sound environmental benefits; however, they vary greatly by company, contract specification and fleet characteristics, making it difficult to estimate overall emissions and fuel benefits at this time.

Conclusion

The case studies highlighted in this report represent a small portion of projects around the world that are making the freight sector cleaner and more efficient. They prove that workable alternatives exist. These projects often involve multiple stakeholders and economic interests joining to implement creative initiatives that go beyond what is mandated to reduce greenhouse gases and criteria pollutants.

Trade is the lifeblood of the global economy, and freight movement is the backbone of the system. In the coming decades, global trade is predicted to increase. We need a system that accommodates increased trade without burdening the environment and public health. The current U.S. and global freight network needs to be modernized, and it needs to be done in ways that are smart, efficient, and clean.

Examples like those cited in this study should not remain innovations; they should become universal practices. Federal and state transportation funding programs—including the federal transportation bill—provide opportunities to make this happen. To green freight movement, spur innovation and develop a freight system for the future, these programs should prioritize spending in a way that:

- Identifies important freight corridors and hubs;
- Ensures planning for cleaning up freight transportation's emissions and other environmental impacts in those hubs and corridors;
- Implements those plans and reduces freight transportation's environmental impacts even as the sector grows; and
- Continues to advance innovation and cleaner technologies and practices, including the funding of demonstration projects.

Port of Long Beach

We need policies that can support a growing freight system without harming our environment and health.

This report highlights freight movement reforms that do not jeopardize—and in some cases even improve—a company's financial performance. With the right policies, innovations like those reported here can be adopted on a broader basis to benefit the environment and the economy.

Chapter 8: Truck stop electrification (continued)

[4] Kevin Downing, Oregon Department of Environmental Quality, personal correspondence with author, November 2009.

[5] "Governor Kulongoski Launches Project to Curb Diesel Emissions on I-5," State of Oregon Press Release, September 30, 2004, http://governor.oregon.gov/Gov/p2004/press_093004.shtml (accessed October 2009), and "Reduced Idling at Truck Stops: A Truck Stop Electrification Project on Oregon's I-5," State of Oregon Department of Environmental Quality, September 23, 2004, http://www.orsolutions.org/docs/TSE_FactSheet.pdf (accessed October 2009).

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[7] "Reduced Idling at Truck Stops: A Truck Stop Electrification Project on Oregon's I-5," State of Oregon Department of Environmental Quality, September 23, 2004, http://www.orsolutions.org/docs/TSE_FactSheet.pdf (accessed October 2009).

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[12] Ibid.

[13] Ibid and "Reduced Idling at Truck Stops: A Truck Stop Electrification Project on Oregon's I-5," State of Oregon Department of Environmental Quality, September 23, 2004, http://www.orsolutions.org/docs/TSE_FactSheet.pdf (accessed October 2009).

[14] Joe Zeitsman et al., "National Deployment Strategy for Truck Stop Electrification," Texas Transportation Institute, 2006. http://tse.tamu.edu/pdfs/Truck%20Stop%20Electrification%20Paper.pdf (accessed December 2009).

[15] Ibid.

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Chapter 9: Logistics

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