Ports at the Forefront

ACEEE Topic Brief

November 2021

Some of the greatest concentrations of freight activity in the world occur at ports. With this activity comes a range of challenges, including high emissions of local pollutants and greenhouse gases, extensive vehicle congestion, and sporadic labor conflicts. These challenges have pushed ports to actively pursue new solutions, however. They have long been used as test beds for low-emission vehicle technologies and fuels, and today many are working to electrify the fleets that serve them. Ports also are pursuing operational strategies to improve efficiency, including approaches based on information and communications technology (ICT). ICT tools can use real-time data and dynamic analytics to help ports alleviate congestion, reduce emissions, and save energy. A cleaner, quieter port will save money for its operators and users and be a better neighbor to the surrounding community.

Efficiency and Emissions Reduction Opportunities

Approaches to optimizing goods movement at ports include

- efficient use of equipment by minimizing idling, circuitous routing, empty miles, and suboptimal loading
- increased use of energy-efficient modes such as rail and barge to access the port
- electrification of equipment and vehicles

Emerging ICT tools will allow further streamlining of operations and facilitate low-emissions movement of goods that pass through the facility.

Environmental and Community Benefits

Ports and other intermodal facilities are important centers of economic activity. Historically, they have also been sources of pollution and noise, both of which can have severe impacts on surrounding communities, which are often low-income populations and people of color. Many ports have substantially reduced emissions of local pollutants harmful to respiratory health such as particulate matter (PM) and oxides of nitrogen (NOx), largely by controlling the emissions of their vehicles and equipment and in some cases by switching to alternative fuels. Ports have much further to go to address the problem, but federal and state policies will result in additional major reductions in total emissions of NOx and PM in the coming years. The U.S. Environmental Protection Agency (EPA) estimated that total port NOx emissions would decline 23% from 2011 levels by 2020 and 50% by 2030 based on policies and programs already in place.[1]

In contrast, port-related greenhouse gas (GHG) emissions have increased over time and are expected to continue their upward trajectory absent major new policies. The EPA estimated that total port carbon dioxide (CO_2) emissions would increase 22% from 2011 levels by 2020 and 59% by 2030 in a business-as-usual scenario.*

Savings Beyond Port Boundaries

The vast majority of emissions associated with the movement of goods that pass through a port occur not on port premises but during other segments of their journey.[2] Due to the high freight volumes and the convergence of multiple modes of transportation within their limits, ports help shape the networks and practices that move goods throughout the regions they serve. They influence emissions levels far beyond their boundaries through their users' decisions regarding mode of transport, vehicle type, loading, and routing for regional or cross-country trips originating at the port. Ports' indirect influence can extend still further through their development and demonstration of new data systems and tools that can make their way through the entire freight system over time.

Case Study: San Pedro Bay Ports

While port GHG emissions nationally have yet to show the downward trends seen in their local air pollutant emissions, the San Pedro Bay ports in Los Angeles and Long Beach, California, are making considerable progress in reducing GHG emissions. In their 2017 *Clean Air Action Plan Update*, the ports adopted California's GHG reduction targets (40% reduction from 1990 levels by 2030 and 80% by 2050) for their own facilities.[3] Los Angeles and Long Beach reduced CO_2-equivalent emissions by 15% and 19%, respectively, from 2005 to 2019, even as cargo volumes increased substantially.[4] Long Beach CO_2 emissions by port sector are shown in figure 1. Importantly, these data reflect reductions in port-related emissions not only on site but throughout the South Coast Air Quality Basin, a four-county region that extends at least 40 miles from the ports in all directions.

* The EPA's 2016 *National Port Strategy Assessment* did not include reductions in dray truck emissions resulting from the agency's heavy-duty vehicle greenhouse gas standards.

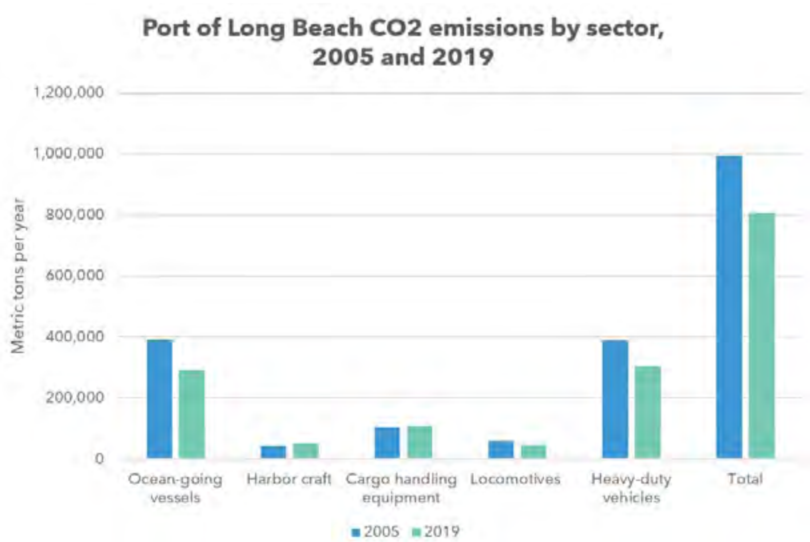


Figure 1. Port of Long Beach CO_2 emissions by sector, 2005 and 2019. Source: Port of Long Beach Air Emissions Inventory–2019.

Much of this progress is due to cleaner equipment and vehicles. Electrification is increasingly playing a role, with opportunities including shore power for oceangoing vessels and battery or hybrid electric cargo-handling equipment, locomotives, and drayage trucks. Electrification eliminates direct emissions from the vehicle or equipment and greatly reduces emissions overall when the source of electricity is clean. The ports' Clean Air Action Plan set a goal of 100% zero-emissions trucks entering and exiting their facilities by 2035; 100% zero-emissions drayage trucks by 2035 is now a state goal as well.[5]

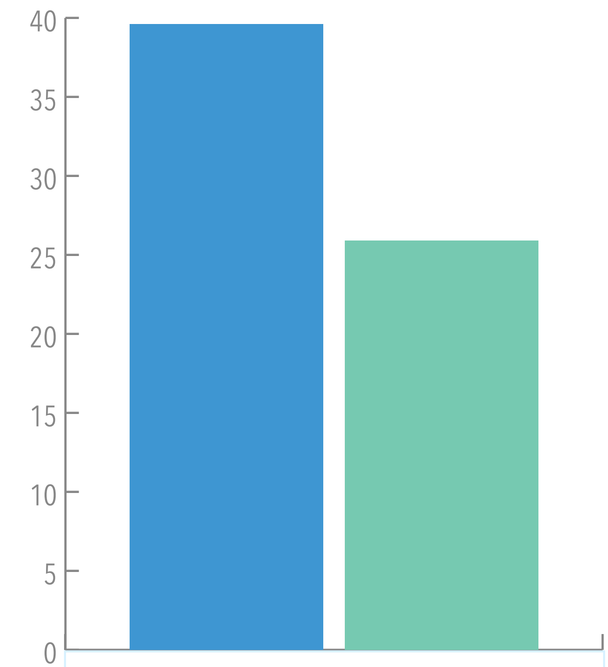
OPERATIONAL STRATEGIES

The San Pedro Bay ports are improving operational efficiency by investing in rail infrastructure through the complex. They plan to accommodate 35% of cargo leaving the ports by rail by 2035 and 50% by 2050, up from 23.5% in 2016. Steps to achieve these goals include expanding support for on-dock rail facilities and investigating the potential to establish short-haul rail service to warehousing and distribution centers in the Inland Empire region to the east.[6]

In the area of ICT-based efficiency improvements, the ports undertook two projects for trucks moving containers through the Los Angeles-Gateway region:

- Freight-Specific Dynamic Travel Planning and Performance, permitting dynamic routing and performance monitoring
- Intermodal Drayage Operations Optimization, promoting container load-matching and freight information exchange to minimize "bobtails" (tractors returning to base with no trailer) and wasted miles**

An early assessment showed that the projects produced a 35% drop in average miles driven per order (figure 2).[7]



	September 2013	June 2014
Daily Miles/Order	**39.6**	**25.9**

Figure 2. San Pedro Bay container movement projects–average daily miles per order before and after (preliminary results).

** These projects were prototypes for the U.S. Department of Transportation's Freight Advanced Traveler Information System (FRATIS).

DrayFLEX, a freight data-sharing project led by the Los Angeles County Metropolitan Transportation Authority and focused on the I-710 South Corridor serving the San Pedro Bay ports, builds on the earlier projects. DrayFLEX will provide information from marine terminal operators, trucking companies, and traveler information services to allow dynamic freight movement planning, including routing, gate appointment scheduling, and empty container pickup.[8] In addition, the Port of Los Angeles and several of its users are engaged with GE Transportation in implementing the company's Port Optimizer tool, a cloud-based container data portal designed to advance supply chain integration and allow predictive analytics.[9]

Case Study: Port of Rotterdam

Several European ports are well along in deploying ICT to improve efficiency. The Port of Rotterdam, the biggest in Europe, aspires to the title of "world's smartest port" and regards a digital transformation as central to its future. Rotterdam digitalization initiatives encompass both control and management of operations on site and facilitation of the exchange of supply chain information among port users.[10] The port offers multiple software tools oriented toward reducing emissions as well as increasing efficiency. One of these is PortXchange, an application using standardized data shared by shipping companies and port service providers to optimize port calls, cutting idling emissions and freeing up port capacity. A PortXchange pilot demonstrated 20% savings in ships' waiting time.[11]

Rotterdam is a champion of "synchromodality"—flexible multimodal transport in real time. This idea, which is key to shifting toward more energy-efficient freight modes, depends greatly on ICT to supply and act on operational data in real time. For example, the port's Navigate tool shows shippers all connections via Rotterdam by deep sea, short sea, rail, or barge, enabling route optimization for CO_2 emissions, among other parameters.

Global context:

In 2021 the port authorities of Antwerp and Singapore hosted 19 port authorities from around the world at a roundtable to discuss best practices and areas of collaboration, especially "their levering function to impact the energy transition, digitalization and decarbonization." U.S. participants were the San Pedro Bay ports and the Port of Seattle. A declaration issued at the event highlighted the need for a global, neutral platform like those developed by the Port of Rotterdam to allow multimodal comparison of container routes for sustainability and cost effectiveness.[12]

Challenges

Ports need to make a business case for taking the lead on programs whose emissions-reduction and fuel-savings benefits accrue throughout the regions they serve. But their clients—shippers and carriers—are increasingly concerned with and held accountable for emissions produced throughout the trips they generate. These users, along with the public sector, should be prepared to provide resources for port and tenant actions to promote emissions reductions off-site as well as at the port proper. Over time, port practices to improve operational efficiency can deliver cost and time savings as well as emissions reductions.

Large segments of the trucking and freight industries are already interested in the efficiencies that new data-driven technologies can deliver, and they are moving aggressively to deploy them. But when these efforts are driven by the private sector alone, the tie-in to emissions reduction can be quite weak. Without this connection, applications of ICT may be deployed to prioritize travel time reduction to the exclusion of other metrics, increasing the share of freight moved by truck and increasing emissions.

Automation: Jury still out

A trend that parallels ICT's takeover of logistics is the automation of ports. Operators have long sought to increase efficiency and reduce costs through automation of operations and equipment such as cranes and yard handlers. Emerging ICT tools are helping to bring down the cost and increase the capabilities of automation, making it more practical for ports.

In some locations the prospect of automation has drawn the opposition of labor due to the potential for job losses, though ports argue that automation can reduce costs without displacing workers. Health and equity advocates have made the case that vehicle and equipment electrification is the best approach to reducing local pollutant emissions and that automation is likely to deliver adverse outcomes for workers and communities near ports absent policies that put people first. These could include engaging affected parties in automation decisions, strengthening workers' rights to organize, improving programs to support workers displaced by automation, and accelerating electrification.[13]

"Public policies and programs enacted by decision-makers at multiple levels of governance are critical to ensure that the future of freight automation promotes health and equity rather than sustaining and worsening problems inherent with the freight system."[xiii]

Source: Irfan Khan/Los Angeles Times***

While improving asset utilization and mode selection through ICT is distinct from the automation of port equipment and operations, there is a substantial overlap of data and tools underlying these two technological approaches to efficiency. Therefore, efforts to improve freight efficiency through ICT applications must likewise guard against strategies that may aggravate ports' negative impacts on workers and neighboring communities.

*** www.latimes.com/business/la-fi-ports-automation-labor-20190321-story.html.

Conclusion

Ports are applying new technologies to add operational efficiencies and strengthen multimodality, making substantial progress toward emissions reduction in the process. These efforts benefit from the support of governments at various levels. An emissions reduction framework within which ports can formulate ambitious programs that are consistent with their business needs is essential. Federal funding, state freight plans, and local government facilitation of stakeholder engagement can all contribute to successful port efficiency and emissions reduction programs.

Digitalization and ICT are coming to the freight sector, but action is needed to ensure that this transformation delivers economic, environmental, and equity benefits simultaneously. Consistent attention to pollution and labor issues is part of being a good neighbor. Careful deployment of advanced technology in both vehicles and operations can help reduce local pollution and greenhouse gas emissions, helping to win support of the community.

Endnotes

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