National Center for Sustainable Transportation

POLICY BRIEF

Cost, Congestion, and Emissions Benefits of Centralized Freight Routing and Efficiencies in Alternative Fuel Freight Modes

Petros Ioannou, Genevieve Giuliano, Maged Dessouky, Pengfei Chen, and Sue Dexter
University of Southern California

August 2020

Issue

International trade continues to increase, with container trade growing at a 9.5% annual rate worldwide and at a 6% annual rate in the United States. Container ships are also getting bigger to meet this growing demand. As a result, cargo is concentrated into the largest ports, which intensifies bottlenecks on the road networks surrounding these ports. Thus, logistics companies are faced with increasing complexity in their operations and increasing traffic congestion that adds costs, as well as greenhouse gas emissions and local air pollution. The transition to zero emission truck technology could add further complexity, requiring companies to plan for electric trucks' shorter ranges and longer refueling times.

Efficiencies could be gained through more balanced use of the road network surrounding ports. When individual users make routing decisions without any coordination, they choose the best routes based on current traffic information without anticipating that other users may do the same. As a result, certain routes may get congested. A centrally coordinated freight routing system that takes into account all user demands and generates individual routes to balance freight loads across the network could reduce congestion for all users, thereby minimizing costs and emissions.

Researchers at the University of Southern California developed a centrally coordinated freight routing system and ran several simulations to minimize the social costs of freight transportation, also accounting for adoption of electric trucks. The researchers also interviewed several individuals with responsibility for trucking operations in the Los Angeles region to better understand the implementation issues of a centrally coordinated freight routing system.

Key Research Findings

Simulations showed that a centrally coordinated freight routing system can reduce costs, traffic congestion, and emissions compared to current practice. Researchers tested the load balancing approach under three different scenarios—congestion limited to a particular highway segment, congestion across the road network, and reduced highway capacity due to lane closures—and found consistent cost savings across all three compared to individual route planning (Figure 1).

A centrally coordinated freight routing system can continue to produce benefits as electric trucks are added to the fleet. Simulations showed that the centralized system reduced costs by 5% for fleets incorporating electric trucks compared to individual route planning, with even greater savings possible as traffic conditions worsen. While fleets that incorporate electric trucks produce clear emissions benefits, the operational cost of electric trucks is not consistently lower than that of diesel. This is mainly due to the drivers' cost of time waiting for batteries to charge. This cost may be reduced or eliminated if charging is scheduled during non-working hours.

A centrally coordinated freight routing system can also be used to minimize empty container movement, further reducing costs and emissions. The system can be used to coordinate container demand, facilitating transfer of empty containers between importers and exporters without the need to return to the port in between.

Interviews with trucking companies suggested several barriers to implementing a centralized load balancing system. While eager to reduce congestion, interviewees expressed concerns that a centralized system would reduce their competitive advantage and take away firms' control over their business, particularly with regard to making on-time deliveries. They also expressed concerns over potential disruptions to drivers' tightly regulated work days and breaks. However, most interviewees said they would be willing to try the scheme if the benefits were clear.

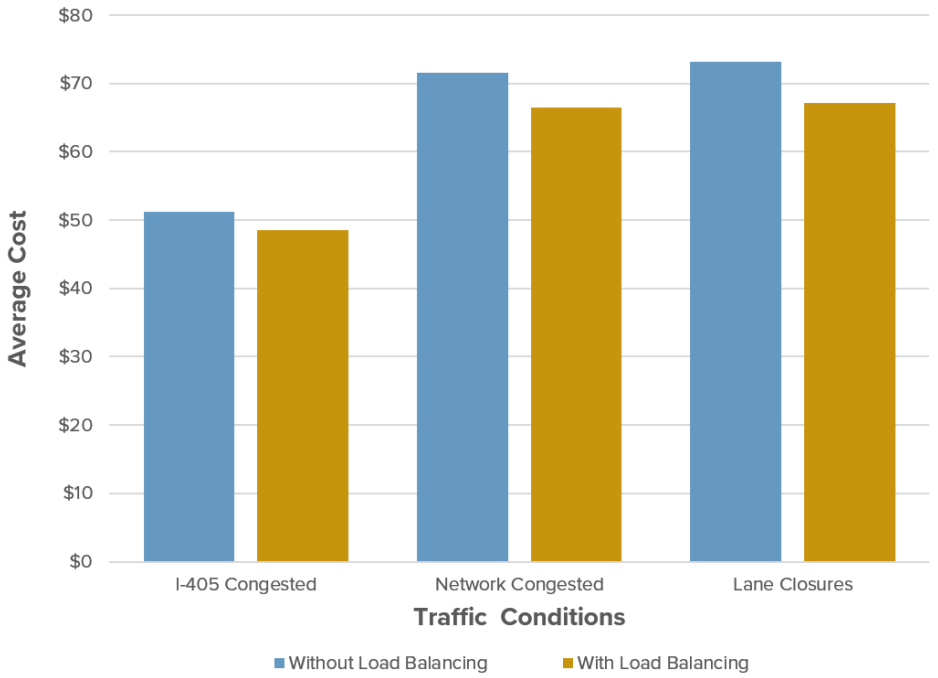

Figure 1. Cost of freight travel under three scenarios—congestion on a segment of I-405, congestion across the road network, and reduced highway capacity due to lane closures—under an individual route planning system compared to a centrally coordinated load balancing system.

Policy Implications

There are clear potential cost, congestion, and emissions benefits of centralized freight routing. However, trucking companies appear hesitant to try a new system. An iterative approach could be used to address concerns and prove the system's benefits. Trucking companies that already work collaboratively through associations and vertical markets would be a good start. These clusters of firms that have established working relationships and trust could demonstrate positive results and entice others to join.

More Information

This policy brief is drawn from "Freight Load Balancing and Efficiencies in Alternative Fuel Freight Modes," a report from the National Center for Sustainable Transportation, authored by Petros Ioannou, Genevieve Giuliano, Maged Dessouky, Pengfei Chen, and Sue Dexter of the University of Southern California. The full report can be found on the NCST website at https://ncst.ucdavis.edu/project/freight-load-balancing-and-efficiencies-alternative-fuel-freight-modes.

For more information about the findings presented in this brief, please contact Petros Ioannou at ioannou@usc.edu.

The National Center for Sustainable Transportation is a consortium of leading universities committed to advancing an environmentally sustainable transportation system through cutting-edge research, direct policy engagement, and education of our future leaders. Consortium members: University of California, Davis; University of California, Riverside; University of Southern California; California State University, Long Beach; Georgia Institute of Technology; and the University of Vermont.

Visit us at ncst.ucdavis.edu

Follow us:

DOI: 10.7922/G2H41PQD