Leveraging Digital Freight Networks to Reduce Emissions

January 2024

KEY FINDINGS

- Usage of digital freight networks (DFNs), which pool data to match shipments to trucks, can provide several benefits, including added capacity, improved efficiency, and lower costs to shippers and carriers.
- DFNs have the potential to reduce energy consumption and emissions, but these reductions are not generally prioritized by shippers and not widely quantified and shared.
- Maximizing the benefits of DFNs requires a coordinated effort by policymakers and industry. In addition to setting emissions targets specific to the freight sector, federal policymakers should take the lead by including energy and emissions concerns in the development of data-sharing standards to facilitate greater understanding of the impacts of DFNs.

Glossary

Term	Definition
Capacity	Capacity refers to the amount of truck space, equipment, and labor (including drivers) available to haul cargo.
Carriers	Carriers are companies that are contracted by shippers to haul goods. Asset-based carriers are carriers that use their own fleet of trucks, and often their own equipment, to transport shipments.
Digital freight brokers	For the purposes of this brief, digital freight brokers are companies that use technology, including DFNs, to work with shippers and carriers in a way that can improve freight efficiency. Among other things, freight brokers help shippers find the appropriate carriers for their needs while helping carriers find cargo to haul.
Digital freight networks (DFNs)	Digital freight networks are technologies that pool data to match shipments to trucks in a way that can improve freight efficiency.
Empty backhauls	Empty backhauls occur when trucks, after dropping off a shipment, make a return trip with no cargo.
Empty miles	Empty miles occur when a truck has no load to bring back after a drop-off or between drop-offs and pick-ups on a multi-leg trip. Empty backhauls contribute to empty miles.

Term	Definition
FTL shipping	Full truckload (FTL) shipping is used by companies with larger shipments and involves reserving the entire truck or trailer for one shipment. Although the full capacity is reserved, this does not always mean that the full capacity is used.
Load factor	Load factor refers to the proportion of a truck's capacity that is taken up by cargo. For example, if a truck has a load factor of 47%, then 47% of its total capacity is being used.
LTL shipping	Less than truckload (LTL) shipping is used by companies with smaller shipments and involves reserving only some of the space in a truck or trailer, and sharing the vehicle with shipments from other companies.
Shippers	Shippers are companies that sell goods. Shippers often have their own truck fleets and equipment, or work with carriers to move their goods.
Tender	Tenders are requests by shippers for carriers to provide quotes on moving freight. The tender usually includes information like type of cargo, timelines, origin and destination locations, shipment weight, and any special service requirements.
Volatile lanes	Volatile lanes are origin-destination pairs that a shipper is looking to move cargo on or is already moving cargo on, and that are difficult for carriers to cover. They are challenging for carriers because the volume of cargo that the shipper intends to put on these lanes is low, inconsistent, or uncertain.

Introduction

This brief is designed for freight industry stakeholders, including policymakers, who are looking to understand the potential impact of digital freight networks (DFNs) on freight efficiency and emissions in the United States. It includes information about how such stakeholders can play a role in guiding this technology to support national climate goals.

The freight sector is responsible for 31% of total U.S. transportation emissions and over 8% of total U.S. greenhouse gas (GHG) emissions (DOT 2021). While heavy-duty vehicle electrification, improvements in fuel economy, and smart use of connected and autonomous vehicles will be critical to reducing emissions over the long run, optimizing the movement of goods through information and communications technology (ICT) can help achieve substantial and more immediate reductions and continue to slash emissions as fleets transition to electric vehicles. ICT technologies can improve load factor by optimizing the organization of goods within trucks, increase fuel efficiency by pairing aerodynamic tractors with compatible trailers, and facilitate the use of more efficient modes like rail and water shipping (Mersky and Langer 2021).

This brief focuses on ways in which DFNs—a form of ICT—can improve trucking efficiency and reduce miles driven. At the most basic level, DFNs pool data from carriers and shippers and match shipments to trucks. This allows shippers, carriers, and freight brokers to coordinate shipments in a way that can save energy and reduce emissions. Use of this technology is outlined as one solution in the National Blueprint for Transportation Decarbonization, which was jointly released by four U.S. federal agencies in 2023:

> Transportation systems operations can be improved and optimized to reduce energy use and emissions. For example, better logistics could increase ... load factors, improving efficiency while also reducing fuel costs. New technologies can help improve ... logistics and enable the use of shared transport assets and services, and more effectively respond to changes or unexpected delays using real-time data. (DOE 2023)

To dig deeper and explore the extent to which DFNs can help achieve climate and energy goals, we worked with Bill Loftis at Supply Chain Ecology to interview 18 freight industry professionals, including two carriers, four digital brokers, four shippers, four technology providers, and two consultants. Interviewees were asked about their business models, how their technology works, reasons for using DFNs, performance results around empty miles and emissions reductions, the future of DFNs, and other aspects of the technology. Their insights informed the bulk of the information presented below. While this brief focuses on trucking efficiency, it should be noted that DFNs can also optimize freight movement across modes, including rail and waterborne shipping.

Reducing Empty Miles

While most truck freight is handled by shipper-owned fleets and large for-hire carriers, digital freight brokers have been increasing in popularity among shippers seeking to reduce administrative costs, cover volatile lanes, and increase capacity (Verified Market Research 2022). Shippers often struggle to find carriers that will cover volatile lanes, which have low or inconsistent volume. However, when a nutrition products company developed a pilot program using digital brokers alongside their core asset-based carriers, they found success not only in general capacity enhancement, but also in quickly finding coverage for volatile lanes. One major home improvement retailer primarily uses core carriers, but takes advantage of digital brokers to improve administrative efficiency for loads that cannot be optimized with their transportation management system, or that they cannot find coverage for. While these companies are not strictly using DFNs to reduce emissions, the carriers transporting these loads may be using DFNs to find loads from other shippers for their return trips, thereby eliminating the empty backhauls that would have occurred if the shipper used its internal fleet.

Uber Freight, an enterprise technology company, has successfully reduced empty miles leveraging its DFN. Uber Freight's platform is able to accept tenders from shippers and offers them to drivers based on several criteria, including proximity of the truck to the shipper. This technology can reduce empty miles by opting to only show tenders to drivers within a certain range of the pickup point. Uber Freight estimates that with perfect optimization of the U.S.

freight network, achieved in part through the use of DFNs, empty miles could be reduced by up to 64% (Uber Freight 2023).

Another major home improvement retailer also identified a solution to empty backhauls by partnering with a freight technology company to find other shippers interested in using their dedicated fleet. The two companies launched a platform to offer capacity to participating shippers on truck trips that would otherwise be an empty backhaul. The platform reads information like truck location and destination to match trucks with shipments at reduced rates. This means that the retailer can generate revenue from an underused truck while providing an affordable service to other shippers and minimizing empty miles. Through this platform, the retailer facilitates movement of over 12,000 loads per month.

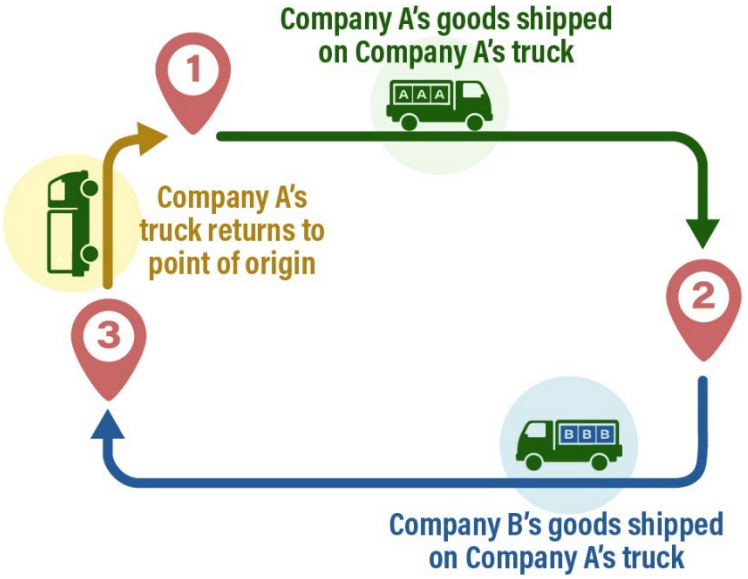

Figure 1. Companies that typically use internal fleets or core asset-based carriers can reduce their empty miles by working through DFNs to identify loads from other companies to transport on their return trips

Improving Load Factor

Increasing load factor is another key strategy for reducing freight emissions. On average, trucks that are not driving empty only carry about 57% of their capacity (Langer 2021). Trucks carrying only a small volume of goods over long distances are emitting a large quantity of CO_2 emissions relative to the amount of product shipped. Some digital freight brokers can consolidate loads from multiple shippers onto a single trailer to improve load factor. This differs from typical less-than-truckload (LTL) shipments because trips are more direct, stopping at fewer hubs along the way.

Flock Freight, a certified B Corporation (a company that meets certain social, environmental, and governance standards) and a leader in freight technology, offers a more sustainable shipping

option than LTL or full truckload (FTL) shipping through what it calls "shared truckloads" (STL). When shippers issue tenders into Flock Freight's platform, the technology calculates pricing estimates based on the probability that the shipments can be pooled. When tenders are accepted, the network creates a shipment plan for a single truck that enables pooling when possible. With more direct routing and improved load factor, Flock Freight estimates that sharing loads in this manner reduces GHG emissions by 15% to 40% (Flock Freight 2022). Additionally, from January through July of 2023, Flock Freight's customers in the food and beverage industry avoided 7,408,111 pounds of CO_2e through the company's shared truckload solution, FlockDirect™.

Flock Freight calculates its average emissions savings of 15% compared to LTL shipping and 40% compared to FTL shipping using data from SmartWay, the Environmental Protection Agency, Oak Ridge National Laboratory, the Sustainability Accounting Standards Board, and Greenhouse Gas Protocol, in addition to data from its customers. The company publishes its methodology online and updated it in 2022 to account for more recent data (Flock Freight 2022). This effort to quantify and share information on emissions savings from technology provides a useful model for similar providers to follow and expand on. More case studies to determine emissions impacts could allow companies, researchers, and policymakers to direct investments toward the most promising freight efficiency enhancements.

While the digital freight brokerage market has gained significant traction over the past decade, interviews with DFN providers and users indicate that multi-shipper load sharing remains a less commonly used solution. ArrowStream, a supply chain technology provider, works with companies to consolidate their loads into fewer trucks by modifying their purchasing patterns. The company previously worked to align purchasing patterns across multiple shippers, but found that this was much more logistically challenging than working with shippers individually. Therefore, ArrowStream focuses on optimization within each company.

Challenges to Reducing Emissions through Digital Freight Networks

Despite the growth of DFNs, barriers to more widespread use of this technology remain. Some of the shippers we interviewed noted that using DFNs was seen as unrealistic for transporting most of their volume due to the need for carriers that can accommodate specific requirements. For example, some look for carriers that can meet safety compliance requirements when transporting materials like flammable gases. Some need carriers that offer drop trailer capabilities (i.e. having the driver leave the trailer with the shipper so the shipper can load or unload it on their time) or have high insurance coverage. Finding and connecting shippers to carriers that meet all of their service requirements will be key to unlocking broader utilization of DFNs.

Additionally, reducing emissions is often not the driving factor behind shippers using DFNs. Added capacity, rather than sustainability, was generally cited as the primary reason for turning

to this technology. For example, two of our interviewees sought a solution to increase capacity, and our interviews with technology providers indicated that optimization to reduce emissions was not demanded by shippers. As a result, comprehensive data on the emissions impacts of using DFNs are not widely available. Without more data on emissions baselines and a consistent methodology for companies to track emissions reductions, it is challenging to estimate the level of impact widespread adoption would have on emissions and compare it to other freight efficiency strategies.

Policy Recommendations

Maximizing the benefits from the growing adoption of DFN applications requires a coordinated and concerted effort by policymakers, industry players, and other stakeholders. The U.S. Department of Transportation (DOT) and other federal agencies can work to support the Biden administration's goal of reaching net-zero emissions by 2050 through various regulatory measures. For example, the U.S. Securities and Exchange Commission (SEC) proposed a rule in March 2022 that would require publicly traded companies to disclose its Scope 1 and 2 GHG emissions. Although a final rule has not yet been released, this requirement would lead to significant shifts in the level of emissions tracking and reporting done by large asset-based carriers and shippers with internal fleets. The rule would also require public companies that have set emissions targets that include Scope 3 emissions to report on these emissions; however, requiring all public companies to do this would push them to quantify these emissions and uncover potential emissions savings through various strategies, including adopting DFNs. The SEC's proposal has not yet not been finalized, and may undergo several changes before publication of the final rule.

Additionally, the Federal Highway Administration (FHWA) has taken a significant step by requiring states and metropolitan planning organizations (MPOs) to set targets for transportation GHG emissions reduction and track progress. However, the rule simply mandates that states set declining targets, rather than requiring a specific level of reduction, and does not contain any consequences for not meeting targets (FHWA 2023). FHWA should go a step further by requiring emissions reduction targets in line with national climate targets, reducing federal funding for bodies that repeatedly miss targets, and requiring targets specific to the freight sector. Targets for freight transportation would help spur data gathering and adoption of freight efficiency strategies like using DFNs.

In May of 2023, DOT launched the nation's first multimodal freight data exchange in collaboration with 53 member companies, including shippers, carriers, digital freight brokers, and other stakeholders. This data exchange allows participants to share and view anonymized and aggregated data on total incoming container demand and availability of tractors, warehouse space, and other assets (DOT 2023b). DOT can strengthen the impact of this data exchange by increasing the types of data that participants can share, including data on origin-destination pairs, average load factor for carriers, and emissions reductions tied to specific efficiency improvements, including those achieved through DFN adoption.

Finally, state and local governments can also take advantage of new federal funding opportunities like the Strengthening Mobility and Revolutionizing Transportation (SMART) grants program (DOT 2023a) to spur technological innovation among shippers, carriers, technology providers, and freight brokers. Funding from the SMART program is competitive and can be used to improve freight efficiency through digitization of information. For example, the Michigan Department of Transportation (MDOT) received $1.8 million in FY22 funding to reduce freight congestion around the Blue Water Bridge by piloting a data-sharing project. According to MDOT, the project will "improve the flow of data between shipping companies, vehicles, border agencies, and infrastructure operators along this key international freight corridor" (MDOT 2023).

Conclusion

DFNs have the potential to improve the efficiency of the freight system while simultaneously cutting costs for shippers and carriers, but more comprehensive and standardized data on empty miles reductions and improved load factor is needed to determine the actual impact on freight emissions. The federal government should play a leading role in encouraging the industry to collect and share these data, in addition to enhancing its freight data exchange and setting targets that will ensure we reach net-zero emissions by mid-century. Meanwhile, state and local governments should seek out opportunities to facilitate data sharing around major freight hubs and corridors.

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