ACEEE American Council for an Energy-Efficient Economy

SMART FREIGHT SERIES

Maximizing Truck Load Factor

ACEEE Topic Brief

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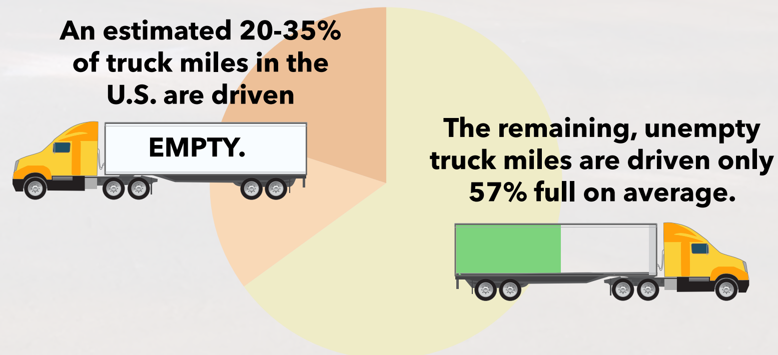
Freight trucks often travel empty or at less than full load. An estimated 20–35% of truck miles in the United States are driven empty.[1] Those that are not empty have an average load factor of 57%—in other words, they are carrying just 57% of their capacity.[2] Consequently, more than half of truck capacity goes unused, increasing the number of miles driven to meet freight demand. Reducing these inefficiencies in trucking is the objective of increasing load factor. Fortunately, the rapid rise of digitized data and the application of information and communication technologies (ICT) in the freight industry are jointly increasing the potential for optimization. The ability to collect location and status information about shipments, vehicles, and infrastructure in real time—and to make these data easily accessible to shippers, carriers, and logistics providers—opens up new opportunities for efficiency.



Opportunities to Increase Load Factor

Efficient loading is fundamental to freight carriers but is subject to constraints. For example, filling a truck to capacity is not effective if it delays time-sensitive loads or causes circuitous routing. Although improving load factor has long been the province of logistics companies, digitized data and ICT tools introduced in the past 10 years have enabled a whole new generation of companies, including tech-based start-ups, to offer tools and services to increase load factor. Digital freight brokerages like Convoy, Transfix, and Uber Freight have proliferated, attracting substantial venture capital. Globally, funding for such enterprises exceeded $2 billion in 2018.[3] To remain competitive in an era of rapid digitalization, legacy freight brokerages and logistics providers also have developed ICT-based tools of their own to improve load factor.

Both shippers and carriers prefer to fill trucks because it lowers costs. Historically, however, filling trucks to capacity has been difficult because it requires locating and combining right-sized complementary loads at just the right time. But with all parts of the freight system, including the items being transported, continuously generating and sharing abundant data, today's ICT tools can facilitate the consolidation of loads to minimize wasted space and wasted miles. A large retailer with its own fleet may use an in-house transportation management system or engage a transportation-as-a-service provider to identify suitable loads in-house, and in some cases to find matching loads for return trips. Software that optimizes the packing of containers can help as well. The Home Depot, for instance, estimates that it has achieved container capacity utilization of 85% using such software, compared with 75% utilization previously achieved without it.[4]

Perhaps most significant, though, is that these new tools may have access to any vehicle with spare capacity traveling between the same origin–destination pair at the same time, regardless of who owns that vehicle. This in principle allows smaller private fleets and carriers to consolidate loads without resorting to slower, hub-and-spoke-based, less-than-truckload (LTL) shipment.* In 2020, 53% of trucks in the United States belonged to fleets of 100 or fewer trucks.[5] The increased ability of smaller companies to consolidate loads is therefore likely to have large energy use implications.

Table 1 outlines strategies to increase load factor that are being implemented in this new ICT-based environment and gives examples of practitioners of each.

Table 1. ICT-enhanced strategies to increase load factor

Strategy	Description	ICT application	Market	Example
Co-loading	Increasing load factor by sharing truck or rail capacity with other shippers on the same route	Dynamic decision-making to facilitate collaboration	Private and truckload fleets	WeDo
Empty mile reduction	Reducing empty miles by load matching	Real-time load matching	Truckload shippers using digital freight brokerage	Convoy, Uber Freight, Transfix
			Drayage operators	Equll, Dray Alliance
Less-than-truckload to shared truckload	Achieving higher load factor and more direct routing by shifting cargo to point-to-point service	Route optimization algorithms	Less-than-truckload shippers	Flock Freight
Last mile	Increasing load factor by crowdsourcing capacity for urban delivery	Real-time trip assignment via mobile app	Urban delivery	Cargomatic
Cube optimization	Improving trailer packing configuration to increase effective volumetric capacity	Loading software	Private and truckload fleets	The Home Depot[6]

* In LTL shipment, multiple shippers' loads are packed together in trailers that travel to hub locations, where loads are unpacked and repacked onto different trailers for travel to the next hub.

Examples

Reducing Empty Miles

Logistics companies and freight load-matching services are being challenged by new companies with no fleets of their own but sophisticated ICT-based products with novel capabilities. Some of these new entrants are zeroing in on the problem of empty backhauls, which occur when a truck has no load on the return trip from a drop-off or, more generally, logs empty miles on a multi-leg trip.

Convoy is a digital network for truckload freight, matching shipper loads to carriers. In 2019 the company launched Automated Reloads, an artificial intelligence–based platform that simultaneously books multiple trip legs for its carriers, reducing empty miles.[7] Convoy estimates that shipments using the platform have produced 45% less CO_2 emissions than they otherwise would have, and that this reduction across the industry would eliminate 32 million metric tons of CO_2 emissions per year.[8]

Similarly, Uber Freight has developed an “algorithmic bundling technology” to string together loads, minimizing empty miles. Judging from customers’ data before and after they adopted the load-bundling service, the technology has reduced users’ empty miles by 22.6%.[9]

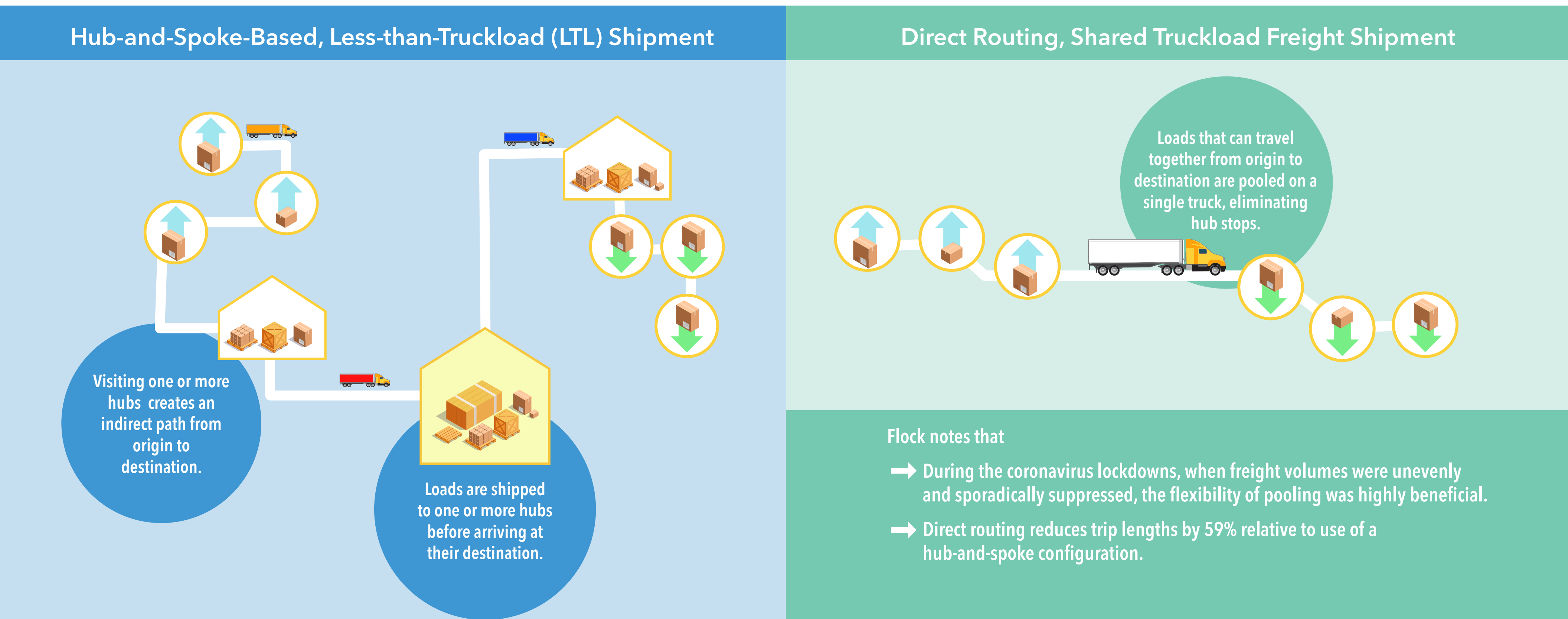
Uber Freight estimates that cutting empty miles in half in the United States would reduce carbon emissions by 40 million tons of CO2 per year.[10]

MOVING TO SHARED TRUCKLOAD

Flock Freight converts LTL freight to shared truckload freight by pooling loads that can travel from origin to destination on a single truck. In LTL service, a load may be transloaded from one vehicle to another as it passes through a freight hub, introducing the possibility of loss or damage. Shippers switching to shared truckload service benefit from the reduced likelihood of loss or damage that this one-vehicle service provides. Furthermore, Flock claims cost savings of up to 20%.[11] Delivery times may be shorter and more predictable as well.

Flock points to the special attraction of pooling during the coronavirus lockdowns: With freight volumes somewhat suppressed, but unevenly and erratically so, the flexibility of pooling was highly beneficial, especially to companies that had come to rely on predictable demand levels to make stocking decisions. Furthermore, because delivery time requirements were at least as stringent during this time as they had always been, shipments were typically smaller, causing shippers to send more partial loads rather than waiting to ship full truckloads.

Converting LTL to shared truckload reduces emissions through shorter routes as well as increased load factor. Flock has found that direct routing reduces trip lengths by 59% relative to use of a hub-and-spoke configuration, although this is partially offset by an increase of 20% in out-of-route miles for the shared truckload vehicles.[12] This implies a net 51% reduction in route miles. Flock states that LTL service accounts for 18% of trucking carbon emissions.[13] Using this figure, we calculate that a shift from LTL to shared truckload could reduce annual U.S. CO_2 emissions by 19 million tons through more direct routing alone.



Challenges

Increasing trucking efficiency has been a principal logistics function for decades. Broadly speaking, the approaches discussed here such as shared truckload and other forms of so-called horizontal collaboration among shippers have been pursued for some time but have had limited success, as noted in the first quote (found in the green box below).

It is the rapid growth of real-time data collection and maturation of ICT tools that create the opportunity to greatly increase load factor in trucking. Optimism on this score is high (see second quote in the blue box below), but success is by no means assured.

> **"For horizontal collaboration in general, failure in 'one off' attempts seem far more common than successes . . . Therefore, while the potential seems to theoretically exist, sustainable implementations yielding measurable impacts are not widely reported." Ferrell et al.**

> **"ABI Research forecasts FaaS [freight as a service] to represent 30% of total goods transportation revenues by 2030, with benefits including cost reductions, resource utilization improvements, and convergence of market landscapes through the adoption of a sharing economy business model." FleetOwner.com**

Data Sharing

Reaching the full potential of ICT-based load factor strategies depends on high visibility into the universe of vehicles, loads, and infrastructure in the relevant shipping corridors. For many players in the industry, however, the detailed data enabling such visibility are sensitive or of high value. Furthermore, freight data formats are not standardized, posing another barrier to the data's wide use. Consequently, data sharing is limited, with some data available only to larger, better-resourced companies.[14]

More extensive sharing of data could create very substantial public and private benefits, however. A neutral party ensuring data security, interoperability of platforms using the data, and fairness to the diverse user groups could promote this outcome.**

**See ACEEE brief on data sharing for smart freight at aceee.org/topic-brief/2021/11/smart-freight-topic-brief-series

Commitment to Emissions Reductions

The cost reduction potential of increasing load factor is considerable, and hence the economic interests of shippers are largely consistent with the energy efficiency gains and emissions reductions these strategies bring. Much of the freight industry continues to strive for ever-shorter fulfillment and delivery times, however, which can create pressure for trucks to be dispatched partially loaded.

> **Even in an era of heightened awareness of climate change and commitments to reduce carbon emissions as a key component of corporate responsibility, suboptimal load factor can be difficult to counteract absent**
>
> 1. **Standardized methods for quantifying and disclosing emissions associated with each trip and load**
> 2. **Pricing on transportation fuels and services that reflects the social costs of carbon emissions**
> 3. **Codified national targets for greenhouse gas emissions reductions and policies to achieve freight sector reductions commensurate with those targets**

Rebound

Economic theory dictates that, all else being equal, the efficiencies of increased truck load factor and the associated cost reductions will result in higher trucking demand. While the magnitude of the effect is open to debate—some analysts argue that freight truck miles are fairly inelastic relative to transport costs—such effects should not be ignored.[15]

Researchers in the Department of Energy's SMART Mobility Consortium modeled the energy impacts of truck load consolidation and found them to be negative in some scenarios.[16] This resulted from trucking cost reductions that would follow from more efficient loading, which in turn would divert to trucks some goods currently traveling by rail. Averting such unintended consequences of efficiency improvements will require heightened commitment to emissions reduction, as discussed in the previous section.

Conclusion

Unused truck capacity is a major, longstanding inefficiency in the movement of goods. The availability of detailed, real-time freight data and new ICT tools can help to address the problem, and the potential for reductions in U.S. CO_2 emissions is substantial. New software and services are increasingly available to raise load factor, and digitalization of trucking is well underway. However, due to competitive pressures and the absence of clear and enforceable GHG reduction targets for the freight sector, these developments are not guaranteed to realize their emissions reduction potential.

Broader sharing of data across the industry, shippers' and carriers' adoption of well-defined and ambitious goals and implementation plans for reducing their carbon footprints, and incentives to reduce inefficient truck miles and increase the use of cleaner freight modes will all be necessary to achieve the full benefits that new data and ICT tools offer. Policies at the federal, state, and local levels have an important role in achieving this outcome.

Endnotes

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