



The Role of Environmental Sustainability in Freight Transportation

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By Jon Chorley, Oracle Chief Sustainability Officer and Group VP SCM Product Management

I recently had the pleasure of attending and speaking at “[The Movin’On Conference](#)” in Montreal, Canada. This annual conference is organized by Michelin, a valued Oracle customer, as part of its commitment to help create the future of transportation. This world summit has been called the “Davos of Transportation” in that it brings together thought leaders from all aspects of the public and private sectors and fosters a free exchange of ideas with the common goal of creating a better path forward. To prepare for my panel session my team collected some material on transportation, focusing on freight transportation, and its impacts on the environment. Their findings were fascinating and illuminating, so I thought I would also share them with you.

HOW IMPORTANT ARE TRANSPORTATION RELATED EMISSIONS?

- Transportation accounts for 64% of global oil consumption, 27% of all energy use, and 23% of the world’s energy-related carbon dioxide (CO₂) emissions.¹
- Transportation accounts for 29% of total United States (U.S.) GHG emissions (2017).²
- Domestic freight (trucking, freight rail, ships and other boats, pipelines, and commercial aircraft) accounts for approximately 30% of total transportation emissions.³
- Business logistics cost as a percentage of GDP is 7-8% in the U.S., 13% in India, and 18% in China.⁴
- Air cargo emits 10 to 50 times more CO₂ than sea freight per metric ton of freight and per km of transportation.⁵

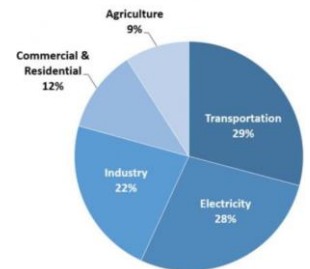
Transportation remains predominantly a fossil fuel energy consumer and is therefore a major greenhouse gas producer, and by extension, a major contributor to climate change. However, in the U.S., only one third of that is related to domestic freight, the remainder being personal transportation. Therefore, while improvements in the freight sector are important, we each need to look at our own personal transportation choices for the remaining two thirds. However, I will focus on that one third which is related to freight-related transportation.



Emissions are dependent on the mode selected. Air transportation is the most highly polluting as measured by CO₂ production per unit of goods transported. Truck is the next “worst”, with rail being more energy efficient (less than 50% emissions as compared to trucks), and with ocean as the best (less than 20% of trucks). In fact the rule of thumb is slow = low. The primary reason for using air over other modes is speed. The “need for speed” is driven by three primary factors: potential spoilage of product; weak planning and forecasting

(which drives the need to expedite); and increased consumer expectations (“next-day is better than two-day”). There is a limited product segment where spoilage risk drives a real need for air (for example cut flowers or live lobsters) so I will not spend time on it. In the next section, I will discuss the consumer expectations in the context of online retail. I will cover forecasting and planning later in the article as it is an area where Oracle Cloud solutions, such as Oracle Supply Chain Planning and Oracle Transportation Management, can and do have a huge positive impact.

It is important to note that the transportation infrastructure in developed countries is twice as efficient as those in developing countries. This difference is not only an inhibitor to their economic



Total U.S. Greenhouse Gas Emissions by Economic Sector in 2017⁵

Emission Factor per Mode:
Amount of CO₂ (in grams) emitted per metric ton of freight and per km of transportation
Air plane (air cargo): 500 g
Truck: 60-150 g
Train: 30-100 g
Ship (sea freight): 10-40 g

¹Transport, The World Bank, <https://www.worldbank.org/en/topic/transport/overview>

² Sources of Greenhouse Gas Emissions, United States Environmental Protection Agency, <https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions>

³ U.S. Greenhouse Gas Emissions from Domestic Freight Transportation, Bureau of Transportation Statistics, <https://www.bts.gov/content/us-greenhouse-gas-emissions-domestic-freight-transportation>

⁴ Impact of Globalization on Logistics Costs and Influence on 3PL Revenue Growth, Supply Chain World, <https://vijaysangamworld.wordpress.com/tag/asia-pacific/>

⁵ CO₂ Emissions for Shipping of Goods, Time for Change, <https://timeforchange.org/co2-emissions-shipping-goods>

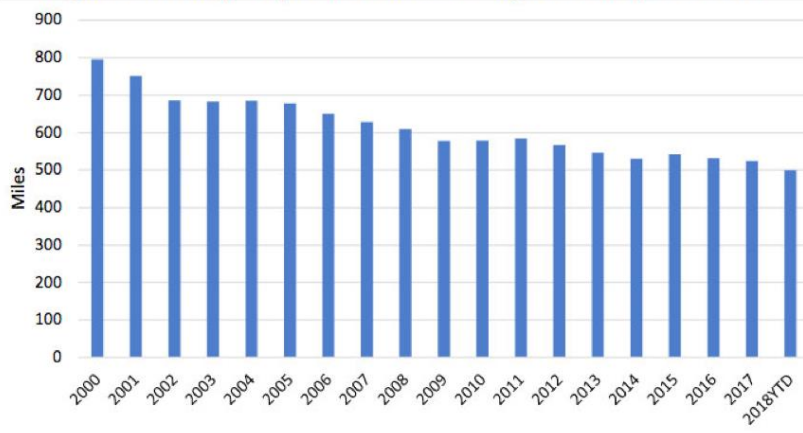
development, but also contributes to the waste and spoilage of product, and significantly higher emissions. Investments in modern infrastructure, together with the simplification of intra-country and inter-company regulatory and tax barriers (such as the introduction of IST in India), will have a large positive impact.

HOW IS E-COMMERCE IMPACTING TRANSPORTATION AND ASSOCIATED EMISSIONS?

- E-commerce sales in 2018 accounted for 9.7% of total retail sales in the U.S. They have been growing at 13-16% per year in the last five years.⁶
- Worldwide parcel volumes rose by 17% to 74.4 billion parcels in 2017 (22 parcels shipped per person globally, and 2,300 parcels shipped every second).
- The U.S. parcel shipping market handled more than 12.7 billion shipments in 2017, and the majority of these packages weighed less than five pounds.
- In 2000, residential deliveries represented 25% of United Parcel Service's (UPS) volume. Today, that figure exceeds 50%.⁷
- The average truck trip lengths shortened by 37% since 2000.⁸
- Between 13 to 30% of all online orders were returned, compared to just 8% for in-store purchases. This necessitates efficient handling of reverse logistics.⁹

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Figure 6: Average Dry Van Truckload Length-of-Haul, 2000-2018



The convenience of online shopping in our increasingly busy lives is undeniable. However, those packages do not just appear by themselves on your doorstep. There is a significant and growing infrastructure dedicated to making that happen. To meet the two-day or even one-day shipping expectations that infrastructure requires more distribution centers, more short-haul deliveries, more packaging, and all of that generates more emissions.

⁶ How is the Growth of E-commerce Affecting Trucking?, HDT Truckinginfo, <https://www.truckinginfo.com/324451/how-is-the-growth-of-e-commerce-affecting-trucking-and-Quarterly-Retail-E-commerce-Sales>, US Census Bureau News, https://www.census.gov/retail/mrts/www/data/pdf/ec_current.pdf

⁷ Analysis: USPS' Parcel Future is in the Mailbox, JOC.com, https://www.joc.com/regulation-policy/analysis-usps-parcel-future-mailbox_20181217.html and Global Parcel Volumes to Surpass 100 Billion Mark in 2020, Pitney Bowes Study Forecast, CEP Research, <https://www.cep-research.com/news/global-parcel-volumes-to-surpass-100-billion-mark-in-2020-pitney-bowes-study-forecasts>

⁸ How is the Growth of E-commerce Affecting Trucking?, HDT Truckinginfo, <https://www.truckinginfo.com/324451/how-is-the-growth-of-e-commerce-affecting-trucking>

⁹ How is the Growth of E-commerce Affecting Trucking?, HDT Truckinginfo, <https://www.truckinginfo.com/324451/how-is-the-growth-of-e-commerce-affecting-trucking>

SHOULD WE ALL BE GOING TO THE MALL INSTEAD OF BUYING ONLINE?



Well that depends. Two thirds of transportation-related CO₂ emissions of items bought at traditional retail stores is generated from your own drive to the mall, with only one third related to getting that product on the shelf.¹⁰ Therefore, whether home delivery is greener depends on how many items you buy per trip. If you buy one item, home delivery might be greener. If you buy multiple items, it results in multiple home deliveries, so buying in-store would be greener. However, people are

not reducing their trips to shopping malls by buying online, we are still doing both. This fact reminds me of the growth in sweetener consumption where the massive addition into the food supply of high-fructose corn syrup calories was additional and did not displace sugar consumption, which remained more or less the same.

So do we need to go on an online shopping diet? Well, perhaps like any good diet, we can instead make better consuming choices. If you increase your consolidation of home deliveries then the equation shifts to favor those deliveries over trips to the mall. This can be “nudged” by offering or defaulting delivery options such as “ship by Friday”. After all, are you really going to use that new-new thing before the weekend? The systems in place at online retailers can then use the additional time to consolidate orders that you place later, or use slower but more emission-friendly shipping options. You can of course do this yourself by grouping your own orders and by not selecting the faster shipment options unless you really need to. There are other options to consolidate, such as picking up that Amazon package at Whole Foods when you go there for your grocery shopping. Similar models could be used at commuting transportation hubs.

There is also the challenge of returns. If you tend to buy two sizes of clothing with the intention of returning one, then there is an environmental price to pay. However, returns too can be consolidated, and perhaps if the e-tailer has better knowledge of your sizing and relates that more accurately to their products, the need to double-order can be eliminated. Some online retailers, such as Etsy, are using already carbon offsets (investments in ecologically friendly projects) to offset their emissions. This could be done by default or as an opt-in by the consumer. Perhaps too, the thrill of fast deliveries will pale somewhat and consumers will take a more balanced view, just as they have with other environmentally related matters such as single-use plastic bottles and plastic straws. The speed with which those attitudes have shifted make me hopeful.

WHAT ABOUT THE DELIVERY FLEETS THEMSELVES?



The vehicles used for those parcel deliveries can shift to lower emitting options. As the average working life of a truck is significantly lower than that of a personal automobile, that changeover can happen relatively quickly. UPS has the goal of sourcing 40% of its ground fuel from low-carbon or alternative fuels and to achieve a 12% reduction in absolute greenhouse gas emissions across its global ground operations by 2025. DHL is expanding its fleet of electric vehicle delivery vans, which will use electricity or natural gas

and clean diesel as an effort to reach its long-term goal of reducing logistics-related emissions to net zero by 2050.¹¹



Unilever

Unilever has a very forward-looking position as regards sustainability and won an Oracle Sustainability Innovation Award:

Unilever cuts CO₂ emissions in North America, drives sustainability, and reduces transport costs with help from Oracle Transportation Management.

Unilever's goal was to decrease CO₂ emissions by 2020 from Unilever global logistics network to at or below 2010 levels.

The result: Unilever confirmed that, five years in, it is on track to meet the vast majority of the targets within its Sustainable Living Plan, the company's blueprint for achieving its vision to grow the business, while decreasing its environmental footprint and increasing its positive social impact.

¹⁰ Carnegie Mellon Study Finds Shopping Online Results in Less Environmental Impact, Carnegie Mellon University, https://www.cmu.edu/news/archive/2009/March/march3_onlineshopping.shtml

¹¹ Jeff Bezos is Finally Ending Secrecy Over Amazon's Role in Carbon Emissions, CNBC, <https://www.cnbc.com/2019/03/08/jeff-bezos-to-end-secrecy-over-amazons-role-in-carbon-emissions.html>

WHAT ABOUT SMALL PACKAGE DELIVERY BY DRONES?

These seem outlandish until you realize that to deliver your little parcel, there is a two-ton van driving around your neighborhood. Drone delivery of a package results in about 0.42 kg of greenhouse gas emissions, while truck delivery of the same package results in 0.92 kg – that is a saving of 54%.¹² Examples so far are limited, but drones have been tested in Iceland to deliver goods between two parts of the city separated by a wide river, reducing delivery time from 25 minutes by car to as little as 4 minutes by drone.¹³ Domino's delivered the first pizza by drone in 2016 to a New Zealand couple.¹⁴ Medical drones have been used to deliver defibrillator kits to people suspected of having heart attacks, and also to deliver disaster relief, including water and medical supplies, to isolated areas.¹⁵ So while not exactly mainstream yet, drones are a likely component of package deliveries in the future.

WHAT ABOUT OTHER EMERGING TECHNOLOGIES?

Adaptive cruise control, eco-navigation, on-board vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communication technology such as traffic light synchronization, could reduce GHG emissions by 2-4% every year.¹⁶

- Truck platooning, where trucks travel very closely together on the highway to reduce wind drag, have been shown to reduce carbon emissions by 10%.¹⁷
- By 2050, connected autonomous vehicles could reduce fuel consumption by as much as 18% for trucks, according to a new study released by the Energy Information Administration.

These technologies benefit both local deliveries and longer haul routes, and they are not pipe-dreams. The U.S. Postal Service is already testing a fleet of autonomous trucks travelling a 1,000 mile route in the mid-west. This is a route that has been challenging for them to staff with sufficient drivers given its distance. All major truck manufacturers are investing in autonomy, often linked to a new generation of electric trucks. Standards bodies (such as BITA) are at work to create the information infrastructure, likely based on blockchain, to ensure seamless and secure interaction between all parties and equipment.

WHAT ARE OTHER WAYS TO MAXIMIZE TRUCK EFFICIENCY?

There is a truism that the best truck is one that is always carrying a full load. However upwards of 25% of trucks on the roads today are empty. The truck may go outbound fully loaded, but when it returns (the “backhaul”) it is empty. That equates to 100% emissions for no commercial value-add. Fundamentally, this is the result of breakdown between the supply of transportation capacity and the demand for that capacity. This is further complicated by the fragmentation of that capacity itself between fleets owned by logistics providers (e.g. Schneider National), individual owner operators (e.g. Jesse's Trucking), and fleets owned by corporate shippers (e.g. Coca-Cola) – each operating within their own supply-demand silo. Techniques such as cooperative routing, where loads can be shared between different companies or back-hauls be synchronized can help enormously and are well supported by Oracle software. A more recent development is the marketization of that supply-demand balancing, such as by Uber Freight. They aim to do the same for segments of freight trucking as they have already done for passenger rides. An owner-operator can look for a load that matches his/her location and destination and accept or reject that load tender, and they no longer have to drive home

¹² Future of Energy: Is Drone Delivery Good for the Environment, Smithsonian.com, <https://www.smithsonianmag.com/innovation/drone-delivery-good-for-environment-180968157/>

¹³ RBR Robotics Coverage Goes to China, RBR, [https://www.roboticsbusinessreview.com/wp-content/uploads/2018/03/RBR_\(DroneDelivery\)_FreeReport.pdf](https://www.roboticsbusinessreview.com/wp-content/uploads/2018/03/RBR_(DroneDelivery)_FreeReport.pdf)

¹⁴ Domino's Delivers World's First Ever Pizza by Drone, Tech Transformers, <https://www.cnn.com/2016/11/16/dominos-has-delivered-the-worlds-first-ever-pizza-by-drone-to-a-new-zealand-couple.html>

¹⁵ Google Tests Drone Deliveries in Project Wing Trials, BBC News, <https://www.bbc.com/news/technology-28964260>

¹⁶ Self-driving Cars Could Cut Greenhouse Gas Pollution, Scientific American, <https://www.scientificamerican.com/article/self-driving-cars-could-cut-greenhouse-gas-pollution/>

¹⁷ EU Bets Truck Platooning Could Result in Huge Fuel Savings, Automotive, <https://www.tu-auto.com/eu-bets-truck-platooning-could-result-in-huge-fuel-savings/>

empty. The goal is to create a more efficient market and through that save costs and emissions.

WHAT ABOUT THE RAIL AND OCEAN AND SHOULD WE ELECTRIFY?

Unlike in other countries such as Europe where much of the rail network is electric powered, the U.S. freight rail network is virtually 100% diesel powered. Should it be electrified? The challenge is that the cost of an electric engine with equivalent hauling power of the diesel engines used to pull the mile-long freight trains we have in the U.S. is currently about 12 times more compared to diesel (\$18m vs. \$1.5m). Also, the working life of these diesel vehicles can be 30 years or more, so change-over is slow. In addition U.S. railroads are under-capitalized, making such a major investment very unlikely. Railroads are not favored with government funding in the same way that we underwrite the road network. This a holdover from the punitive backlash the railroad “robber barons” received over a century ago. So electrification is more likely to be seen in shunting yards and in port facilities, where transmission, power and batter storage capacity is less of an issue. Similar arguments apply to ocean, though frankly that is already highly energy and emissions efficient when compared to other modes.

HOW CAN ORACLE SOFTWARE HELP?

Oracle produces the industry leading transportation management system (TMS), and you don't have to take my word for it. Oracle Transportation Management (OTM) has been a leader in the TMS Gartner Magic Quadrant since 2006, and in the latest version has a leadership placement far ahead of the field. Here are some key points about OTM and its capability to help save costs and emissions:

- OTM helps you manage your transportation needs globally across all modes and geographies. Transportation costs are directly related to fuel consumed and distance traveled and, as such, optimizing on cost inherently reduces carbon footprint. OTM's sophisticated optimization capabilities create fewer, more consolidated shipments on more efficient modes of travel and lead to cost savings and greater utilization and efficiency and hence directly improves sustainability.
- Using OTM you can closely monitor your freight in real time using IoT and other means to predict, detect, and resolve anomalies and exceptions even before they occur, leading to improved efficiency in how you move your freight.
- You can use transportation analytics to measure your sustainability performance and keep track of your carbon footprint related to transportation.
- You can use OTM to model your transportation network and design to make it more efficient incorporating sustainability considerations.
- OTM works with your supply chain platform to control and coordinate your freight flow end-to-end leading to improved efficiency and ensuring high on-time in-full (OTIF) values. This helps to reduce unnecessary shipments and returns, etc., saving both cost and carbon.

As noted earlier too, expediting (rush shipments) can be reduced by better forecasting and demand management and Oracle has a leading solution on the Cloud for Supply Chain Planning which enables companies to become demand-driven. This also reduces excess and obsolete materials which further contributes to the reduction of emissions.

So there you have it. Efficient freight transportation is a key factor in the health of any economy, and we all benefit when it works well. Part of that equation is to reduce freight transportation's impact on the emissions and the environment. There are challenges for sure, but there is also a wide range of technologies, which when combined with consumer choice, can help. Oracle is committed to supporting those developments.



“Oracle Transportation Management (OTM) [makes our transportation more efficient](#), saves greenhouse gas emissions, and saves costs. We have clear targets and OTM helps us to achieve our ambitious goals.”

Robert Meckel, Corporate Senior Manager, Henkel Global Supply Chain



Femsa Logistica

[Oracle Transportation Management helps Femsa Logistica](#) improve its planning and routing cycles, thereby reducing total distance that trucks need to travel. The net result is reduced fuel consumption and carbon footprint.

Together we are changing lives around the world, and with the growth in new disruptive technologies, including the cloud, I am more hopeful now than ever before that we can achieve the [United Nations Sustainable Development Goals](#) necessary to benefit our planet and the life it sustains.

For more information, visit oracle.com/green.

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