

An Essential Shift to Sustainable Freight Transport in the Aftermath of the COVID-19 Pandemic: Autonomous Robots, Crowdshipping and Cargo Bikes

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Key Messages

- The COVID-19 crisis continues to disrupt manufacturing and global supply chains, with a noticeable shift in freight travel patterns and last mile deliveries
- With careful planning, the landscape of post-COVID-19 freight deliveries can be made sustainable by adopting new low-carbon initiatives. Several emerging examples include:
 - Autonomous delivery robots being deployed in neighborhoods of multiple universities and hospitals in North America
 - Crowdshipping services emerging as a sustainable delivery alternative for congested megacities in Asia
 - E-cargo bikes widely adopted by logistics companies in Latin American and Caribbean (LAC) countries

1. Introduction

Day in and day out, trucks contribute to the tremendous fuel consumption levels generated in cities around the world by delivering all kinds of products to households, offices, distribution centers, retail stores, and warehouses.¹ Emissions from freight deliveries are projected to increase by nearly a third, and freight traffic delivery vehicles in the top 100 cities around the world are expected to grow by over 36% in the next decade.² Even when the outbreak of the COVID-19 pandemic halted passenger transport to a standstill, freight transport continued to keep the economy afloat and deliver essential goods and services.³ Physical shopping trips to brick-and-mortar stores, retail shops, city centers, and restaurants were replaced by online shopping and deliveries to our doorsteps.⁴ The post-COVID world is uncharted territory for most of the consumer industries and service sectors, including the freight transport sector.⁵ It is also not surprising that there are unprecedented changes in preferences and needs of consumers, around which transport planners and policymakers will have to adapt and innovate to foster a sustainable shift in the post-pandemic world. Therefore, if there are any lessons to be learned from this pandemic, among them is its power to serve as a wake-up call to focus on the threat of climate change while we still have time to stave off its most damaging effects.

About 50% of a product's total transport cost consists of last-mile delivery services. The final-mile delivery of an item accounts for about 181gCO₂/km, which is much higher than the limits set by the EU in 2017 – i.e., 0.175mgCO₂/km.⁶ Therefore, the conventional form of freight delivery is unsustainable in the long run and needs to be replaced with low-carbon

alternatives.⁷ The COVID-19 crisis should be treated as a critical chance to rectify the vulnerabilities in freight transport systems, especially in the last-mile delivery services. Therefore, adopting low-carbon freight transport options (*autonomous deliveries, crowdshipping, cargo bikes, etc.*) is a direct response to the calls for green and sustainable recovery from the COVID-19 pandemic.⁸ The subsequent sections take a closer look at the various sustainability measures implemented in freight operations in different countries, and the lessons learnt from these initiatives. The public response to these innovations, the early-stage reliability of the systems and the underlying potential for cutting GHG emissions are critical factors that need to be investigated for designing improved low-carbon logistics strategies and tackling the climate change crisis already underway.

Case Study I - Autonomous Delivery Robots in North America

Autonomous delivery is one of the emerging technologies in retail and a crucial part of the supply chain ecosystem.⁹ ADRs are defined as self-driving ground vehicles, which can deliver parcels or other goods like groceries and prepared meals to the doorstep. ADRs are designed like little moving robots (Figure 1-A) or like a mobile parcel locker (Figure 1-B) and they drive at a speed of approximately 5–10 km/h on the sidewalks. The short-range local deliveries by ADRs (up to 4 miles) typically handle packages weighing up to 20 kilograms. With various tests underway, researchers believe that automation could revolutionize the system and reduce delivery costs by 80% to 90%. In light of rising online purchases (16% in the USA), Jennings and Figliozzi¹⁰ have shown that a sustainable solution for counteracting the increased carbon emissions from these last-mile deliveries and pick up is the deployment of ADRs. The COVID-19 pandemic has amplified the demand for contactless deliveries; essential workers (Figure 1-C) and pharmacies (Figure 1-D) have relied upon ADRs for handling package deliveries. Although the current state of autonomous delivery has many vulnerabilities, the capabilities of the technology to revolutionize freight deliveries are considerable.¹¹ In the near future, multiple ADRs carried by large autonomous vans are expected to carry even heavier loads covering longer distances seamlessly.¹⁰

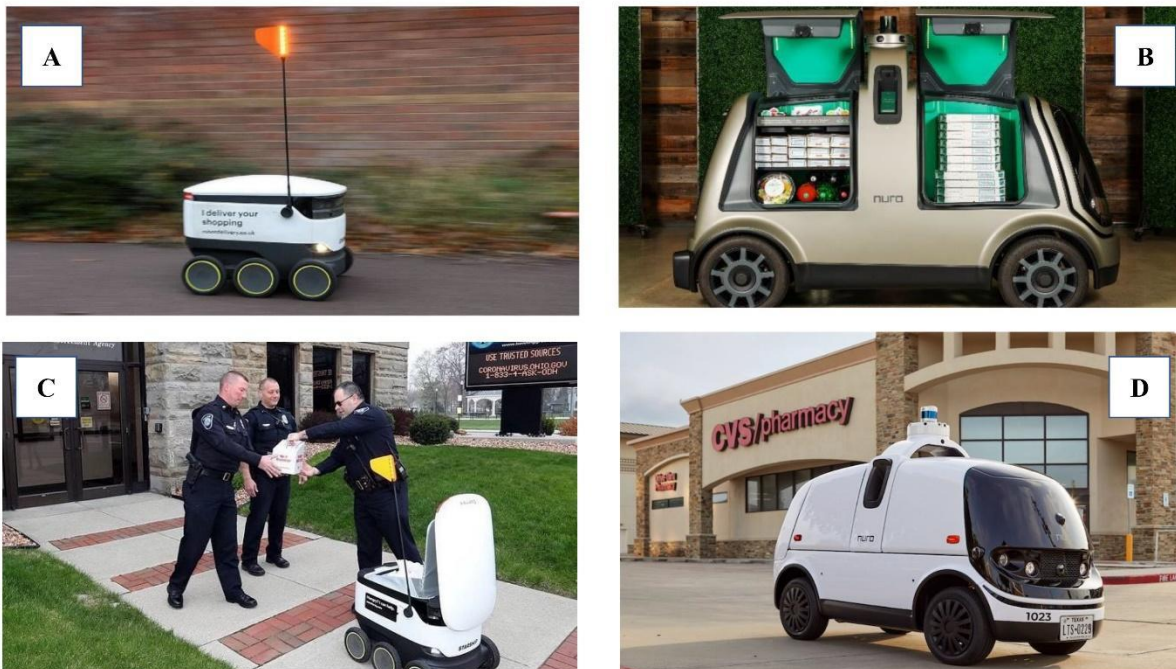


Figure 1 Case studies of autonomous delivery robot deployment in the USA

Starship technologies is one of the market-leaders working on automated delivery systems.¹² In August 2019, Starship announced their plan to deploy thousands of ADRs across university campuses in the United States. It also has a remarkable record when it comes to delivering parcels autonomously: the ADR services from Starship have been tested in about 100 cities in 20 countries. They have travelled about 563,270 kms, and completed their 100,000th delivery.¹³ This is a remarkable feat for a start-up company which came into existence only a few years back with a technology that was not tested for performance until then. It is also proof that the technology can be scaled up to neighborhoods and to cities effectively and contribute to a significant modal shift in the freight transport sector, accompanied by greater energy savings and less carbon emissions. **Nuro.ai** is another start-up ADR company that has partnered with Kroger, the largest supermarket chain in the US. Nuro has developed autonomous delivery vehicles capable of carrying the parcel deliveries to the end-consumer without human interaction and has started deployments in Scottsdale, Arizona and Houston, Texas.¹⁴ Nuro deployed the first crewless delivery vehicle in Scottsdale, Arizona in December 2018.¹⁵ **Refraction AI** is another ADR developer in the USA that focuses on delivering food and grocery items to those who opt for contactless delivery from service outlets partnered with the company. The cost of the delivery is about half that of the conventional truck delivery systems and can also result in significant fuel savings.¹⁶ According to Refraction AI, the pandemic has completely changed consumer behavior and that the demand for ADRs delivering groceries and food has increased significantly, forcing the start-up to pace up its production of delivery robots.¹⁷ While the pandemic has catalyzed the acceptance of ADRs, it is likely that the trend will continue well after the pandemic, given the technological developments in the fields of connected vehicles and 5G communication systems.

Case Study II - Crowdshipping in Asian Countries

Crowdshipping is a concept that incorporates underutilized passenger transport mode capacity and related infrastructure to deliver freight packages in the last-mile.¹⁸ Packages are delivered with the help of regular passengers (i.e., transit users, car owners) wherein they drop off packages at designated places on their way, which will, in turn, be picked up by another commuter and delivered to the customer at the destination (see Figure 2). Crowdshipping follows the principles of the *sharing economy* and can be a front runner for low-carbon logistics in the years to come, especially for last-mile deliveries. The products are sent along with trusted individuals who are commuting towards the direction of the customer. Unlike in the case of business-to-consumer (B2C) shipments, the products do not have individual straight travel paths, instead they undergo a series of piecewise commutes before the destination. As there is no need for dedicated delivery trips, it significantly reduces the carbon cost of deliveries.

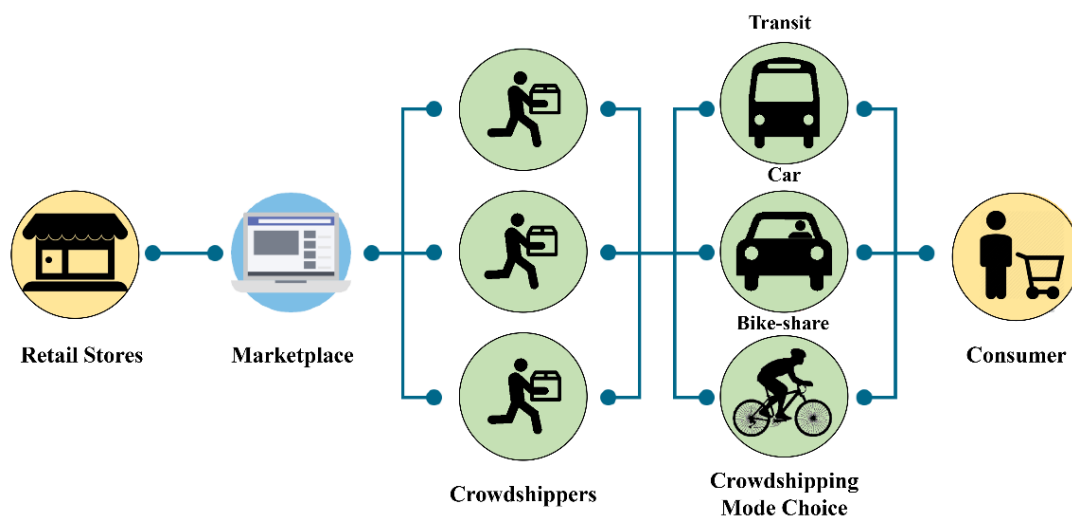


Figure 2 Overview of crowdshipping services for last-mile delivery

In the Philippines, senders can avail crowd-sourced delivery services by transporters. The crowdshipping platform called **Jojo** was made available across three cities and 19 municipalities of Pampanga province in Manila.¹⁹ This project has resulted in the monetizing of Metro Manila traffic, all the while reducing a huge share of delivery vehicles on the road.²⁰ In the time of COVID-19, using already available commuters on the road to effectively deliver parcels on their way is an ingenious idea both from the perspective of enhanced delivery times and carbon emission reduction. Implemented in Manila, this is said to have created a win-win situation for both the sender and transporter.²¹ However, right now, the company has limited the transporters commuting on a motorcycle even though the plans for other modes of transporting freight parcels are underway.

Another instance of successful crowd-sourced delivery is the **Dabbawala** (lunch-box carrier) system in Mumbai, India. The dabbawala system is as-yet non-digitized and collects food parcels from individual households in Mumbai and delivers them to workplaces in time for lunch. Each “dabba” eliminates a trip by the office-going person to their individual houses or to the nearest restaurant for lunch, saving both time and the environment. The dabbawalas rely on cycling, walking, and the Mumbai suburban railways for their commute from households to workplaces, none of which contributes to added GHE. This business model can therefore be expanded to other products with perpetual demand and homogeneity.²² While the dabbawala

system was limited to lunch boxes for the most part, in 2015, the Indian online-delivery giant Flipkart teamed up with the venture to improve their last-mile delivery capabilities in Mumbai using the lunch carriers to deliver the online-orders to the designated places along with the food packages.²³ In the first phase of the system, the “dabbawalas” will collect the packages from Flipkart delivery hubs in Mumbai along with the dabbas. As of now, this mode of delivery is available only for prepaid orders, even though further expansion to cash-on-delivery is also expected soon. In the case of nearby sellers, the dabbawalas can even assist in bypassing the seller to delivery hub trips by delivering the product directly to the customer. This venture is set to have huge impacts in bringing down the carbon footprint associated with the last-mile delivery of Flipkart products, all the while improving the speed of delivery.

Case Study III - Cargo Bikes in Latin American and Caribbean Countries

As a distribution solution, non-motorized cargo bikes were conceptualized in the last decade to deliver last-mile packages on bike routes. The loading rate of cargo bikes typically range up to 100 kg, and large-scale implementation at a city-level is projected to decrease last-mile delivery cost by up to 45%. These are zero-emission alternatives to light goods vehicles but have several adoption challenges. There is also an increasing market for the use of electric cargo bikes in several parts of the world, especially in European countries with dedicated bike lanes. From the research into the feasibility of adopting carbon-neutral bike deliveries of goods, the European Union concludes that about 25% of all goods can be delivered by cargo bikes in urban settings. As per an ITDP internal survey report, many cities have low but growing use of e-bikes, whereas a few cities in Brazil are reported to have higher levels of e-cargo bike delivery.²⁴ In Copacabana, Rio de Janeiro, Brazil, about 11,000 deliveries are made each day by means of cargo bikes.²⁵ In a 2011 study on cargo bike deliveries in Copacabana and surrounding regions, researchers identified 372 establishments that used cargo bikes. An overview of cargo bikes and the weight of the cargo delivered by bike trips are shown in figure 3 based on the Rio de Janeiro study.²⁶

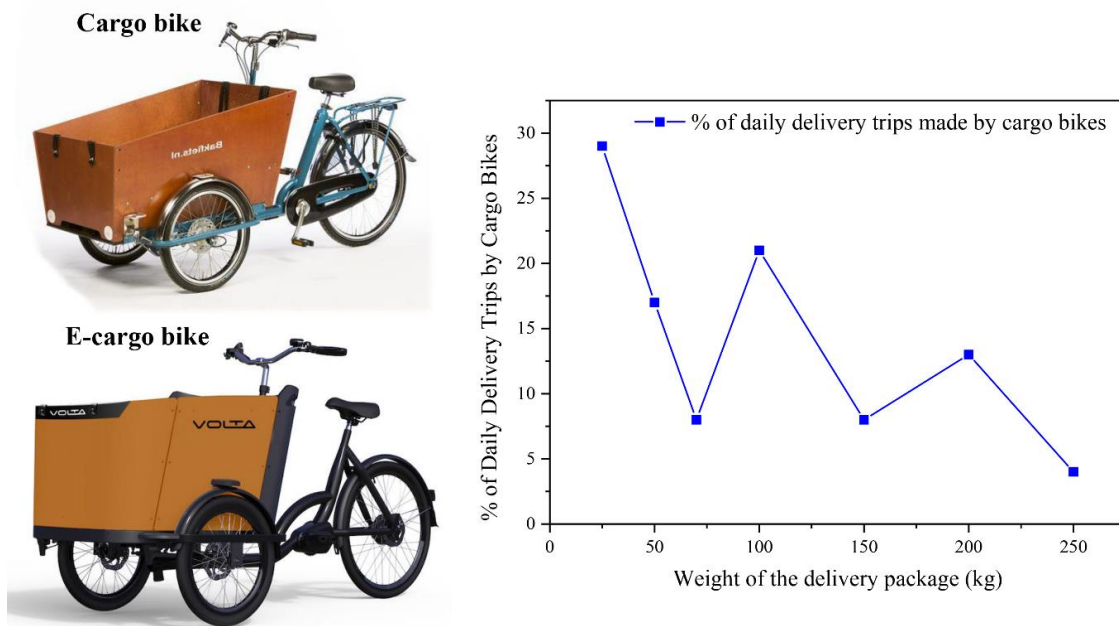


Figure 3 Overview of cargo bikes and percentage of delivery trips in Copacabana, Brazil

The advent of apps and extensions such as EcoCart²⁷ will further boost the adoption of cargo bikes because it empowers consumers to make their deliveries carbon neutral. Once the delivery apps show the greenhouse gas (GHG) emissions avoided by choosing a low or zero carbon delivery method, it is expected that a sustainable shift in last-mile delivery choices can be fostered among consumers. Data-driven tools for calculating the exact cost of offsetting the emissions from each package delivery will also help to inform consumers about the impact of their internet orders and assist the global efforts to curtail GHG emissions.

Summary

It is quite evident that consumer behavior has shifted tremendously during the COVID lockdown period. People are hesitant to go out of their homes to purchase goods in person and increasingly prefer online deliveries. This reliance on e-commerce has resulted in increased delivery trips to households and has pushed online delivery platforms such as Amazon and Flipkart to expand their delivery network coverage.²⁸ Even though the extent of the permanence of this behavioral shift cannot be determined before the lockdown restrictions are lifted, and COVID-induced fear has subsided, it can be assumed that a large portion of the population has warmed up to the convenience of having things delivered to their doorsteps without having to spend exorbitant amounts of time in crowded shopping malls and grocery stores. Therefore, the post-COVID world is going to see a tremendous increase in last-mile delivery trips, which can significantly contribute to carbon emissions. Therefore, a gradual shift to low-carbon freight delivery is the need of the hour, as it can reduce the carbon footprint of freight delivery services without compromising delivery efficiency. The deployment of autonomous delivery robots, crowdshipping services, and adoption of cargo bikes piloted in different countries are indeed the essential first step towards the low-carbon future for freight delivery services in the last-mile to consumers.

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