

EXECUTIVE SUMMARY

Automating the Last Mile

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Executive Summary

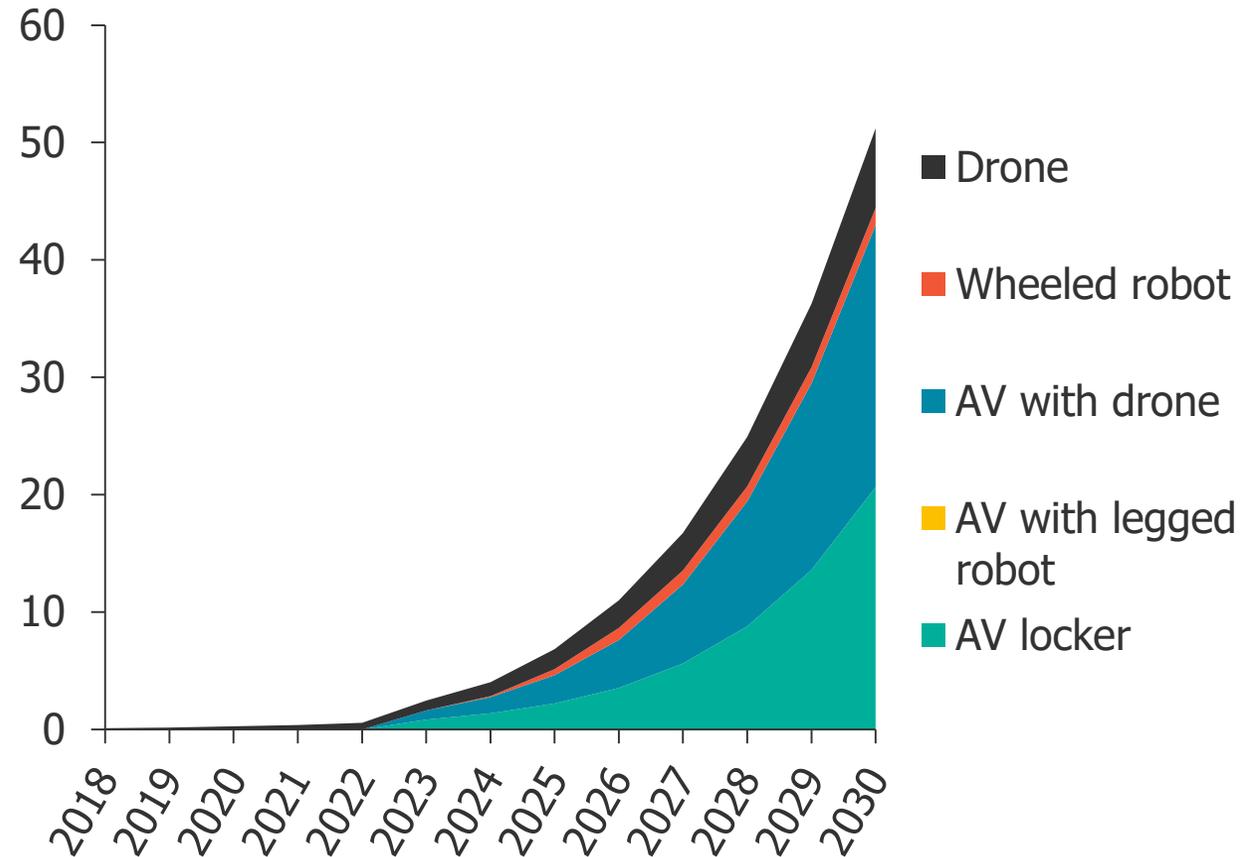
The rise of e-commerce is fueling growing parcel delivery volumes, a market that Lux expects will exceed \$650 billion by 2030. Interest in automating the last mile of delivery, the most complex and expensive part of the delivery process, has peaked in light of increasing delivery volumes and competition in the space.

This report analyzes key last-mile delivery technologies and finds:

- Drones will be limited to rural delivery routes, which are the most expensive and have the lowest regulatory barriers for aviation.
- Autonomous vehicles are the most promising technology and will likely be used as a mobile locker or paired with a drone.
- Automated delivery technologies will generate between \$33 billion and \$48.4 billion in annual delivery revenues by 2030 and deliver less than 20% of all parcels.

Parcel Delivery Volumes Using Automation Technologies

Billions of parcels

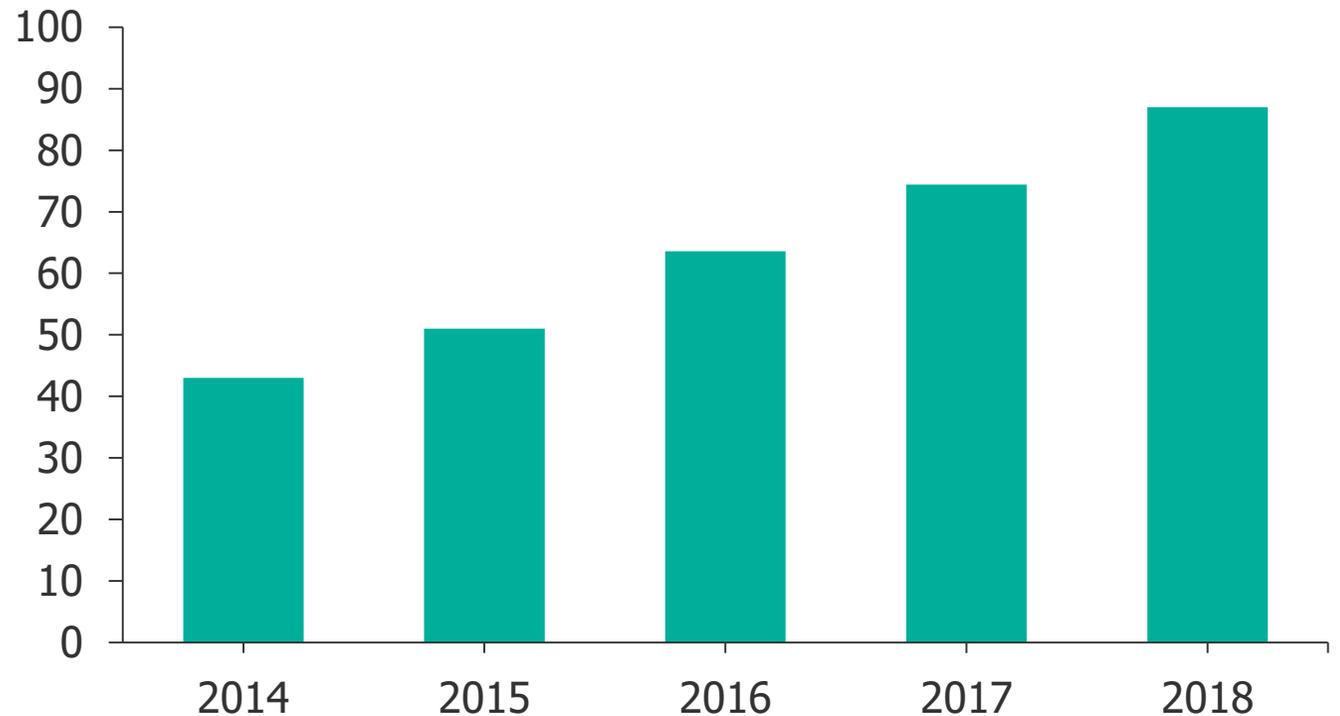


The rise of e-commerce is driving a rapid increase in the volumes of parcels delivered

The ubiquity of mobile devices and the rise of e-commerce platforms are transforming how consumers access goods and services. Although it started with books, Amazon is now the world's highest-valued B2C e-commerce platform and only the second company to ever achieve a \$1 trillion market capitalization, and very few products *cannot* be purchased through its platform.

Consumers' embrace of e-commerce platforms now means more parcels are being delivered than ever before. Pitney Bowes tracks global parcel delivery across 13 of the largest markets and found that **global parcel delivery increased from 43 billion in 2014 to 87 billion in 2019, representing 104% growth.**

Parcel Delivery Volumes
Billions of parcels



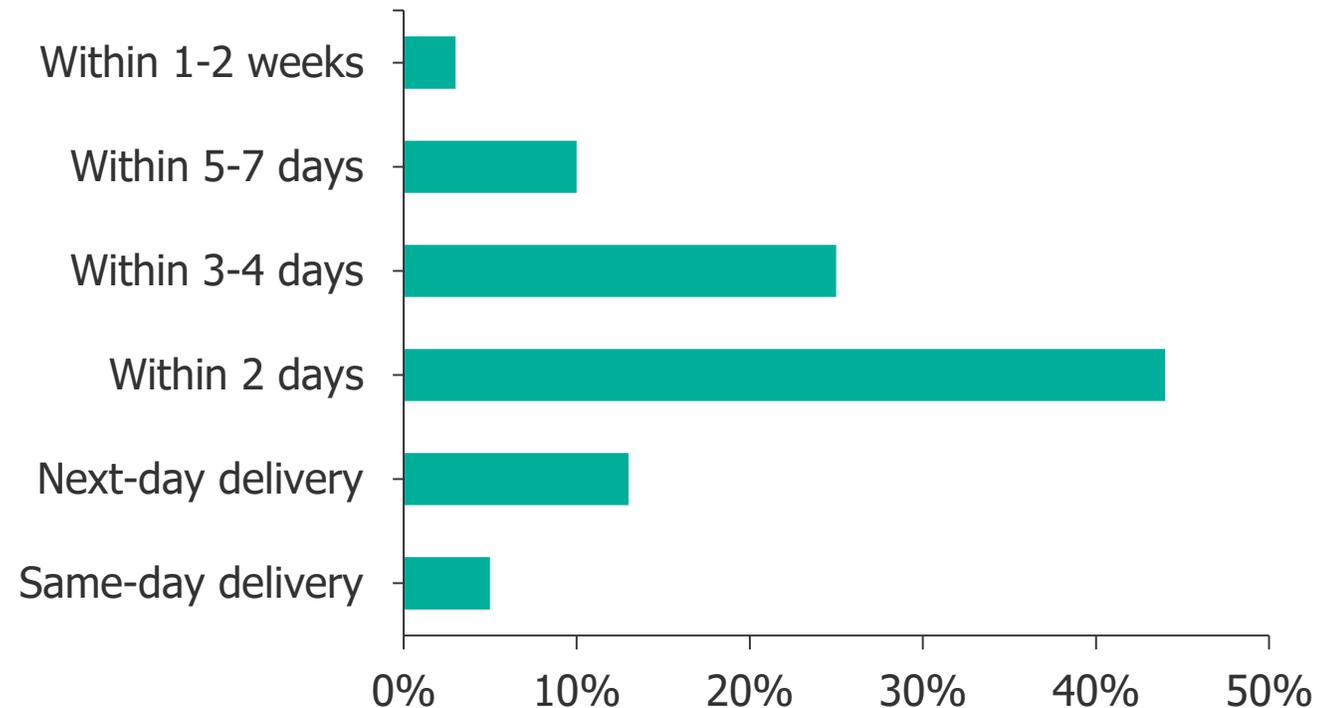
Data source: Pitney Bowes

Consumer expectations are changing – shipping needs to be faster and cheaper

Most consumers expect parcels to be delivered within two days of ordering, significantly faster than most brick-and-mortar retailers can manage today. E-commerce retailers from Amazon to Alibaba have announced multibillion-dollar investments into their respective supply chains, aimed at promising customers faster deliveries.

Amazon has been at the global forefront of reducing delivery times, introducing features like standard two-day delivery for Amazon Prime members – redefining customer expectations and pushing many other retailers to also offer faster shipping. In a survey from Deloitte, more than half of respondents indicated they aren't willing to wait longer than two days for fast shipping. On the following slides, we walk through key innovations introduced by Amazon, its competitors, and partners to deliver on faster shipping promises.

Time Frame Willing to Wait for Fast Shipping

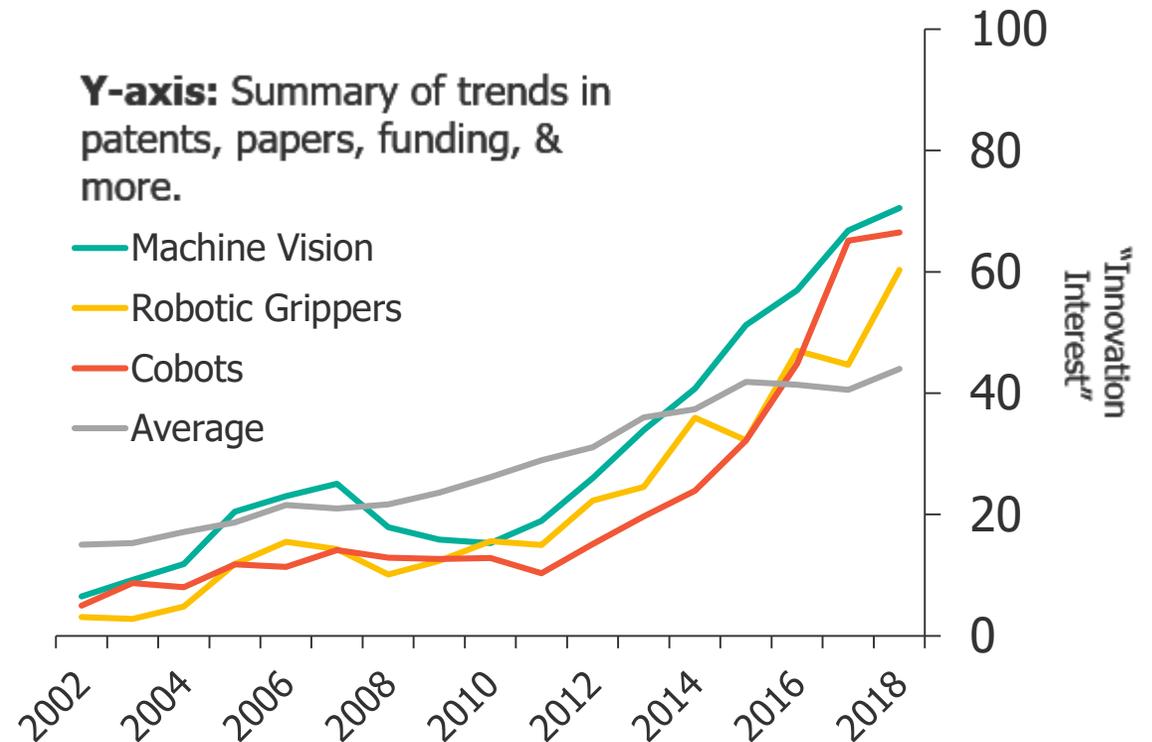


Source: Deloitte

Logistics companies have already started innovating in most areas of parcel delivery

Inside the warehouse or fulfilment center, optimizing workflows like bin picking and parcel packing is crucial to reducing delivery time and cost. Most picking and packing today is manual, but intense efforts have gone into automating these complex tasks.

Advancements in machine vision, robotic grippers, and collaborative robotics are all improving the outlook for automating these tasks. Today, use of automated picking and packing of parcels is limited; startups like [RightHand Robotics](#) already have customers using their robotic picking systems, but only for specific products. **Full automation is likely more than a decade away due to the increased complexity of handling all items, and Jeff Bezos publicly set a target of [2030 for full automation of picking](#).** In the interim, Amazon's acquisition of Kiva Systems enabled mobile shelving, which allows Amazon to optimize shelf location to minimize walking distance from pickers.

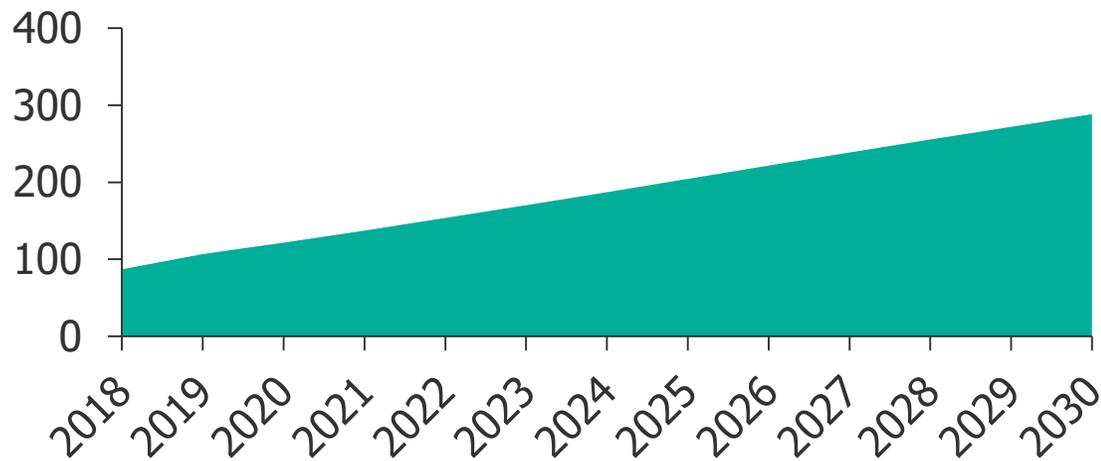


The market for parcel delivery is expected to reach \$665 billion by 2030

Lux expects the total market for parcel delivery, not only last-mile but also first- and middle-mile, to grow from just over \$350 billion from 107 billion parcel deliveries in 2019 to \$665 billion from 289 billion parcel deliveries in 2030. This results in a compound annual growth rate (CAGR) of 9.5% in parcel count and 5.8% in market value. Continued growth of e-commerce, particularly in Asia, where populations in China and India still have relatively low parcel deliveries per capita today, are going to drive most of this growth.

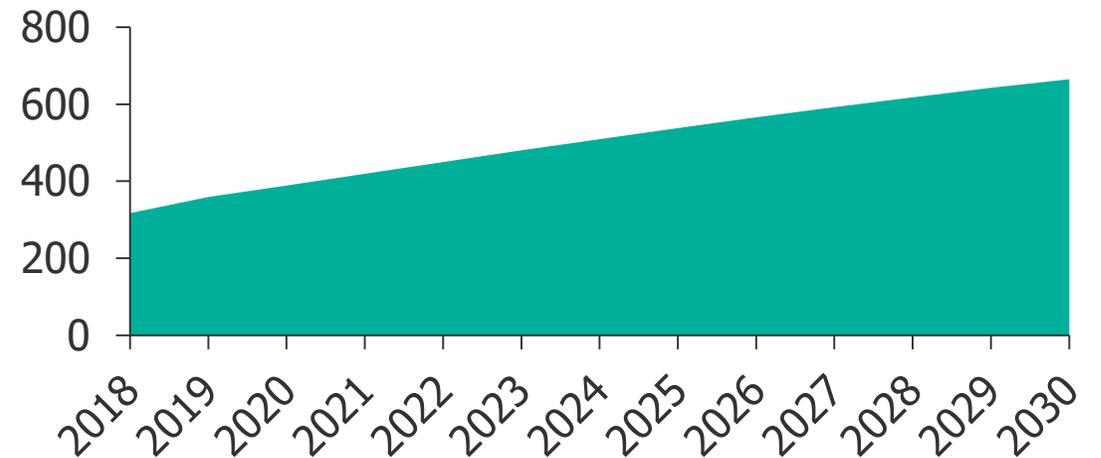
Parcel Delivery Market Size

Billions of parcels



Parcel Delivery Market Size

\$ billions



We identify four automated last-mile delivery technologies to consider in this analysis

There are many companies developing automated last-mile delivery technologies, including startups and large incumbents, as noted below. These fall into four key categories we will focus on for the report: drones, legged robots, wheeled robots, and autonomous vehicles. For each one, we discuss their advantages, disadvantages, technology readiness, and regulatory barriers and ultimately forecast the number of parcels each technology will be used to deliver.



1 DELIVERY DRONES

2 LEGGED ROBOTS

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3 WHEELED ROBOTS

4 AUTONOMOUS VEHICLES



Wheeled Robots

Key Players – FedEx, [Amazon](#), [Starship Technologies](#), [Kiwi Campus](#), [ZhenRobotics](#)

Advantages and Disadvantages

Wheeled robots are easier to develop than autonomous vehicles because they only need to operate on sidewalks and understand few traffic rules. These robots are generally limited to 5 mph when operating on sidewalks. They can also only carry a couple of packages at a time.

Technology Readiness

Deployments of wheeled robots on college campuses started in 2017, although human operators still need to be ready to remotely take over control at any time.

Regulatory Factors

Regulations are generally not an obstacle for this technology due to its slow speeds. Permits are given to companies on a campus-by-campus or city-by-city basis. States in the U.S. have begun establishing regulations that consist of speed limits, weight limits, and rules around how they operate.

Washington became the eighth state to create these regulations in April 2019.

Use Case



Image source: Starship

Starship Technologies



These self-driving robots have made more than 100,000 food deliveries on college campuses in just two years. The company also conducted pilots with logistics companies like Swiss Post. In 2019, Starship Technologies conducted a pilot in the U.K., where parcel recipients could schedule a time and place for final delivery that was convenient for them.



Wheeled Robots

Assumptions

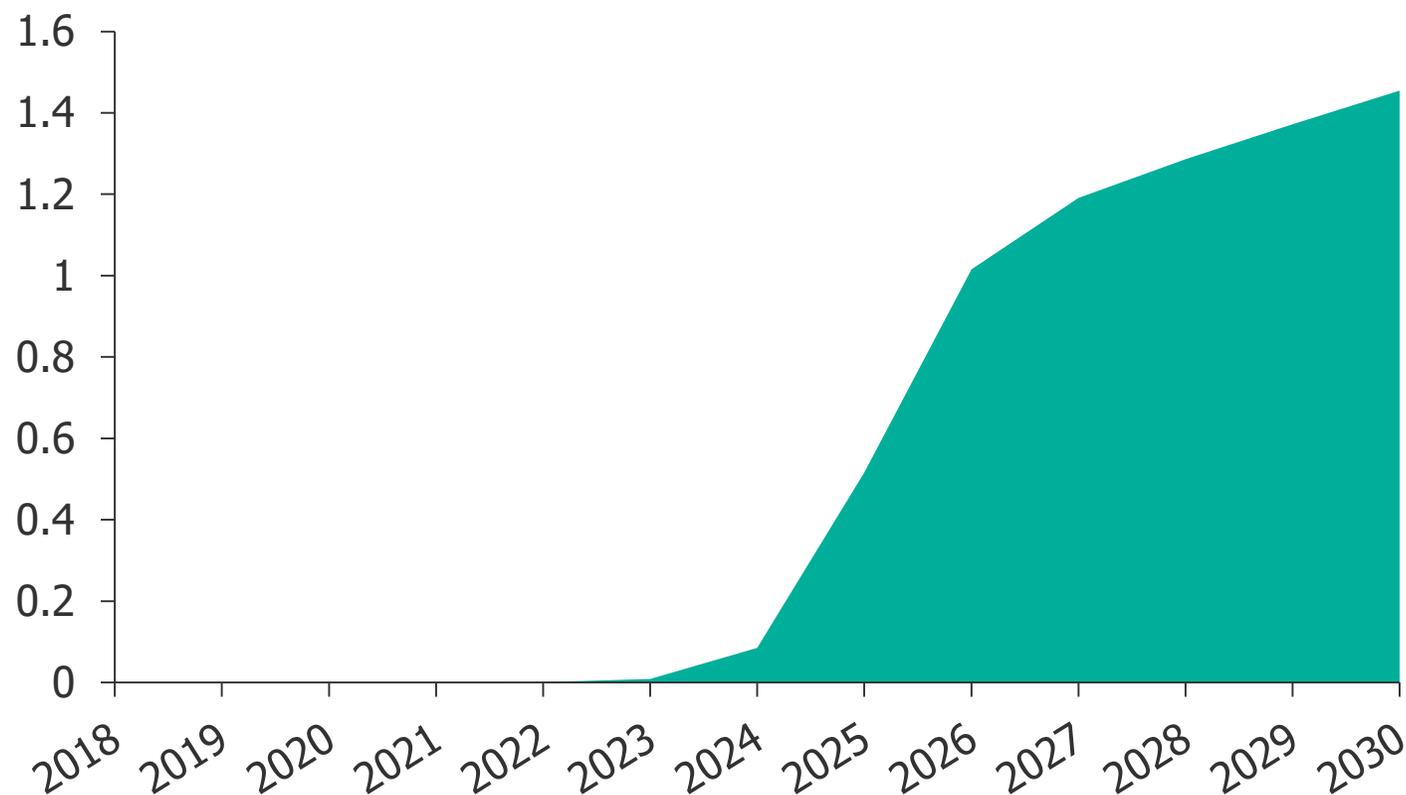
End customer	Consumer
Weight	Any
Address type	College campuses

Reasoning

Wheeled robots will only be feasible on college campuses, where the incumbent delivery method would be a courier moving by foot or bicycle. The cost benefits of autonomous vehicles make them the better choice in any environment with roads.

Parcel Deliveries by Wheeled Robots

Billions



Autonomous Vehicles With Drones

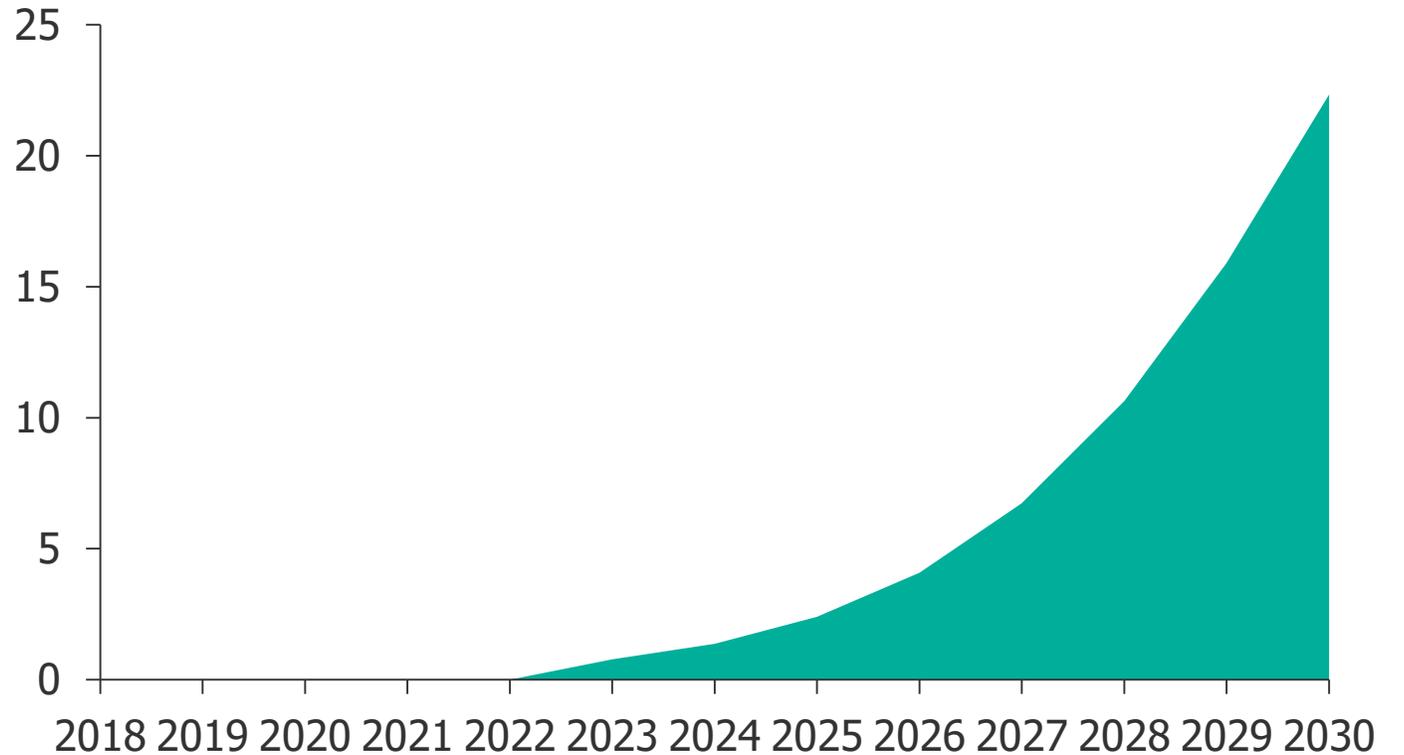
Assumptions

End customer	Consumer
Weight	Small
Address type	Rural

Reasoning

While drones alone are limited in range to flying within a small radius of a warehouse, deploying from a moving autonomous vehicle extends the address type to any rural environment. Due to noise and congestion, these systems will not be deployed in urban areas.

Parcel Deliveries by Autonomous Vehicles With Drones (Billions)



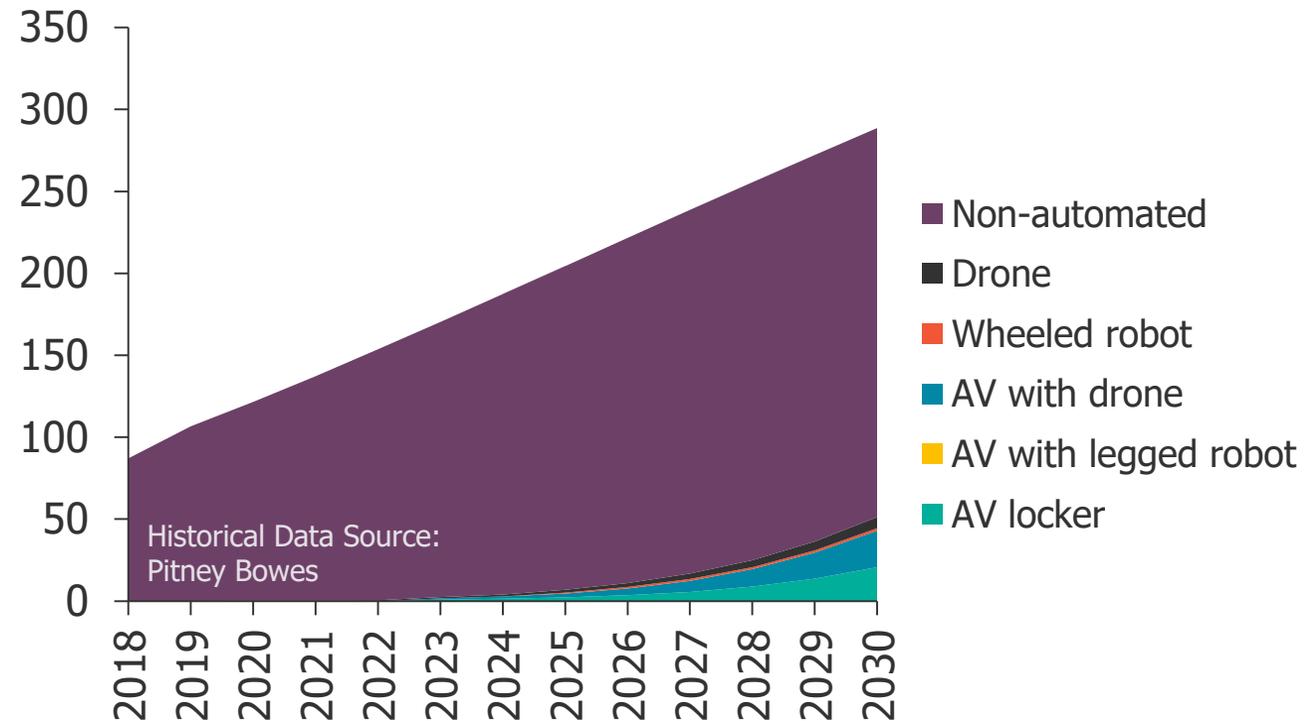
Less than 20% of parcel delivery will be automated in 2030, but it will generate more than \$33 billion in revenues

Parcel delivery will remain mostly manual in 2030, primarily because few business recipients are expected to use automated delivery. Today, business recipients account for almost half of all parcel deliveries and are among the most profitable routes due to the high number of parcels each person can deliver at once. There is less cost pressure to automate when receiving many parcels at a single address.

Estimates for last-mile delivery as a portion of total costs typically range from 28% to [41%](#) of total parcel delivery costs. **This means automation technologies should be expected to generate between \$33 billion and \$48.4 billion worth of delivery revenues**, assuming pricing for these new delivery technologies is the same as for conventional delivery.

Parcel Delivery Volumes

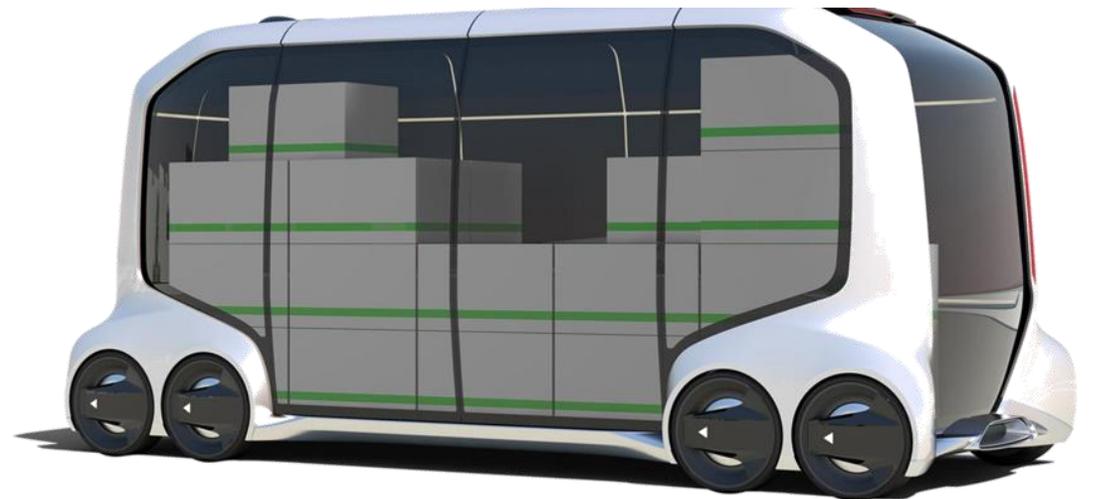
Billions of parcels

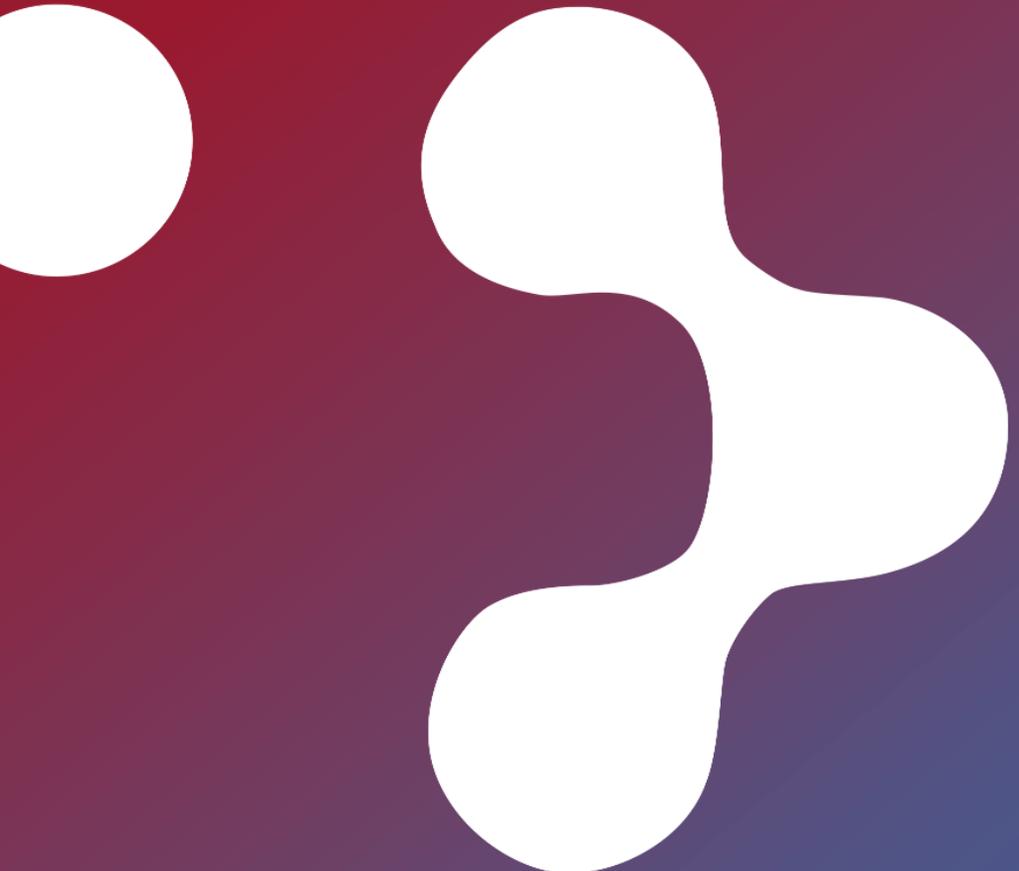


Robotics as a service will take a hold of last-mile delivery

Startups creating technology for last-mile delivery are positioning themselves as “robot-as-a-service”-type businesses. Because logistics companies have little experience in robotics, it may be easier for them to outsource the last mile to these technology companies, which, in addition to the hardware, are building fleet management and route optimization software.

While large logistics companies with internal technology groups (e.g., Amazon, JD.com) will be less likely to engage in this service model, small and midsize companies will. Logistics companies and retailers will most likely acquire the most promising technology startups after an initial period of paying for services.





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