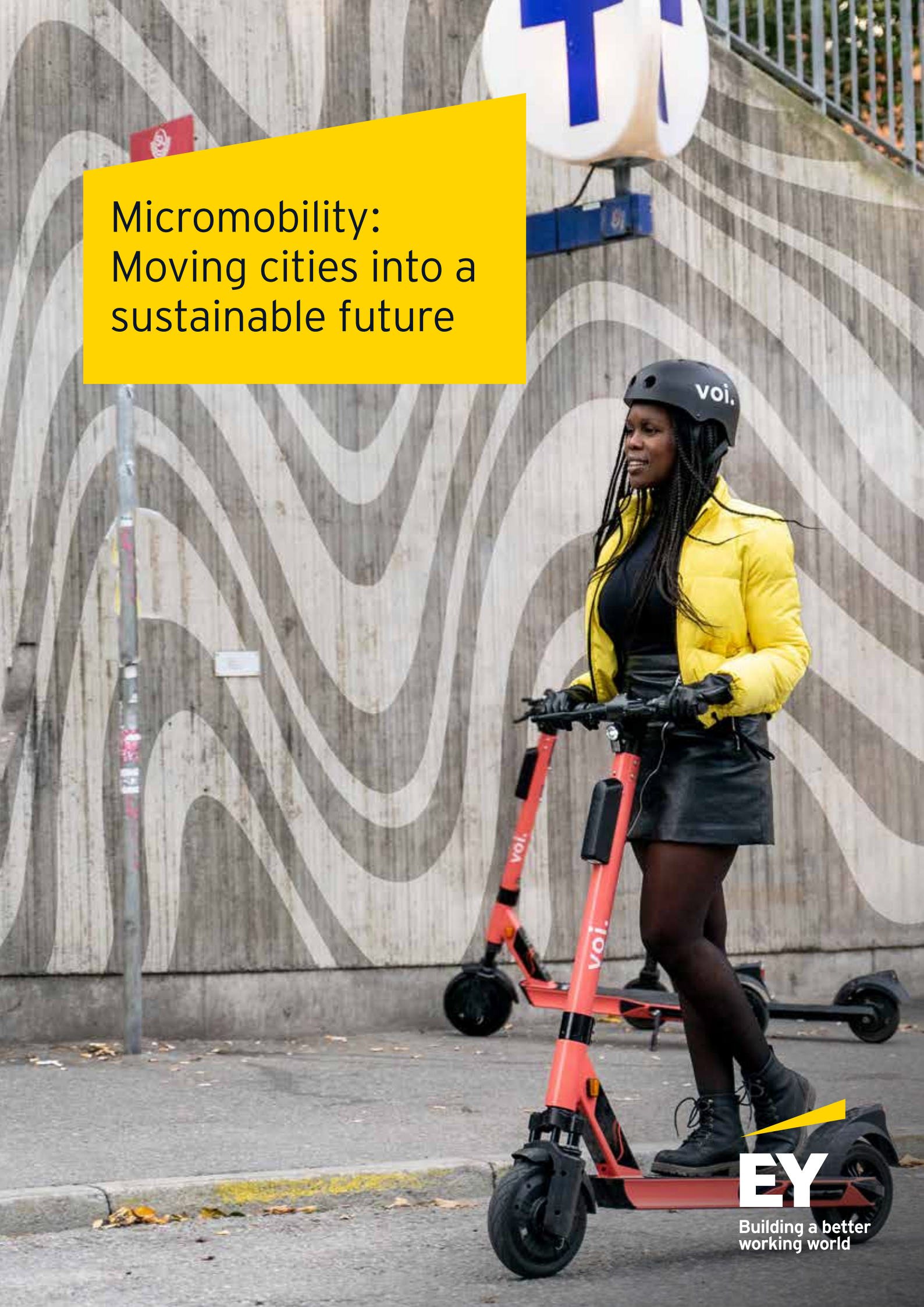
Micromobility: Moving cities into a sustainable future



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Building a more sustainable urban transport system has been a central focus for cities globally with the goal of creating a well-connected seamless mobility experience while reducing traffic, noise and pollution. Despite all the careful planning by government officials to that end, the rise of micromobility has been an unexpected, grassroots success story of recent years in the urban transport sector. In cities across Europe, the US and Asia, thousands of users are taking advantage of a growing range of shared micromobility options. E-scooters in particular are growing in popularity at an incredible rate surpassing an estimated 20 million users in Europe alone. With this adoption of micromobility and e-scooters growing at an unprecedented speed, could e-scooters be the critical link to help speed up a transition toward sustainable, people-centric cities that leads to improved quality of life? Does micromobility truly deliver a sustainable impact that can be replicated in cities around the world?

As market observers we could see the possibilities and opportunities that micromobility offered but we needed real world data to confirm our hypotheses about the benefits of an integrated multi-modal mobility ecosystem. To find the data we turned to one of our clients, Voi Technology, one of the original scooter operator pioneers in Europe with currently more than 4+ million scooters in operation around Europe. We were already working with them to help them assess the environmental impacts associated with all the stages of the scooters life-cycle and through our work we knew they had an extensive database of use data collected that we could utilize in our analysis. With Voi's permission we were able to take a deep dive into data and test our hypotheses regarding the benefits of scooter use. In addition, Voi gave us permission to publish the data and share the insights across the industry.

With Voi data in hand, we took our analysis one step further and interviewed city officials in major cities across six European countries to understand their view of the role of e-scooters for urban development. Finally, to interpret the findings and derive recommendations for how cities can unlock the benefits of micromobility to create more sustainable and accessible cities, we enlisted the help of EY subject matter professionals across several practice areas, including Climate Change and Sustainability, Future of Mobility and Strategy.

We think you will find the resulting report interesting and enlightening. Our aim is to transparently share these relevant findings across the industry and derive recommendations for collaboration between operators and regulators to unlock the benefits of micromobility for cities around the world.

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At a glance

Rapid adoption of e-scooters indicates potential to transform urban mobility habits

In the span of the last two years, e-scooters have evolved from a gadget to a sustainable shared micromobility option that may help cities curb congestion and pollution levels and improving quality of life. Featuring extraordinary adoption rates – estimated to be four times faster than that of e-bike sharing schemes, surpassing 20 million users in Europe – e-scooters have the potential to serve as a catalyst toward post-car inner cities by becoming the missing last-mile complement to public transport and helping change urban mobility habits. Cities are taking different approaches to this mobility option, increasingly using tenders and licenses to cap the number of operators and set operational, safety and sustainability requirements.

First Life-Cycle Assessment published by an operator shows 71% reduction in emissions over one year

While early-stage practices drew criticism, the industry has innovated and matured at tremendous speed, improving their environmental impact through new operational models and hardware. EY's Sustainability and Climate Change Services practice conducted a full Life-Cycle Assessment of an operator's (Voi Technology) service. Voi agreed to be the first operator to share these insights publicly. Taking Voi's Paris service as an example, we assessed current practices and the contribution of the latest innovations and share our insights. We found that the combined initiatives yielded a 71% reduction in emissions since January 2019 resulting in 35g CO_2 equivalent per person per kilometer, on par with many public transport options. Swappable battery scooters and cargo bike operations drive a 51% reduction.

Adapted policies enable e-scooters to support sustainable mobility and enhance quality of life

E-scooters, however, are no silver bullet. Their main contribution lies in improving access to public transport and supporting mobility behavior transformation to reduce taxi and car trips in cities. To unlock their potential, it's vital that governments and cities implement policies while addressing the challenges. That includes making clear regulations that foster responsible and sustainable behavior and enabling access to micromobility infrastructure, such as parking and lanes.

Contribution

This report sets out to assess the potential contribution of e-scooters to urban mobility and decarbonization. It presents city perspectives and considers the latest innovations of the rapidly evolving sector. Voi Technology has given EY permission to publish the latest data collected for their Life-Cycle Assessment based on their Paris operations and have given us insight into their key initiatives. Our aim is to transparently share these relevant findings across the industry and derive recommendations for collaboration between operators and regulators to unlock the benefits of micromobility for active and sustainable cities.

This information is based on a non-verified LCA study, performed by EY, considering the full life cycle of a Voi e-scooter service (model: Voiager 3) and based on data from Voi for the city of Paris. EY has performed the LCA study in line with the ISO 14040/44 standards, modelled using SimaPro 8.5.2, EcoInvent 3 database and ILCD 2011 Midpoint+ V1.10 / EC-JRC Global, equal weighting impact method.

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Micromobility – more than fun and games

In cities across Europe, America and Asia, millions of people have adopted a growing range of shared micromobility options. While bike and e-bike sharing schemes have become increasingly popular over the past five years, no one anticipated the massive uptake of e-scooters. Overnight, people riding through cities on e-scooters have become a common sight around the world. Within two years of the first service's launch by Bird, in Santa Monica, California, in September 2017, e-scooter sharing services have reached 626 cities across 53 countries.[1]

Cities tackling car-centric mobility

Today's cities are facing alarming air and CO_2 pollution rates – with cars as the main driver.[2] Decarbonizing urban transport is now a central focus of global, national and city climate plans. The C40 network is challenging cities to draft high-ambition, Paris Agreement compatible climate plans, with cities like Paris, Stockholm and London paving the way. Cities must reduce pollution, congestion and noise while meeting the mobility demands of a growing population and a modern economy. There is increasing awareness around the burdens of car-centric mobility linked to pollution, noise and inefficient use of limited space. Post-car city roadmaps are becoming common. Paris has been first to set remarkable targets: zero diesel cars by 2024 and zero fossil fuel cars by 2030 with Mayor Anne Hidalgo committing to green mobility and 1000 km of cycling lanes across the city with her "15 minute city" plan.

626

E-scooter sharing services have reached 626 cities across 53 countries since launching two years ago

The burden of car-centric urban mobility

- **Climate change:** Transport is Europe's largest source of GHG emissions, contributing to 27% of the EU's total CO_2 emissions.[2]
- **Air quality:** Air pollution levels exceed safe levels in many European cities leading to premature deaths.[3]
- **Noise:** The EU estimates that 40% of Europeans are exposed to dangerous levels of road traffic-related noise, impacting mental health and well-being.[4]
- **Congestion:** The average person living in Paris spends 65 hours in traffic per year, 49 in Munich and 35 in Stockholm, leading to a loss of productivity.[5] Reduced commuting time is a strong predictor of well-being and has been linked to poverty alleviation.
- **Space:** Research in Stockholm shows that 50% of the city's space is allocated to roads and car parking.[6] This rate is similar across European cities.[7]

Micromobility: enabler of a sustainable mobility mix?

New micromobility options promise a convenient and affordable complement to public transport, unlocking the first- and last-mile, and improving accessibility. But to what extent are e-scooters a solution to the pressing urban development challenges we face today?

EY reached out to cities across Europe, which have different regulations and approaches to e-scooters that have yielded various outcomes. We spoke to city officials across seven European cities to understand their view of the role of e-scooters for urban development.

Astrid Zwegers and Jan Willem van der Pas, who are leading a pioneering MaaS project in Eindhoven are set to include e-scooters once they are made legal in the country, comment that "The main upside of micromobility is that it contributes to building a more sustainable city, with well-connected seamless mobility while reducing traffic. We aim to provide citizens with a shared mobility network that improves urban sustainability by encouraging multi-modal transport rather than cars." Christian Humpert, Officer for climate-related matters in urban transportation in Hamburg is positive about the potential of e-scooters: "We see the e-scooters sharing providers taking responsibility for their offer and making it more sustainable. Unlocking the sustainability benefits is the next step big step for us."

If able to improve public transport access and replace ride-hailing, taxis and private cars, e-scooters can help decrease pollution, noise and congestion levels, while using urban space more efficiently. Could e-scooters help speed up a transition toward people-centric cities and improve quality of life?

We have talked to city officials in seven cities across six European countries.

Main benefits and challenges

Benefits

1. Environmental footprint – improve urban air quality and reduce climate change
2. Get people out of their cars
3. Efficient mobility – provide convenient and flexible transportation for citizens and tourists

Challenges

1. Modal shift – an issue if e-scooters take passengers from bikes and walking instead of cars
2. Infrastructure – cities are not yet set up for the new micromobility options
3. Visual pollution – people don't take care of the scooters and throw them all over the city

2

A two-year old industry maturing fast

In less than two years, the e-scooter sector has matured and innovated at tremendous speed. The abrupt introduction of the new mode, often without suitable regulatory frameworks, led to a number of challenges. Under pressure to expand rapidly, early stage companies sometimes resorted to unadapted hardware or operating models, leading to socially and environmentally questionable practices. Increasing criticism around the negative environmental impact of these services, unsafe riding behavior and poor parking fueled the debate, leading some to call for an outright ban of e-scooter sharing.

Rapid improvement

Nonetheless, e-scooter operators are demonstrating their ability to learn, adapt and drive sustainable innovation. Today, companies like Voi, a European e-scooter leader, are pioneering sustainable practices, working together with cities, their suppliers and users to reduce the environmental impact and responsibly integrate the service in cities. We take a look at key improvement areas and innovations.

1. Cities are embracing micromobility

While still in a learning phase, a surge in e-scooter regulation across the world and particularly in Europe indicates that cities are embracing the trend. Since 2018, European countries started to include e-scooters into road safety codes and national law. France, for instance, adopted the eagerly awaited Loi d'orientation des mobilités (LOM) in December 2019 which enables cities to regulate e-scooters. However, attempts to regulate e-scooters vary from city to city, with diverging outcomes.

Some cities are enabling benefits ...

"We see a shift in cities from the 'wild west' (unregulated micromobility) to stricter regulation and lately toward flexible regulatory frameworks linked to operators' performance indicators, using incentives and penalties backed up by data," states Diego Canales, Head of Strategic Partnerships at Populus, a platform that helps cities manage shared mobility. French, Belgian and German cities have been at the forefront of creating frameworks for city-operator collaboration through tenders and licenses. Enabled by national legislation, these cities are setting requirements and limiting the number of players, creating an environment conducive to responsible and sustainable practices.

... but others are restricting them

Alongside promising policies are examples of poorly designed city regulations that hamper potential benefits – often because of little or no direction from the national level. Rather than addressing common

Voi in numbers

Since launch in August 2018:

10 Countries	**16m** Rides	**400+** Employees
35+ Cities	**4m** Users	**10+** Licenses

Source: Voi Technology company data.

issues, local authorities are creating an environment that neither benefits users, nor allows operators to provide a quality service. Fleet sizes are capped low, spread out amongst 10+ operators thwarting the user experience and increasing the complexity of management for the city. In these cities, companies struggle to achieve profitability hindering long-term investment in sustainable operations. Examples are Madrid, which granted licenses to 22 players, each assigned to specific neighborhoods, or Copenhagen, which is set to grant a license to 11 companies for 300 e-scooters each. Certain cities require all e-scooters, even charged ones, to be taken off the streets at night, increasing unnecessary CO_2 emissions.

2. A complement to public transportation

Well aware that the first- and last-mile problem is a key barrier to public transport adoption, public transit operators have been keen to experiment with micromobility services. Analyzing navigation and Google Maps data, researchers in France found that the best predictor of switching between a car ride and public transit was easier access to public transport, rather than an improved public transport quality.[8] Along these lines, Eindhoven mobility experts point out that encouraging multi-modal and shared mobility can help reduce car use. Voi's user surveys[9, 11] shows that 63% of users combine e-scooters with public transport, indicating e-scooters do in fact act as a feeder to public transport.

Collaboration between public transport and e-scooter operators is becoming common, ranging from data sharing and passenger deals to integrated payment and MaaS solutions. A recent partnership between Hamburg's Hochbahn and Voi aimed to improve mobility offering reach in suburban areas. "Moving forward, we'll see an increase of cities subsidizing trips on routes that might not be profitable but provide social value, just as we see with public transport," comments Diego Canales from Populus.

3. E-scooter lifespan: from months to years

In order to reach the market rapidly, many operators started operations with off-the-shelf e-scooters not designed for shared use. It turned out that these scooters could easily be hacked and privatized, and were vulnerable to vandalism. Reports surfaced that scooters only lasted weeks or months before they were no longer usable. However, Voi data shows that investment in repairs allowed even first generation e-scooters to last longer than expected, reaching 12 months in certain cities.

Voi and Hochbahn – unlocking the first- and last-mile in suburban areas

Hochbahn customers living in Poppenbüttel and Berne benefitted from reduced ride prices (no unlocking fee and reduced price per minute) on their daily commute during a pilot phase. The first three-month evaluation concludes the partnership has been a success: 40,000 commuter trips were enabled to and from public transport hubs, improving accessibility in the suburban area.

Leveraging data from millions of rides, the industry has made enormous improvements in terms of hardware design. E-scooters are designed for intense, shared use and outdoor conditions, improving lifespan and safety. Voi's latest Voiager 3 scooter is estimated to have an average operational lifespan of 24 months.

63%

of Voi's users have used a combination of public transport and scooter to complete their journey

4. Swappable e-scooters – from diesel vans to electric cargo bikes

Navigating congested cities on light-weight, electric vehicles sounds great. Behind the scenes, however, these services have until now relied on networks of vans to collect low-battery scooters bring them to a charging station, and deploy them once again across the city. Enabled by hardware innovations, operators are redesigning their operational models to reduce the environmental impact of the service. Initiatives include electrifying the service fleet and sourcing renewable energy. For instance, Voi has 100% electric operations in certain French, German and Nordic cities with plans to scale these up.

Swappable batteries: a sustainability game changer

This latest innovation removes the need to transport e-scooters for charging. Only batteries are transported to be charged and swapped on the spot, drastically reducing the service's energy consumption and congestion contribution. Voi has started deploying swappable battery scooters in France and the Nordics, but stays committed to using previous models as long as possible to avoid unnecessary production of new scooters.

The latest Voiager 3 scooter features swappable batteries and is expected to have a 24 month lifespan

5. From piles of e-scooters to orderly parking

As e-scooters took Europe by storm, piles of scooters littering sidewalks became a common sight. Free-floating services effectively help solve first- and last-mile gaps but comes with challenges related to parking and use of public space.

Operators and cities are developing parking solutions

Cities are starting to allocate space to new modes of transport, either by converting empty space or car parking spots. Voi developed a solution leveraging geofencing technology called Incentivized Parking Zones (IPZ), which encourages users to park in city-designated parking hubs with a ride discount. First piloted in Aarhus, the solution has since been rolled out to other cities and has become an industry best practice. In Aarhus, 60% of e-scooter rides end in parking hubs, indicating it's possible to foster responsible behavior and a culture of shared mobility. Other solutions include infrastructure solutions such as parking racks, which Voi is rolling out in several cities.

6. From freelance workers to employees

In early days, certain players relied on freelance or gig workers to collect and charge scooters, a model still used in the US and Latin America. In Europe, however, pressure from regulators and an internal push to streamline processes prompted most operators to rapidly abandon the practice. Operators now work with logistics partners or in-house employees, providing workers with formal contracts and benefits. Professionalizing operations leads to greater control over the quality and sustainability of operations. Fully-owned or partnership operations allow operators to guarantee the type of vehicles that are used for operations, energy source for charging (renewable vs. not) and optimize operations.

7. Moving toward a sustainable mobility mix

A barrier to the sustainability impact of e-scooters is that they may fail to replace cars, limiting their potential urban mobility decarbonization contribution. Voi surveys[9] indicate that 12% of trips replace cars, can this increase over time?

12%

of e-scooter rides are replacing cars, taxis or ride hailing services

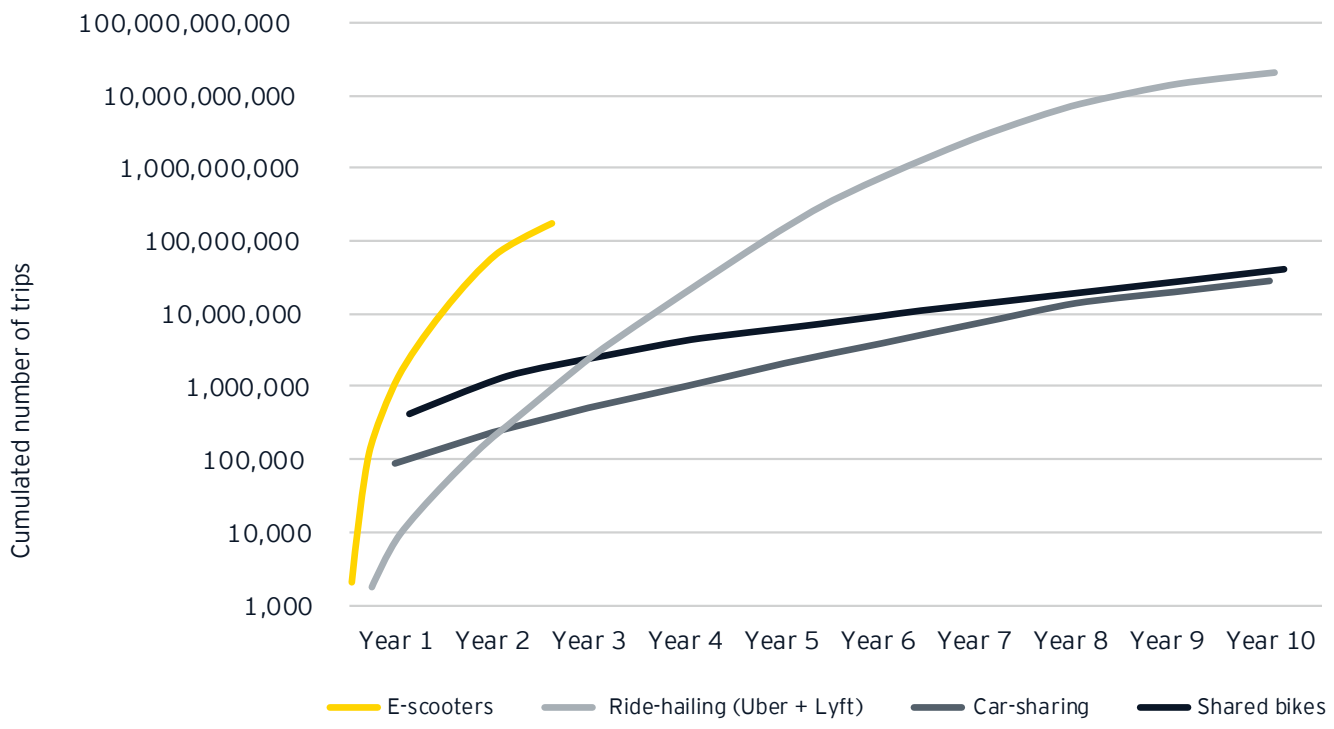
Whirlwind adoption

In a mobility adoption rate study of Paris conducted by mobility research-oriented firm 6t found that the adoption of e-scooters was four times faster than the e-bike scheme Vélib, a publicly backed and financed service, taking only six months to reach Velib's two-year mode share.[10] The whirlwind uptake indicates promising potential for driving behavior change. Prof. Grant-Muller from Leeds University, points to the challenge of changing mobility habits with barriers ranging from value systems, social status, infrastructure, finances and more. She points to the need to act early and target young people, encouraging them to use public transport and alternative mobility to avoid creating habits that are hard to change.

While people try e-scooters for fun, convenience seems to keep people coming back

E-scooters accumulate over 300 million trips globally just two years after launch.

Historical growth of e-scooters compared to other modes



Note: Ride hailing includes only Uber and Lyft data; car sharing excludes peer-to-peer car-sharing trips. Year 1 for car sharing and shared bikes based on first available data.
Source: EY research, UC Berkeley Transportation Sustainability Research Center, PLOS ONE, company websites.

Drivers of e-scooter use evolve over time

A closer look at the motivations of scooter users shows an evolution as the service matures and indicates it can be induced through partnerships between public transport and micromobility operators. For example, the 6t study shows that in the early stages, the main drivers of scooter adoption are fun and time saved.[10] A user survey conducted by Voi in July 2019 across 3,700 respondents from 31 European[11] cities shows an increase in functional trips such as work and errand commutes in cities where shared e-scooters have been around the longest. Ride pattern analysis shows that in the early stages, more trips were taken over the weekend in cities like Stockholm, Berlin and Oslo, potentially indicating leisure use. Over time, the difference between weekday and weekend trips balances out.

Commuter trips and car replacement increase over time

This suggests that as a service matures, the more likely it is to be used for commuting purposes rather than leisure. This could be linked to increased reliability of service, and to the fact that citizens have now had the time to integrate the new service in their daily commutes.

Gustav Friis from the City of Aarhus, where Voi won an exclusive concession, comments on the same trend, "In the beginning, we saw little scooter use in the morning. We are now starting to see morning commuter use, which is a really good sign." While people may try e-scooters for fun, convenience seems to be what keeps people coming back. Emerging traffic data from Stockholm is showing an encouraging trend. For the first time since 2012, traffic has decreased in the capital announced the Vice Mayor, Head of Traffic Division, Daniel Hellden,[12] – the same year e-scooters were widely introduced.

Researchers found that the best predictor of switching between a car ride and public transit was easier access to public transport

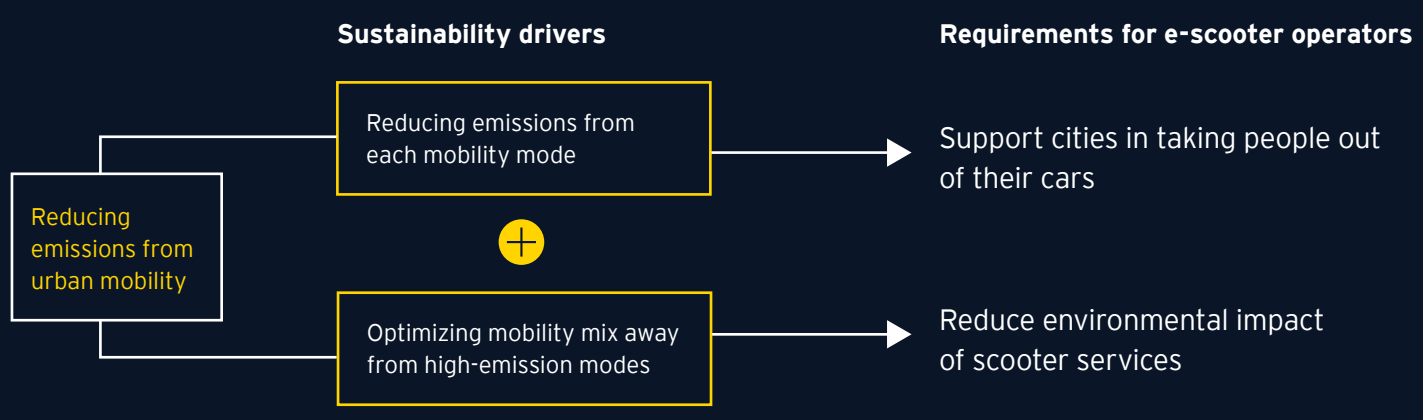
3 Environmental contribution of scooters

Two key drivers to improve the environmental impact of micromobility

Building a credible sustainability case for micromobility requires (1) measuring the overall impact throughout its lifetime and (2) considering what mode of transport they are substituting. For micromobility providers, this suggests that they must focus on:

- **Reducing service emissions:** reducing the overall environmental impact of their service across the full value chain
- **Modal shift:** strengthening the alternative mobility offering to support a sustainable mobility mix and help cities foster a modal shift away from cars and high-emission forms of transport

Sustainable mobility is driven by two main factors.



Reducing emissions: A life cycle perspective

Publicly available evidence on the life-cycle impact of e-scooters is limited. The North Carolina University published the first life-cycle assessment (LCA) for e-scooter sharing services in May 2019. The study estimates the total life-cycle impact of electric scooters to be 126 grams of CO_2 equivalent emissions per person per kilometer, roughly on par with a diesel bus.[13] The findings sparked debate, calling the sustainability claims of e-scooters into question. However, as these LCAs are based on a US service using a gig-economy model and does not account for the many recent improvements of the sector, the study can not directly be used to assess the state of European e-scooter sharing today.

In 2019 Voi approached the EY Sustainability and Climate Change Services practice to help it understand their environmental performance and how to improve it. In addition, Voi has agreed to be the first operator to share the results of its LCA publicly, believing that transparency will help regulators with policy decisions. Voi's LCA allows for European e-scooter services, including recent innovations, to be assessed providing insights into the current environmental impact of e-scooters sharing.

Life-cycle assessment definition

The first sustainability driver depends on the full environmental impact of the mode. A full life-cycle assessment (LCA) must be conducted to understand the climate impact of e-scooters, which measures all environmental impacts – direct and indirect – related to transporting one person for one kilometer on an electric scooter. This is needed to facilitate a comparison across different modes of transport and enables cities to make informed decisions about which modes to favor.

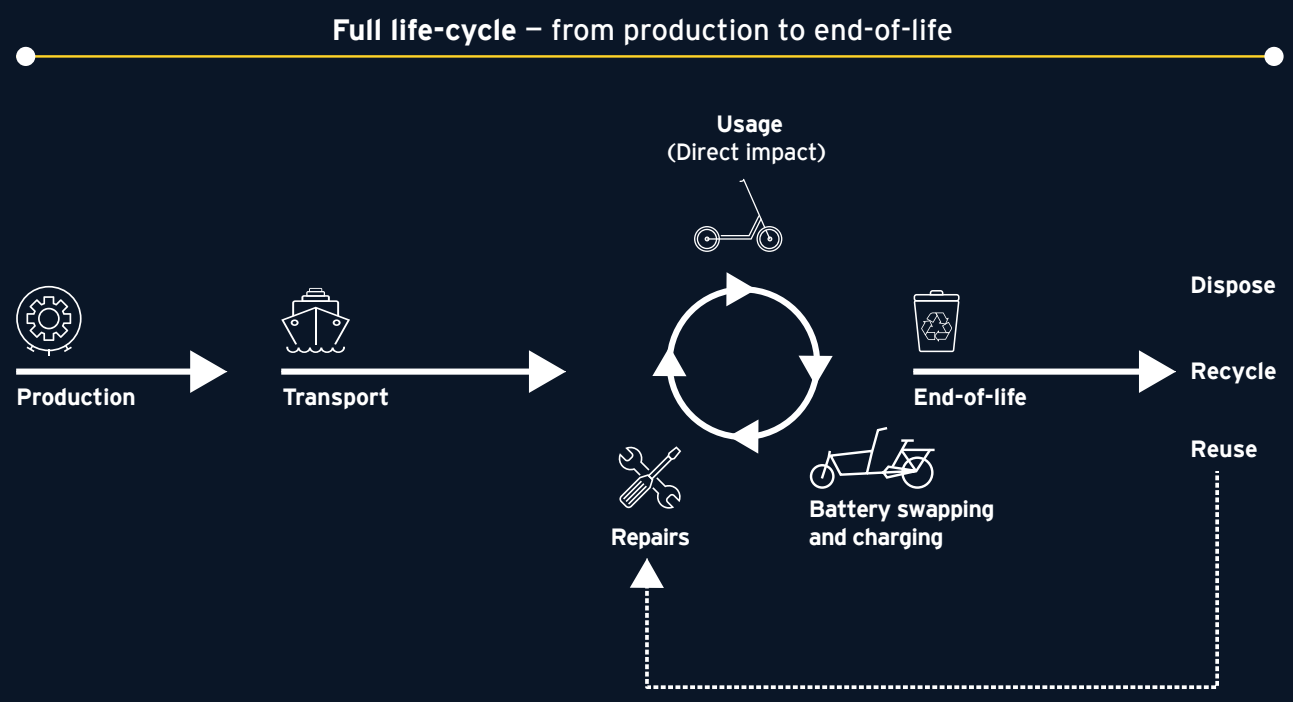
1. E-scooters sharing case study: Paris

EY's full life-cycle assessment of Voi's Paris operations shows that Voi's service emits 35g of CO_2 equivalent per person per kilometer in Paris, France, 72% lower than the North Carolina University study estimate for a service in Raleigh, USA. The main contributors to these emissions are the production and transport of the e-scooters from production sites to Europe. Emissions from usage and operations have been significantly decreased 0.3g and 1.1g, respectively, thanks to the use of cargo bikes and e-vans powered by renewable energy. Voi's strong focus on repairs, reuse of spare parts and recycling of materials, in collaboration with local partner Paprec, enables the production impact to be offset significantly.

35g

CO_2 eq. per person per kilometer for Voi's Paris service with its swappable scooter

A full life-cycle assessment covers both direct and indirect environmental impacts.

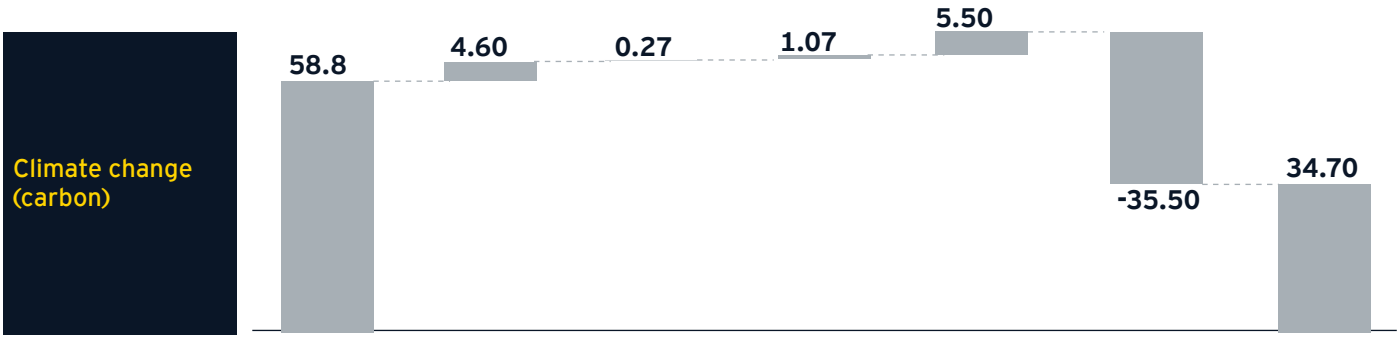


Source: EY analysis.

Production is the largest contributor to carbon emissions.

Emissions split across Voi's value chain*

Grams per person per km



	Production	Transport	Usage	Distribution	Repairs	End-of-life	Total
Climate change (carbon)	58.8	4.60	0.27	1.07	5.50	-35.50	34.70
Particulate matter	0.0620	0.0030	0.0000	0.0010	0.0070	-0.0400	0.0330
Photochemical ozone formation	0.1800	0.0100	0.0000	0.0000	0.0200	-0.1100	0.1000
Acidification	0.0005	0.0000	0.0000	0.0000	0.0000	-0.0002	0.0003
Marine eutrophication	0.0500	0.0000	0.0000	0.0000	0.0100	-0.0300	0.0437

Note: Carbon (CO_2 eq.): potential impact on climate change; particulate matter (PM2.5 eq): potential effect of fine dust emissions on human health; photochemical oxidation (NMVOC eq): effect of summer smog on human health; acidification (molc H+ eq): impact on soil and freshwater that becomes more acidic due to the deposition of certain pollutants from air; marine eutrophication (N eq): the degree to which nutrients emitted in Europe reach the oceans and lead to eutrophication.

*EY LCA analysis is based on ISO standard 14040, and based on Voi data and business assumptions. The results are not third party verified
Source: Voi LCA data, EY analysis.

Reducing emissions

In Q1 2019, the life-cycle assessment of Voi's Paris service measured CO_2 equivalent per person per kilometer at 121g, for early generation scooters, a 12 month scooter lifespan and combustion engine operations.

In Q3 2019, emissions decreased to 68g. Multiple factors contributed to this reduction such as higher scooter lifespan, increased utilization and fully electric operations using e-vans.

The swappable battery effect

In Q1 2020, the transition to a fully swappable battery scooter fleet, which enable cargo bike operations and increased lifespan further reduces the emissions by 51% to 35g CO_2 eq. per person per kilometer. The Voiager 3 has an estimated lifespan of 24 months, in line with the optimistic scenario of the North Carolina University study.

Combined, these initiatives reduced Voi's emissions by 71% in Paris since January 2019.

71%

carbon emission reduction for Voi's Paris service since January 2019 – thanks to many sustainability initiatives

Swappable battery scooters enable a 51% reduction in emissions

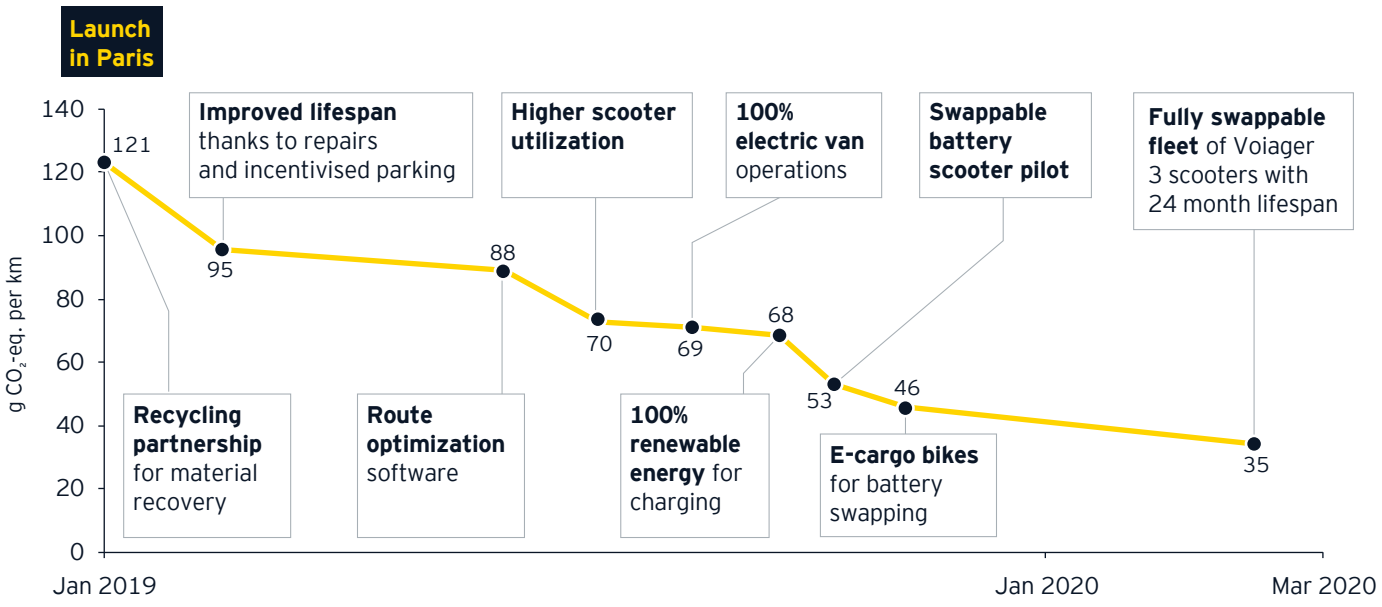
End-of-life treatment

Voi uses circular economy principles, reusing scooter parts where possible and partnering with leading recycling experts such as Paprec in France and Fortum in Sweden to develop reconditioning solutions for damaged lithium-ion batteries.

Nearly 90% of the Voiager 3 is made of easily recyclable materials, enabling high recycling rates for scooter parts that cannot be reused. In Paris, Paprec's network achieves a 99% or above recycling rate for aluminum, steel and plastic, and a 70% recycling rate for lithium-ion batteries.

Voi's Paris service CO_2 emissions have been cut by 71% since launch

The impact of Voi's improvement initiatives in Paris



Note: Paris electricity mix is low-carbon, so the move to 100% renewable has little impact for Voi in Paris.
Source: Voi LCA data, EY analysis, based on Voi internal improvement assumptions.

Key improvement areas for reduced environmental impact

Reducing energy consumption and emissions of operations

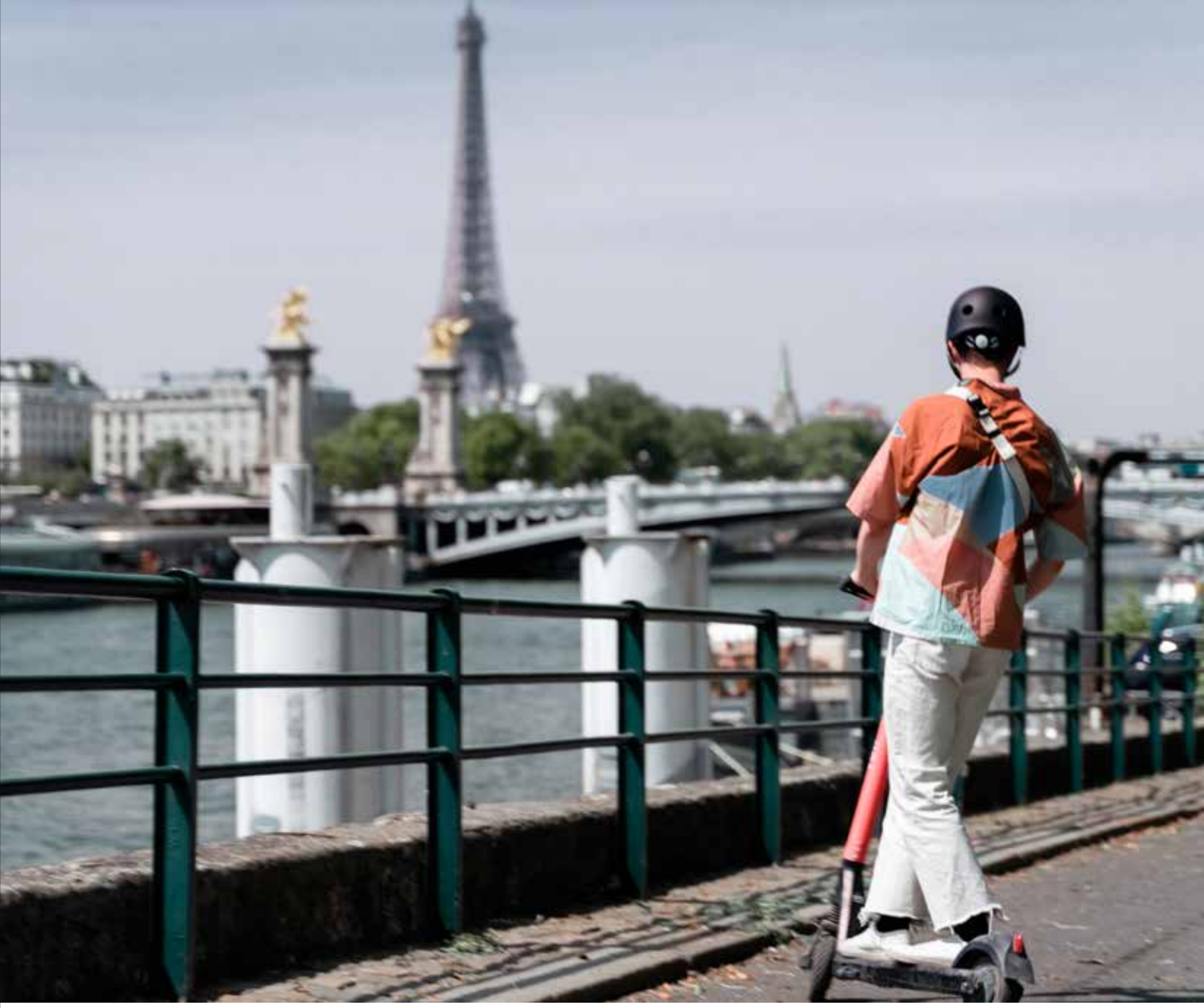
The North Carolina University study study estimates operations to drive 43% of emissions. Our analysis shows its operations account for only 3.5% of Voi's emission in Paris. This has been achieved with a number of initiatives:

1. **Electrification:** Voi uses an all-electric vehicle fleet for daily operations.
2. **Renewable energy:** Voi uses 100% renewable energy to charge all of its scooters and service fleet.
3. **Swappable batteries:** Swappable batteries cut operational emissions drastically by reducing the daily transport charge by 90% as only batteries are transported to be charged and deployed. This allows for cargo and trailer bikes to perform 75% of their in-field tasks. Swappable batteries also enable more rides to be provided with the same fleet size as scooters have much shorter down-time.
4. **Route optimization:** This software has reduced daily distance covered by bikes and e-vans by 30% by identifying shortest routes.

Improving lifespan

The lifespan of an e-scooter is the chief component of both environmental and financial performance. While lifespans have improved, scooters should be a top focus for operators. Voi's latest swappable e-scooter model is expected to have an operational lifespan of 24 months. Key levers for extended lifespan are:

1. **Durable e-scooter design:** Second and third generation scooter design leverage data from millions of rides to build longer lasting scooters, created for intense use in outdoor conditions. Voi has seen over 70% reduction in vandalism and theft since early stages.
2. **Focus on maintenance:** Predictive maintenance software and strong local teams dedicated to repairs are key to ensuring a longer lifespan for scooters. Modular architecture enables easy repairs.
3. **User behavior:** Incentivizing and guiding user behavior to park, use and care for the fleet promotes responsible use and reduces vandalism.



How Paris fosters sustainable practices

Paris has set high-ambition targets in its Air Energy Plan (Plan Climat Air Énergie territorial), which aims for zero combustion engine vehicles (diesel and gas) by 2030 and for carbon neutrality by 2050.

Since the launch of e-scooter sharing in late 2018, Paris engaged in dialogue with operators. The city is now running a tender which will formalize the partnership with operators. The process will select three operators. Highlighting the city's environmental ambitions, Paris has attributed 40% of the grade to sustainability, followed by 30% to safety and 30% to operations.

The focus on sustainability in Paris has made it an innovation hub for sustainable e-scooter sharing. It was Voi's first city to have 100% electric operations powered by green energy. It was one of the first European cities to dedicate space to micromobility parking with over 2,500 micromobility parking hubs ("zone partagée de remisage").

2. Comparison across modes

With sustainable hardware and operational setups, e-scooter sharing is a low-carbon, sustainable mobility option. The "per person km" functional unit enables a comparison across transport modes. It should be noted that comparing life-cycle assessments can be delicate given varying assumptions and limited studies on life-cycle impact of transport modes. We provide ranges for each where possible.

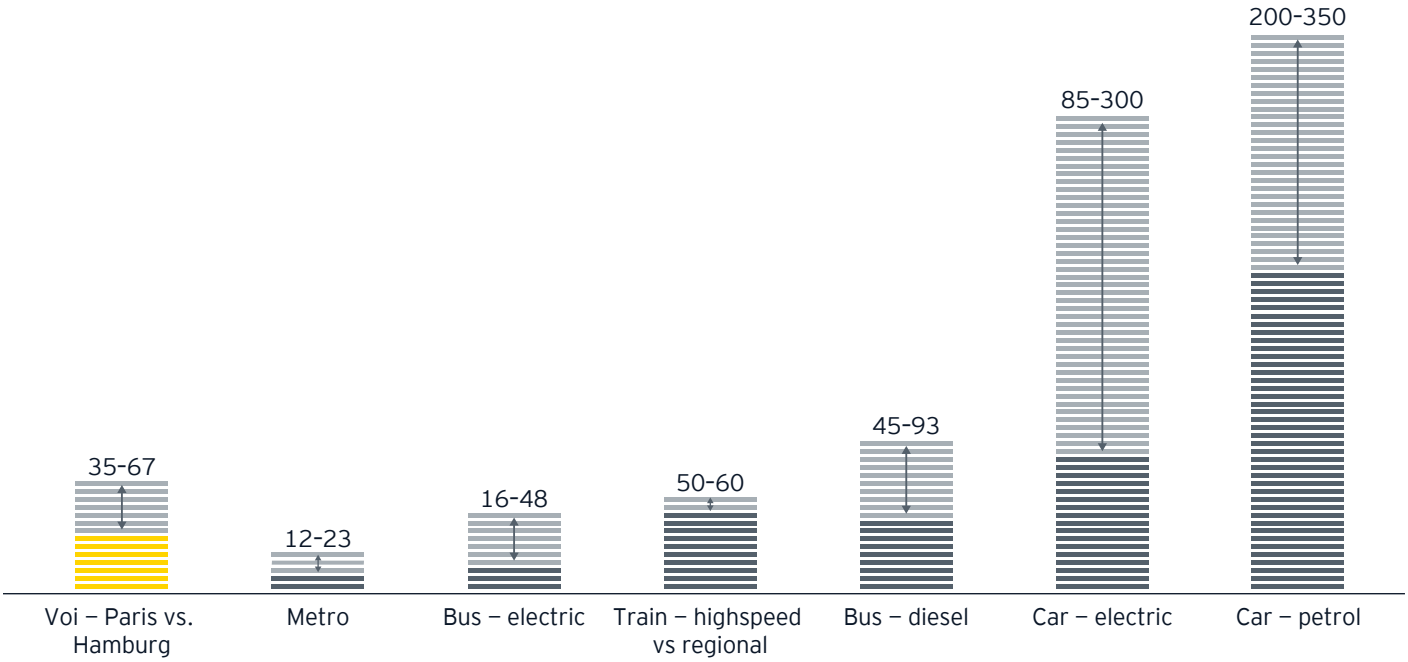
Based on available data, Voi's per person CO_2 impact in Paris is above the metro (12–23 g), roughly on par with that of an electric bus (16–48 g), and less than a train and a diesel bus. E-scooters are well below cars.

More studies needed

Improved life-cycle assessment data is needed for all urban mobility options. The OECD's International Transport Federation, an intergovernmental organization and think tank for transport policy covering all transport modes, has set out to do this. The pending study will compare the environmental performance of urban transport modes by analyzing life-cycle performance and will provide valuable data and insights into which modes should be promoted to cut transport emissions.

Comparisons to other modes

Range of CO_2 grams equivalent per person per kilometer



Multiple factors influence the emissions range for each mode including energy mix, vehicle models and average occupancy rate.

Voi's Hamburg service features a Voiager 2 scooter with an estimated 18–24 month lifespan, no swappable batteries, diesel van operations and renewable energy for charging.

Source: Voi LCA data; EY analysis; The North Carolina University LCA study, Aug. 2019; Arcadis, Extrait de l'étude portant sur l'impact environnemental des trottinettes électriques, Nov. 2019; DTU International Energy Report 2019, Transforming Urban Mobility, Oct. 2019; Lufthansa Innovation Hub, Nov. 2019.

Emissions in context

What does 35g or 126g of CO_2 represent? GHG emissions are at the heart of today's agenda and reports but many of us lack the frame of reference to understand them. Comparing to food, life-cycle analysis data shows that one cheeseburger emits around 4500g CO_2 eq. A chocolate bar 1900g and a latte 340g CO_2 eq.[14] Plant-based foods are much less carbon intensive; an apple emits 0.34g CO_2 eq. According to Nature Climate Change journal, a cotton and polyester t-shirt emit 2100g and 5500g CO_2 eq., respectively.[15]

3. Right moves on modal shift

The other driver of a low-carbon urban transport is a sustainable mobility mix, which requires a shift away from car use. "Beyond avoiding and reducing our emissions at each stage of our value chain and achieving carbon neutrality, we are actively engaged in designing and integrating our service in a way that increases car replacement rates," says Fredrik Hjelm, CEO of Voi. A carbon neutral service which only replaces walking and public transport will fail to help cities reduce emissions.

Voi aims to design its service to attract more taxi and car users. Their initiatives include: commuter packages and discounts, MaaS integrations and a Voi for Business platform.

Voi for Business

Voi for Business enables companies to seamlessly provide employees with e-scooter rides, aiming to convert business taxi and car trips into micromobility trips. AdeoCare, an elderly care provider in Stockholm leases a fleet of 30 service cars used by employees to visit patients around the city. By joining the platform, it aims to encourage employees to opt for e-scooters instead of a car, hoping to save time, money and reduce the company's carbon footprint.

In Paris, the CO_2 impact of Voi's service is similar to that of public transport

4

How can cities unleash the potential of micromobility?

When managed sustainably and integrated effectively within existing transport ecosystems, e-scooters can help cities decarbonize transport and improve quality of life. With e-scooters here to stay, the question is no longer whether cities should welcome e-scooters but how. "Ultimately, cities want to understand the implications of micromobility, handle the externalities and learn how to benefit from it," comments Diego Canales from Populus. Based on our talks with cities and research insights, we come with seven recommendations for policy makers and city officials to unlock the potential of shared scooters and driving sustainability best practice.

1. Implement national policies that foster a transition toward sustainable mobility

Sustainable urban mobility requires governments, cities, public transport operators and private actors to work together toward shared goals. National policies are crucial to enable cities to regulate but also ensure cities move smartly toward sustainable mobility. Governments should set national traffic and product requirements on the one side and push cities to allocate more

space to micromobility — both in terms of parking spots and micromobility lanes. In addition, national legislation needs to provide the right framework for cities to choose operators based on criteria related to safety, operations, data sharing and sustainability.

2. Limit and select players based on sustainability, safety and operational excellence

Cities are increasingly running public tenders to select operators and enforce requirements. Marseille is considered to have run a successful tender, by capping the number of players based on population size and selecting operators according to multiple criteria. A capped market fosters more certainty for operators enabling investment in sustainable service.

Clear requirements for operational and hardware sustainability should be set. Cities should select operators who have a track record in responsible employment, sustainable practices such as extending scooter lifespan and green operations with e-vans, cargo bikes and renewable energy.

Employ dynamic fleet capping based on utilization data to ensure demand is met. User data shows that critical density of scooters is required to unlock the convenience and first- and last-mile benefits of the service.

3. Foster public transport — micromobility collaboration

Experts envision dense shared mobility offerings composed of solutions such as e-scooters and automated shuttles enabling access to public transport and strengthening alternative mobility networks. Cities should not shy away from relying on privately owned companies that shoulder the financial burden and pursue partnerships in order to address challenges. With the 2030 Agenda calling for increased Partnerships for the Goals (SDG 17), collaboration between e-scooter and public transport operators is a promising example of public-private partnerships that has the potential to support a transition toward sustainable urban mobility.

4. Create access to micromobility parking

Policies geared toward levelling the playing field between cars and new modes are needed. With competition for public space, local governments can look at curb productivity, an indicator enabling data driven urban space management, based on how productive (# of passengers) a mode is per time and space. For example, shared e-scooters can be used by up to 8–10 people daily and a single car parking spot can house up to 10–15 scooters, while cars transport on average 1.3 people and are parked 95% of the time. Cities should ensure lighter modes of transport have access to parking space.

The City of Paris has allocated 2,500 micromobility parking spots for a planned 15,000 e-scooter fleet (which will be spread across three operators). By converting the empty space between pedestrian crossings and parking spots, Paris found a low-cost way to enable orderly parking. Other cities should follow suit and put in place a critical mass of spots to meet the demand for parking and incentivize users to park in an orderly fashion. Parking zones, however, should be incentivized rather than mandatory, which could thwart some of the benefits of free-floating services (services without fixed stations) such as a reduction in mobility options for city residents.

5. Support safety efforts and invest in alternative mobility infrastructure

Safe mobility is a shared responsibility between governments, cities and service providers. A report published in February 2020 by ITF concludes that e-scooter riders do not face a significantly higher risk of road traffic death or injury than cyclists. In fact, the real danger on the road remains cars, with heavy motor vehicles at higher speed involved in 80% of fatal crashes with cyclists and e-scooter riders. The report's recommendations for policymakers and city planners include creating protected and connected infrastructure for micromobility. This dramatically increases adoption and safety of the mode, by ensuring car and other modes are separated. Furthermore, traffic calming measures (e.g. speed reduction) has a positive effect on micromobility safety. Cities should favor operators who invest in user awareness and safety events to foster responsible behavior. Cities can support and legitimize safety campaigns and help enforce sanctions for bad behavior such as drunk driving.

6. Harness the power of data and regulate dynamically

Harnessing data insights is a priority for city officials and mobility plans. "Collaboration with providers, access to data and learning by doing are the most important factors for us – we need to know what happens on the street," comments Eindhoven mobility experts. Free-floating, connected mobility services provide invaluable insights into how people move around cities, helping to identify mobility gaps and understand habits.

Cities can use tools provided by third parties. For example, Voi's City Data Dashboard is a platform built to help city stakeholders and regulators understand and manage the use of scooters in their city – the number of trips, trip distance and duration, times of trips, most used routes, etc. These tools can enable evidence driven policies and investment in improved, safer and greener transport options.

Dynamic regulation based on user patterns and utilization data provides flexibility and can maximize benefits. For instance, fleet caps should be adapted to demand data. Voi fleet data shows that critical density of scooters is required to unlock the convenience and first- and last-mile benefits of the service.

Ride like Voila – a digital traffic school

Ride Like Voila is the first certified e-scooter traffic school. It includes gamified e-learning modules about traffic rules and safe riding. 250,000 people have visited the school, receiving free credits for passed modules. The content was created in collaboration with the NTF, the National Society for Road Safety in Sweden and certified by VIAS, the Belgian Institute for Road Safety.

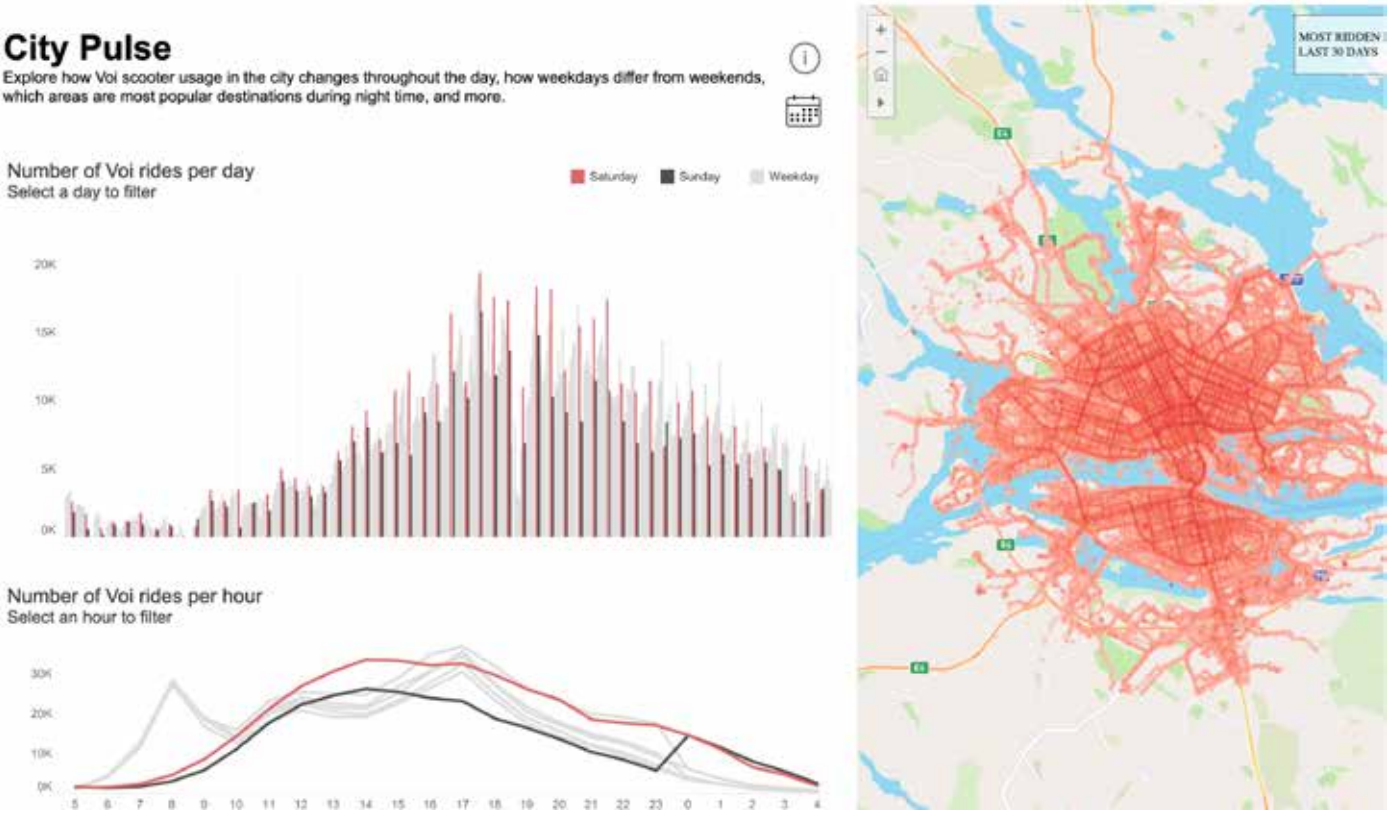
Dynamic regulation responds to data based on key performance measures

7. Foster modal shift

Reducing car trips can only be achieved by combining smart policies that promote sustainable behavior with convenient transport alternatives. Today, most cities have implemented Sustainable Mobility Plans, which set reducing combustion engine based trips and increasing alternative mobility share as central targets.

Alternative mobility has traditionally included walking, cycling and public transport but not micromobility. Widening the definition of alternative mobility to include sustainable micromobility options can help cities effectively reduce transport emissions without thwarting accessibility. Policies focusing on behavior is key. Changing habits is a key challenge for most policies, providing convenient, affordable options while incentivizing behavior through taxes, MaaS integrations and service design is key. Attracting youth early on to alternative mobility rather than car adoption is also crucial and removes the need to convert them later on.

Snapshot of Voi's City Data Dashboard



Source: Voi Technology company data.

5

The path to a sustainable future

Today's cities are facing a challenge: reducing pollution and congestion while improving urban access and quality of life. To usher European cities into post-car centers, noise and pollution free zones will not only take smart policies and infrastructure, but a fundamental shift in mobility habits and behavior. This is where the sustainability potential of e-scooters lies: first tried out for fun but adopted for convenience, they exhibit tremendous uptake pointing to their potential to change the way we move in cities. By making alternative and public transit systems more accessible and convenient, e-scooters can serve as a catalyst toward shared and low-carbon mobility. "Shared mobility is part of the bigger plan of creating a livable, sustainable and accessible city with places that are pleasant to stay in. MaaS and micromobility are key in our plans," say Eindhoven MaaS experts, Astrid Zwegers and Jan Willem van der Pas.

To take advantage of e-scooters, cities and policy makers should embrace the trend and create environments conducive to private sector investment and sustainable practices that benefit the city, its citizens and the planet. Together, investment toward micromobility infrastructure, effective policies, innovation and responsible business practices can help cities reach their climate goals, reclaim space for citizens and improve their quality of life. While some challenges remain for the e-scooter sector, such as solving parking and improving safety, the unexpected rise of the e-scooter in Europe shows that the future of mobility which is people centric and provides low-carbon transport may come faster than we thought. Data-driven smart policies are needed to support the shift rather than delay it.

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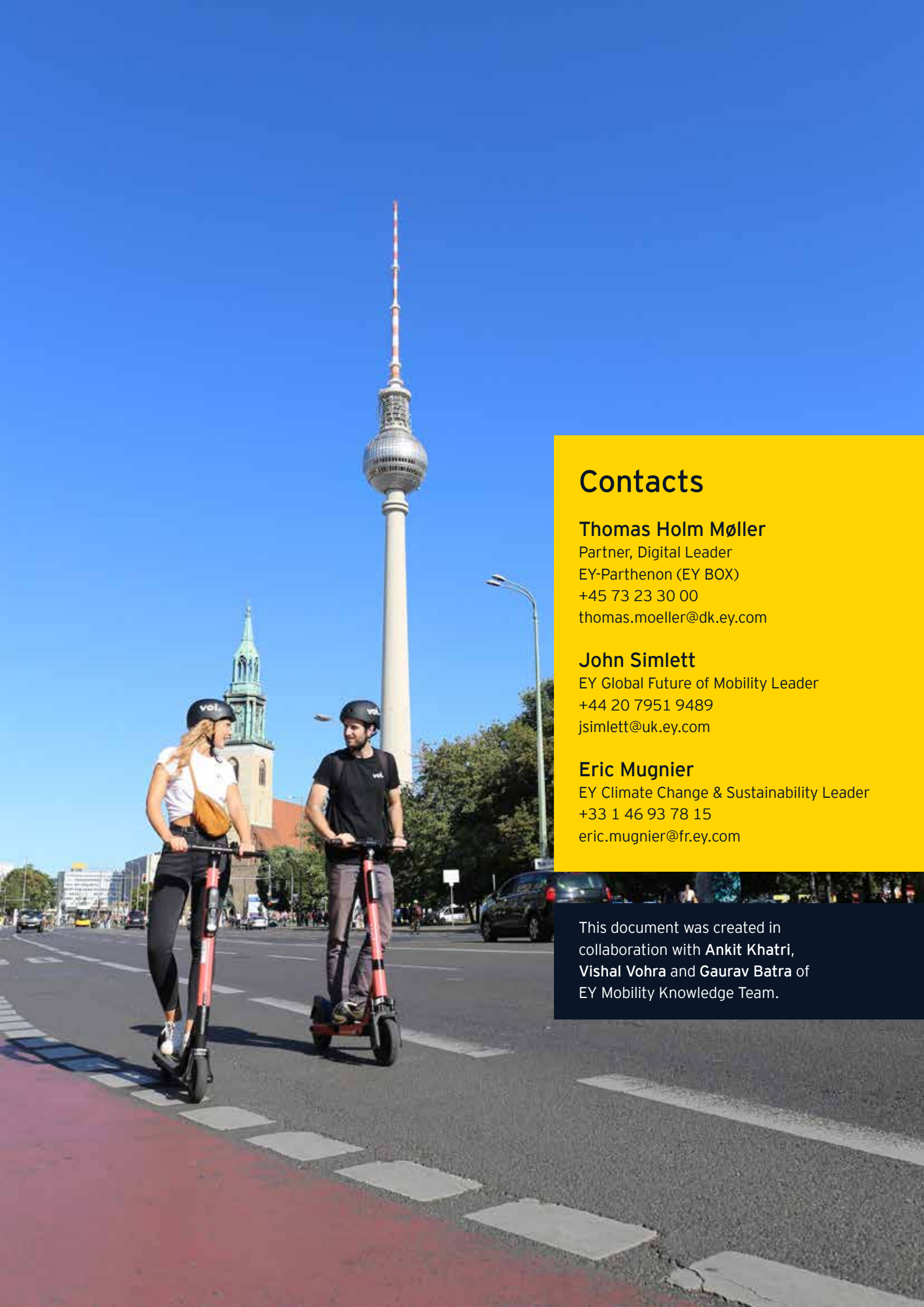

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