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Examining the impact of a sustainable electric micromobility approach in Europe

I. Introduction

Never-ending traffic jams, growing CO_2 emissions and high particulate matter, excessive noise levels, and a lack of recreational space have become some of the most pressing issues for Europe's cities. Still largely focused on the needs of (combustion engine) car drivers and reliant on outdated infrastructures, most cities' transport systems have been unable to adequately address these important threats to the quality of life in our urban areas. It is also becoming clear that, as it stands, they will not be able to accommodate the expected roughly threefold increase in both passenger and freight ton kilometres travelled by 2050.[1]

One of the most recent developments in the urban mobility sector has been the rise of electric micromobility. Over the past two to three years, electric two- and three-wheelers have exploded onto the scene, with numbers increasing four times faster than similar bike sharing schemes. Still in its infancy, micromobility set out with high aspirations to solve some of our cities' gravest problems – such as pollution and congestion – while creating a new, fun mode of moving people and goods. To date, it has not been able to live up to that promise. On the contrary, the hasty and unsustainable manner – both with respect to the technology and the business model – in which the vehicles were introduced to the market has created new problems.

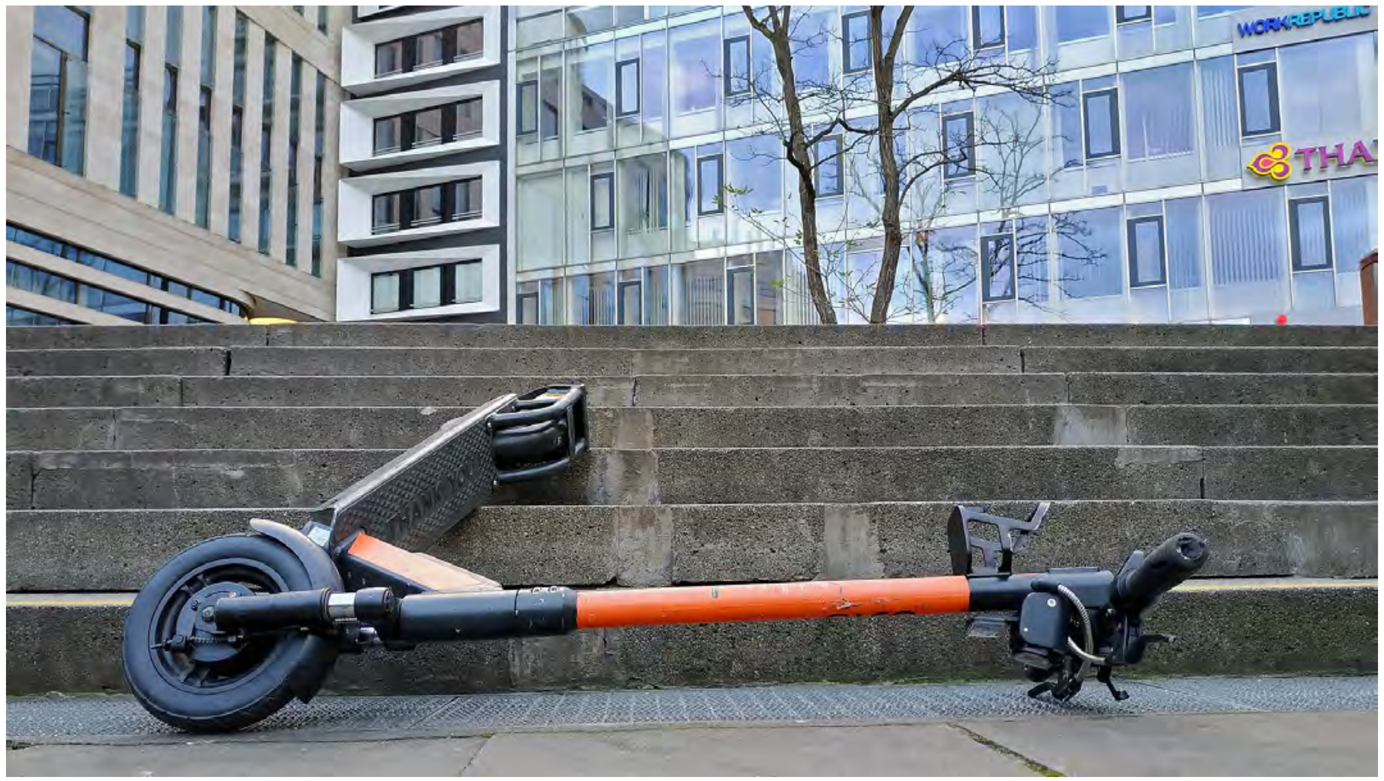
If these teething troubles are eliminated, electric micromobility can be a key element of a distributed, multimodal transit system using sustainable vehicles and business models – ultimately, leading to a highly positive overall impact on the quality of life in Europe's cities.

For this to happen, however, the growth of this sector must be supported and guided. This report will examine the challenges facing electric micromobility today, point out possible solutions and present initial substantiated estimates on the huge impact potential of a sustainable and coherent micromobility approach in Europe. The data is based on assumptions gathered from the McKinsey report "Micromobility: Industry progress, and a closer look at the case of Munich" from November 2019 in addition to discussions and input from diverse industry and academic experts.

Jennifer Dungs Global Head of Mobility at EIT InnoEnergy

II. Challenges facing micromobility today

Many of the issues with micromobility arise from the way in which the technologies were first introduced in Europe. The first waves of micromobility fleets were hastily brought to market, with players rushing to capture valuable market share. This accelerated rollout has led to a number of issues that have hurt both the perception, as well as the actual business case surrounding shared micromobility fleets.



When the first generation of vehicles rolled out, the initial excitement was countered by a wave of viral photos of broken scooters and bikes on many cities' streets. Not only do **short vehicle lifespans and a lack of serviceability** bring sustainability and profitability into question, the negative press associated with broken scooters opens the door to nimbyism against the model as a whole.

The challenge of bringing micromobility to scale in Europe is not simply a matter of building more scooters and putting them on the streets. At present, the vehicle types offered cover **less than 50% of use cases**. To increase the share of micromobility from the current **0.1% of people kilometres travelled in cities**[2], it will be important for the vehicles on offer to be more versatile and inclusive. Improved loyalty to mobility providers could also help reduce the already high customer acquisition costs.

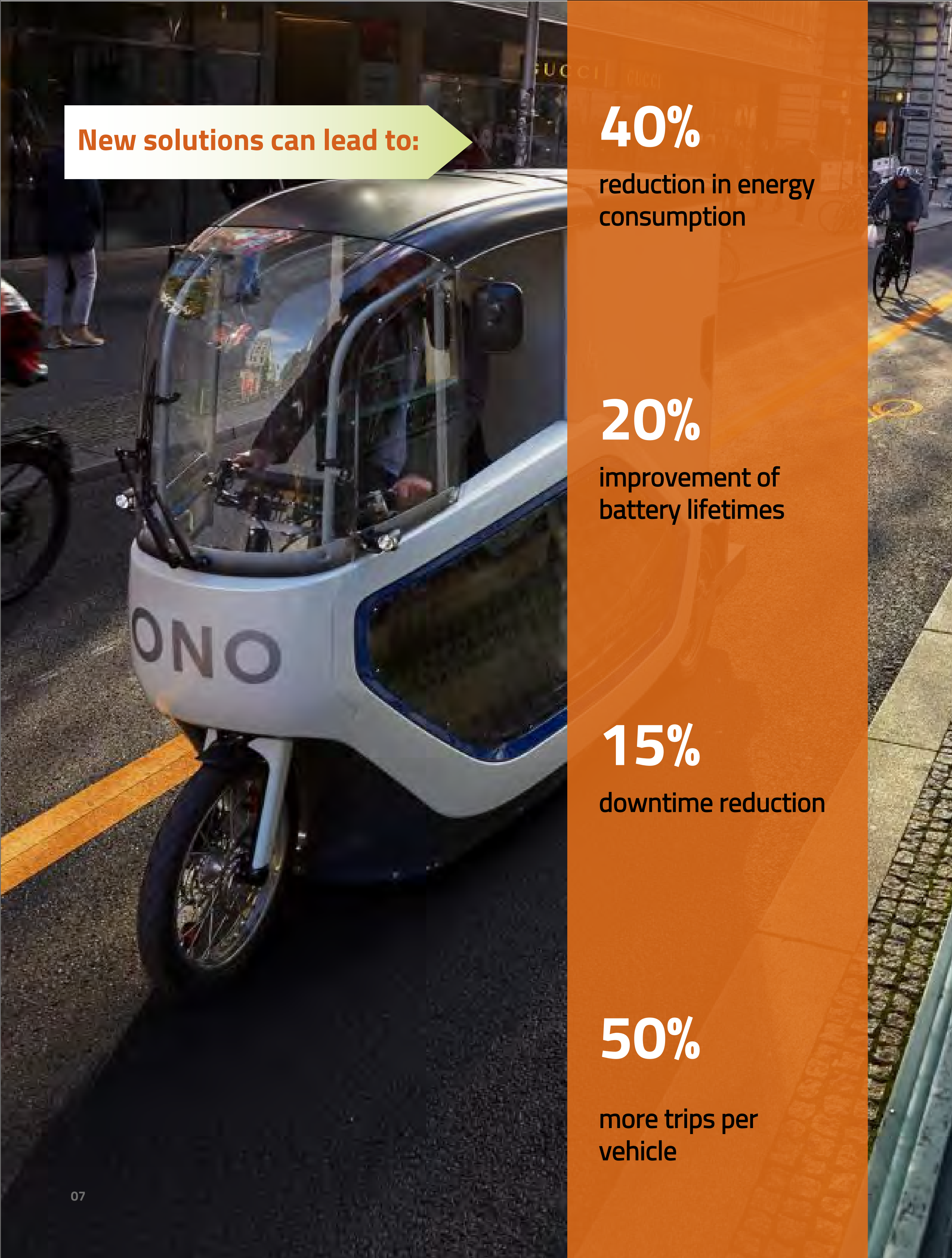
The **operations side of the current shared micromobility fleets also presents a challenge** as the market looks to grow exponentially. Poor management of vehicles, especially related to the **relocation and charging** of vehicles results in **high operational costs**, cutting into already thin margins. In addition, there is a lack of implemented advanced analytics and predictive maintenance solutions.

Lastly, it is also important for micromobility to better integrate itself into the current multimodal mobility system. Shared micromobility can by no means replace all of our other means of transportation – but when efficiently combined with them, it can be a part of a more efficient and sustainable overall system.

III. Solutions to address current micromobility challenges

Thankfully, mobility in general is coming into focus as one of the most important societal challenges to tackle. The inefficiencies, emissions, and delays currently plaguing inner-city travel have taken center stage, and a rethinking of the priorities defining urban life is taking place. Micromobility can be central to this retooling – playing a pivotal role in shaping how we navigate our urban areas.

To play such an outsized role in the redesign of our (urban) societies, new technologies and solutions across the entire micromobility supply chain will need to be implemented. We outline these solutions in the following.



New solutions can lead to:

40%
reduction in energy consumption

20%
improvement of battery lifetimes

15%
downtime reduction

50%
more trips per vehicle

Recent analyses suggest that the current fleet of **micromobility vehicles need to be repaired >1x per month**[3], with overall lifespans only amounting to several months. At the same time, repair costs amount to around 17% of the total overall operating costs.[4] Putting a greater focus on high-quality components, particularly the **electronics**, **battery**, and **motor**, will better equip vehicles to handle more miles, and play a larger role in the mobility mix. In addition, producing batteries locally, using renewable energy has the potential to **reduce CO_2 emissions related to manufacturing by more than 50%.**[5]

Not only can a switch to high-quality components play a major role in increasing sustainability, but utilising recycled parts**can also lead to a 40% reduction in energy consumption.**[6] Its becoming easier to source these recycled components thanks to an increasingly active "Urban Mining" sector, which recovers valuable metals, used extensively in production, through mechanical and chemical processes. At the same time, the development and deployment of new lower weight materials for some components can improve longevity, **reducing emissions by around 10% and energy consumption by 5-8%.**[7]

Purpose-built vehicles with new form factors present another transformational opportunity in the micromobility sector. At the moment, more than **50% of short-distance trips are not supported by the current fleet of micromomobility vehicles.**[8] For instance, transporting groceries, picking up children from school or parcel deliveries are simply not feasible. And for people with certain disabilities, the vehicles are not usable at all. Developing new form factors will be key to opening up **more use cases and helping expand market share**. Alternative micromobility solutions are already making their way to market, with pedal assisted e-cargo bikes such as the popular Urban Arrow, or newcomers in the last mile logistics space like Ono or Ducktrain. These present a step in the right direction, greatly increasing the number of applications for micromobility vehicles.

Additionally, new financing options could help play a major role for micromobility providers to scale, and scale quickly. For them, this would open the door for offering leasing options or subscription models which can make the services more attractive to a larger share of people. These should be complemented by affordable insurance options, making it easier for smaller players and newcomers to enter the fray and drive further innovation. Mobility service providers offering vehicles require support with upfront CAPEX costs to grow and scale quickly. Today, this support is primarily provided by venture capital firms; however, if banks and financial institutions could increase their participation, this would create **more opportunity and flexibility in the business models**.

One of the most significant technology breakthroughs on the horizon for micromobility comes in the form of battery swapping stations in addition to charge and lock stations at mobility hubs and hotspots. Moving to a battery sharing model will allow for more efficient operation – repowering vehicles in a matter of seconds rather than minutes or even hours. Battery swapping also allows this repowering to happen away from an electrical outlet, cutting down on the need to transport vehicles in order to recharge. Ultimately, a battery swapping system will require continued research and development in the sector, with higher energy densities and lower weight batteries (<12 kg) necessary to make the model feasible. In addition, the business model still needs to be proven in terms of the required utilisation of battery swapping stations.

One key to unlocking the benefits of swappable batteries is newly developed software platforms to improve predictive maintenance, analyses, and battery protection. Enhanced predictive maintenance has shown that it can **reduce downtime by around 15%**[9] - which becomes even more valuable as battery swapping systems open up the possibility of higher vehicle utilisation rates. It is estimated that the combination of several software advancements could improve battery lifetimes by 20% and, in turn, increase the number of kilometres travelled between swaps.[10]

Another software-based solution that can play a major role in the advancement of micromobility is in the development of analytics platforms to support relocation and charging.

At present, **relocation costs represent a significant part of overall costs** for micromobility players. However, there is enormous potential in automating relocation. US software provider Zoba, for example, claims that operators can increase the trips per vehicle by **as much as 50%** using their solution.[11]

For shared micromobility fleets to truly take off and secure their place in the multimodal mobility systems we are seeing take shape is no small task. An essential requirement will be **an intensified and structural** collaboration between cities and providers. Such collaboration could come in different forms such as online information platforms, regular stakeholder summits and many more. However, as things stand right now, such structural exchange between cities and providers to access information, or share data, important learnings and best practices does not exist. This deficit must be eliminated quickly.

Not only will cities and providers need to work together to find solutions, but they will also need aggregator platforms **to help facilitate a better integration with existing transport modes**. Shared electric scooter operator VOI found that **63% of its users regularly combine micromobility and public transport**.[12] This points to the inherent usefulness of micromobility as a complimentary mode of transport, allowing people to make their existing commutes more convenient. There are also ample opportunities for **new businesses** to emerge as these aggregator platforms come to maturity. This includes new business models and partnerships with restaurants and other businesses. The relative infancy of these sharing models means providers are still only scratching the surface when it comes to unlocking both usability as well as profitability.

Finally, for micromobility to reach its full potential as an important part of the urban mobility system of the future, more favourable regulation **will be necessary**. This includes local laws regarding existing challenges such as the parking and operation of vehicles, as well as implementing favourable regulation for future issues such as battery swapping stations and local manufacturing. A number of Europe's leading micromobility providers have joined forces to create "Micro-Mobility for Europe" (MMfE) - a coalition advocating for a coherent policy framework that shall help usher in a rapid transition to sustainable urban transit.[13]

To design the right solutions and ensure a successful rollout, it is important that the tasks at hand be viewed through multiple lenses which come with a set of key questions that need to be addressed:

1 Consumer	2 Technology	3 Sustainability	4 City/regulation	5 Market
Which pain points exist for consumers when using micromobility? How can we create a seamless integration with other modes of transportation?	Which breakthroughs are needed to drive wider adoption and enable a viable business model?	How can vehicles, batteries and the operation be made more sustainable for people and the planet?	How can cities and regulators contribute to creating an integrated and meaningful ecosystem of mobility, including micromobility?	What are the economic implications of purpose-built, sustainable electric mobility? What levers can we pull to help create opportunity for jobs and growth in the EU?

The challenges, solutions, and lenses (or perspectives) can now be ordered along the micromobility value chain.

	Value Chain	Challenges	Solutions
1	**Vehicle components**	Lack of **sustainable production and recycling**	High-quality components produced locally
2	**Vehicle integration & testing**	Limited coverage of **customer use cases**	Purpose-built vehicles
3	**Financing / asset ownership**	Lack of **flexible leasing solutions** and **insurance**	Asset provision for micromobility players
4	**Operations**	High costs due to **fragmentation** and **labour costs**	Aggregated battery swapping and fixed stations network
5	**Fleet management**	Inefficiencies due to **lack of analytical tools** and **predictive maintenance**	Analytics platform to support relocation, charging and predictive maintenance
6	**Collaboration models**	Lack of established **collaboration models** between **cities and providers**	Best practices sharing between cities and providers
7	**Aggregator platform**	High **customer acquisition costs** and **low loyalty**	Aggregator platform for better integration with other transport modes
8	**Regulation**	Missing **incentives** and **synergies with public transport**	More favourable policies and regulation for micromobility

IV. COVID-19 and other sector developments driving the momentum for integrated micromobility solutions

By honing in on the solution elements outlined in the previous chapter, it is possible to address most of the revenue potential across the micromobility value chain using two- and three-wheeled vehicles.

At present, there is considerable momentum for tackling these challenges. Cities, regions, and even entire countries are beginning to announce and implement diesel and ICE (internal combustion engine) bans (e.g. UK, California) and emission-free zones (e.g. London, Paris, Milan, Rotterdam, Utrecht, Hannover, Stockholm, Brussels).[14]

The EU as a whole has already committed to go carbon-neutral by 2050, as well as cutting greenhouse gas emissions by at least 55% by 2030.[15] This signals a desire to move in a more sustainable direction with coordinated actions being taken, albeit on a longer timeline.

In addition to these measures **COVID-19 has pushed cities to take steps to support micromobility**, as the pandemic has shifted mobility activity to become more hyperlocal in nature (e.g. through the introduction of new bike lanes or the expansion of existing ones). As a result, electric two-wheeler sales have continued to grow, and it is expected that by 2033 50% of all sales will be electric.[16] To put the current volume in perspective, sales revenue from the top two-wheeler manufacturers amounted to 60B in 2019.[17]

The impressive growth seen in the sector has resulted in **considerable interest from the investor community**. In fact, this past November, European micromobility leader TIER completed a 250 million USD Series C funding round led by SoftBank Vision Fund 2.[18] In just two short years the Berlin-based mobility company has grown from a new start-up to having more than 60,000 vehicles in 80 cities. The growth in micromobility is also converging with a massive boom in e-commerce, with a 31% year-over-year increase in Europe in 2020. This varied from country to country, with Germany and Spain recording a 22% and 75% increase, respectively.[19]

One important principle towards enabling a higher adoption of micromobility options is that the **transition must be guided**. This means decision-making must become less fragmented – considering both the end-user as well as the needs of the city, allowing solutions to scale faster and move between cities and providers. Putting a high priority on coordination among players (e.g. micromobility, ridesharing and ridehailing providers, logistics operators, manufacturers, regulators, public transportation, consumers, urban planners) and **data sharing** in the industry will enable a paradigm shift to occur in mobility. A holistic view, taking into account all relevant players, will be needed to ensure that congestion, commute times, and GHG emissions can all realise their maximum potential decreases. Surprisingly, if the correct steps are taken, this can all be achieved while overall spending on transportation by the city as well as the end user shall decrease.[20]

V.The impact potential of an integrated electric shared micromobility approach in Europe by 2030

The potential impact of a coherent micromobility approach can be significant. The impact can be measured **across three dimensions**, which guide EIT InnoEnergy's Energy for Transport and Mobility investment strategy: Planet, People and Profitability.[21]

The emissions of one average ICE vehicle are equal to roughly two EV's, or 7.4 to 12 electric scooters[22], meaning a shift to more micromobility solutions can play a massive role in fighting climate change. At the same time, the **space needed for one car equals that needed for roughly 12 bicycles**.[23] A shift to more sustainable micromobility could provide massive savings when it comes to emissions as well as space. At the same, it could propel the market development and create thousands of jobs.

For a deeper dive into the overall impact of electric, shared micromobility in Europe, the McKinsey report "Micromobility: Industry progress, and a closer look at the case of Munich" from November 2019 was used as a basis. This was combined with validated assumptions to create a projection regarding the potential impact if deployed across 100+ European cities. Currently, around **60% of all car trips in cities are less than 8 km**[24] – and with the addition of new form factors, it is assumed **50% of those trips, which are taken with cars, could be replaced with a suitable micromobility vehicle**.

Today, shared micromobility trips account for <0.1% of all trips. However, it is projected that the modal split will evolve and that shared micromobility trips may reach 15% by 2030 (aggressive scenario). Note: two additional assumptions included in the calculation are that kilometres travelled and use cases served are both expected to increase. However, restrictions such as age, weather and customer adoption were still applied. In consequence, **roughly 13% of all possible shared micromobility kilometres travelled were used as the basis.**

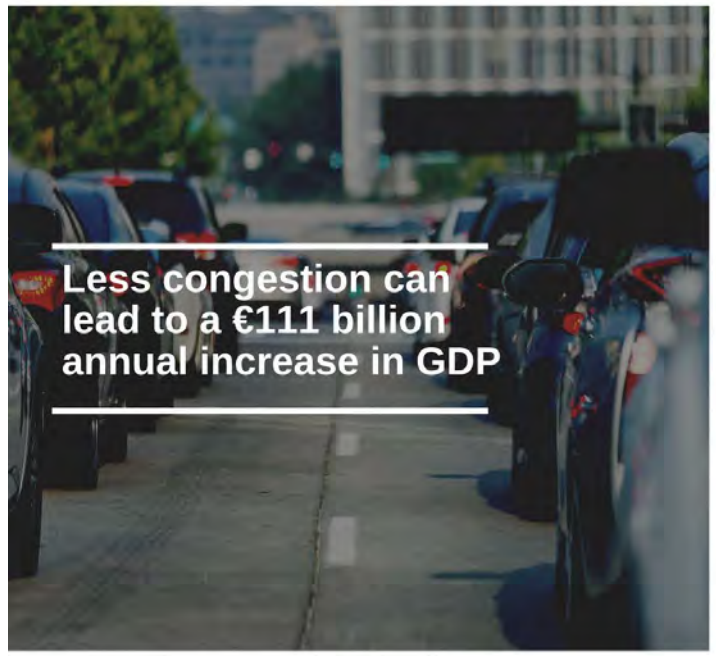
The results are presented below in terms of CO_2 emissions and energy consumption saved, jobs created, impact on the GDP, and space creation.

ca. 30.7 million tons of CO_2 emissions and 127 TWh of energy consumption could be saved per year – this is equivalent to ca. **12.5% of the German energy sector's CO_2 emissions in 2019**[25] and **ca. 23% of Germany's transport sector's overall energy consumption (751 TWh, 2018).**[26]

Around 990,000 direct and indirect jobs could be created on the continent – as a comparison: the **entire automotive sector in the EU currently provides ca. 13.8 million jobs** (direct and indirect).[27]

~ €111 billion increase in GDP could be realised, thanks to ~ 999 million person hours saved per year due to decreased congestion. This is equivalent to **almost 1% of the GDP of the Euro zone**[28] **or more than the combined GDPs of the four EU countries Malta, Cyprus, Latvia, and Estonia.**[29]

In addition, 48,000 ha of inner-city land could be freed up, equivalent to more than **4x the total area of Paris.**[30]



VI. Conclusions and outlook

Urban mobility tomorrow: Micromobility as an integral part of a tightly integrated and sustainable urban transportation system

Short-distance travel in our cities must become more efficient and greener, and there is no time to waste. There is a growing understanding that this transformation requires a guided scaling up of micromobility as it will allow cities to optimise urban mobility holistically across supply and demand.

In the short term (1-3 years), there is a need for a **technical and consumer push** – improving the technical solutions and increasing the attractiveness for consumers. In the mid- and long-term (3-7 years), there will be a need for a system switch – **onboarding more cities, holistic planning, and scaled solutions** which will continue to attract investment.

The scale-up of micromobility is well underway, but it is important that it is planned and supported to ensure all parties involved can benefit accordingly. Cities, their inhabitants, as well as companies can all benefit greatly from a well-functioning, well-planned multimodal mobility system. As micromobility is presenting itself as a missing piece in the mobility puzzle, it is vital that all parties help it find its proper place in the bigger picture.

Key assumptions

The key assumptions made for this report are based on data from the McKinsey report "Micromobility: Industry progress, and a closer look at the case of Munich" from November 2019 by Kersten Heineke, Benedikt Kloss, and Darius Scurtu.
The mobility data from Munich was scaled up to larger cities across Europe with a population of >300,000 inhabitants.

The calculations are conservative and already include improvements made to both manufacturing and operation of the vehicles for the base case in 2030. Regarding manufacturing, 70% CO_2 improvement was included to account for increased lifetimes plus better maintenance. Reductions in CO_2 were also included for improvements to battery life and vehicle transport (due to more local production). Regarding operations, CO_2 improvements related to frequency of charging, collection and distribution, and energy required for full charge were included.

About EIT InnoEnergy

EIT InnoEnergy brings people and resources together, catalysing and accelerating the energy transition. New ideas, products and solutions that make a real difference, and new businesses and people to deliver them to market. We engage at every stage of the journey – from classroom to end customer. Operating at the centre of the energy transition, we build connections worldwide, bringing together innovators and industry, entrepreneurs and investors, graduates and employer.

Our bespoke support to accelerate sustainable energy innovation knows no borders or boundaries

- Industry are linked with innovation and alumni, providing commercially attractive technologies spanning the energy value chain, and top talent to enhance innovation.

- Start-ups, scale-ups, and innovators receive tailor-made support to boost and derisk business cases and speed up time to market.

- Students and learners have access to eight master's programmes at 16 top technical universities and business schools, as well as online and blended courses.

As a result, in just ten years we have built the largest sustainable energy innovation ecosystem in the world.

- €560 million has been invested into more than 480 sustainable energy innovations.

- 90% of our start-ups already work with global brand names including ABB, BMW, EDF, Engie, Tata Steel and Vattenfall.

- Our EIT InnoEnergy Master School has attracted students from almost 100 countries. We now have 1,200 graduates and 1,500 students enrolled.

Our rich network of more than 500 key players from 18 different countries enables us to be a key vehicle for the energy transition. Together we make up the ingredients needed to bring a constant pipeline of sustainable energy innovation to market.

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