

FRIWO



WHITE PAPER

## The Future of Micromobility

How autonomous electric vehicles are accelerating the development of sustainable mobility infrastructure

# Micromobility: A Crucial Building Block on the Path to Climate Neutrality in the Transport Sector



**Rolf Schwirz**  
CEO, FRIWO

As the single greatest challenge facing us in the future, climate change demands that we make every effort to ensure that our world becomes more sustainable, allowing future generations to lead happy, prosperous lives. As an innovation-driven company with over 50 years of engineering experience, we're well aware that tackling climate change requires both ingenuity and smart engineering solutions.

A vital area on the journey towards a climate-neutral future is electromobility. It creates the prerequisite for replacing fossil-fueled means of transport with modern electronic solutions that can be powered in a climate-neutral manner using renewable energies. In Europe, road traffic alone is responsible for more than a quarter of total CO<sub>2</sub> emissions.

At first glance, electrically powered micromobility is a small but crucial building block on the path to climate neutrality in the transport sector. In urban areas, however, it can make a decisive contribution to paving the way to a climate-neutral future. To achieve this, micromobility must be regarded as an intelligently designed component that has the potential to combine public transport with the needs of private transport.

Although recent studies still suggest that e-scooters and e-bikes have had a mixed impact on the climate balance thus far, mobility researchers are nevertheless convinced that they have great untapped potential. To unleash this potential, we have to roll up our sleeves – whether as engineers, urban planners or decision-makers in politics and government – and strive together to develop sustainable solutions.

As an innovation-driven tech company, FRIWO is our contribution to this crucial movement. To this end, we support the enablers of the mobility revolution – whether manufacturers, mobility service providers, startups, or market leaders – with our holistic solutions for electric drives and battery storage. We want to be a trustworthy partner working towards a climate-neutral future.

## 5 Key Points

1

Micromobility is an important transport planning component that can effectively combat CO<sub>2</sub> emissions and the threat of traffic congestion in urban areas.

2

According to forecasts, the markets for e-bikes (pedelecs) and e-mopeds are expected to see the highest growth rates in the coming years.

3

Micromobility needs the right policy and urban planning framework to fully unleash its potential as a climate-friendly means of transport.

4

New offerings such as subscription and sharing models are vital drivers of micromobility.

5

Providers have by no means exhausted the potential of micromobility when it comes to developing means of transport.

## What Role Does Micromobility Play in the Overall E-Mobility Market?

Our economy works according to the well-known principle of supply and demand. When looking at the topic of micromobility, it is crucial that we keep this simple principle in mind. This is because it reflects the fact that mobility in our society in general is in the midst of a transformation process. The most important drivers of this transformation are global climate change and changing living conditions, which are forcing humanity to rethink the issue of mobility:

The transport sector is the third largest emitter of greenhouse gas emissions, accounting for 20 percent of total CO<sub>2</sub> emissions. According to the German Federal Government, a whopping 96 percent of this 20 percent is emitted by road transport. The most crucial instrument for reducing emissions from road transport is the switch from fossil fuels to electric drives. In Germany, for example, government initiatives such as subsidies for electric vehicle purchases or building charging infrastructure are being launched to kick-start this switch.



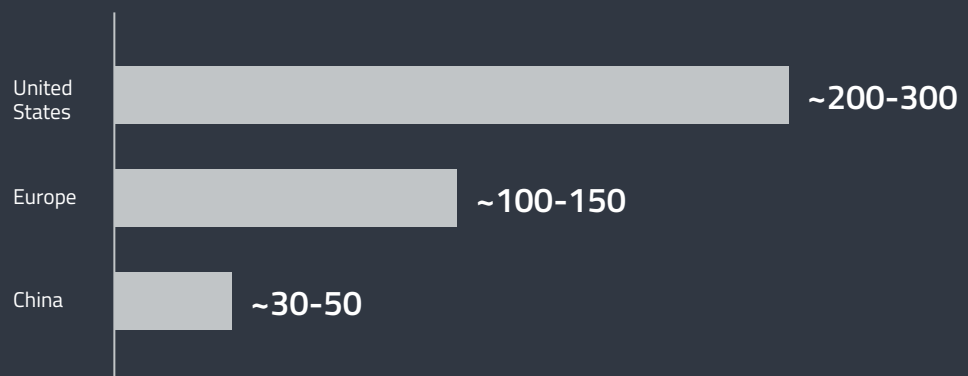
In this context, traffic in urban areas poses a particular challenge. An increasing number of people across the globe are living in cities and metropolitan areas, and the demand for mobility is expected to continue rising in increasingly congested cities. However, a mass migration to electric vehicles won't solve this problem on its own, as you'd still be left with the issue of insufficient charging infrastructure. What society also needs is new solutions in the form of alternative mobility concepts.



Micromobility is one of these solutions, addressing two major problems of future mobility: excessive CO<sub>2</sub> emissions and the threat of traffic congestion in urban areas. Yet micromobility must be thought of as a building block within urban mobility. It offers a demand-driven combination of private and public transport, which can also be implemented in a climate-neutral manner using electric drives. At the same time, micromobility is a business sector that is not exclusively dependent on the interplay of supply and demand. In the future, this market will also be shaped by the controlling intervention of various players who will continue to drive forward the proclaimed goal of mitigating climate change.

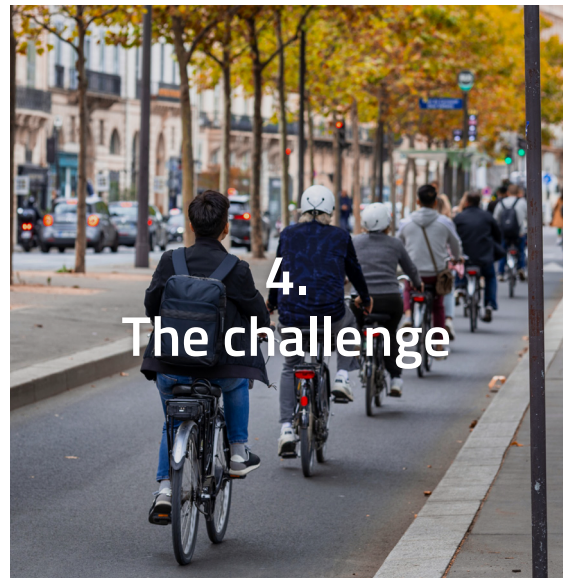
The idea underpinning micromobility is that it covers the last (or first) mile that people travel in urban areas: from the metro stop to the office, from the restaurant to the concert hall, or from the shopping mall to home. In this case, mobility is not defined in terms of individual means of transport, but rather as a solution concept. But how can infrastructure be built in urban spaces that provides residents, commuters, and visitors alike with a seamless mobility experience covering as many use cases as possible? Well, micromobility provides a link between long-established forms of urban mobility.

## The micromobility market in China, Europe, and the USA (2030 forecast in billions of dollars)



Source: McKinsey

# Micromobility in Practice



## 1. Vehicles

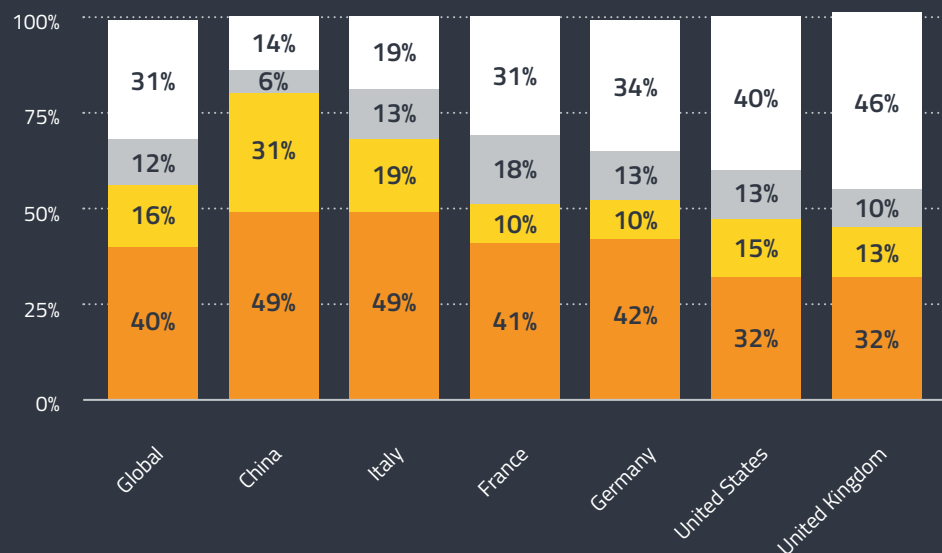
There’s no universally accepted definition of which vehicles fall under the term “micromobility”. In general, however, it encompasses all micro and light vehicles that people use with or without a motor to travel across short distances. For example, these would include e-mopeds, bikes, pedelecs and e-bikes, pedal scooters, e-scooters (pedal scooters with electric motors), segways, hoverboards, monowheels, skateboards and e-skateboards.

All these vehicles share several benefits:

- Due to the light weight and relatively low speeds for which they are designed, they can be operated with small e-motors and consume relatively little energy.
- Thanks to their small dimensions, they take up less valuable space in urban areas than cars, while their lighter weight makes them significantly easier to transport.
- They place fewer demands on users than, for example, cars and can therefore be used by more people.
- They are comparatively inexpensive to produce and maintain, making them highly scalable.
- No major investment in existing transport infrastructure to use and upgrade them.

What type of micromobility vehicle would you prefer for your daily journey?

- Bicycle
- Moped
- E-scooter
- Other form of mobility/not micromobility



Source: Statista

## 2. Types of offering

The phenomenon of micromobility cannot be understood without considering the evolving forms of usage. In metropolitan areas, means of transport used to be very clearly marked. On the one hand, you had public transport, often controlled by the respective municipality, which was used for shared journeys with a single or season ticket. On the other hand, people used private cars or bikes as a personal means of transport. The only alternative available in this model was taxis, enabling people to forego personal vehicle ownership and still travel individually.

In the area of micromobility, there are four offering types that have emerged and will continue to coexist in the long term:

1

**Ownership:** For many users, the concept of owning a personal means of transport that was purchased with their own money and becomes their personal property will remain attractive.

2

**Leasing:** Through new financing models such as JobRad leasing, smaller and thus potentially less expensive vehicles such as bikes and e-bikes are also purchased for private use over a certain period of time. Vehicle maintenance is covered by the lessor, while repairs are usually covered by the lessee.

3

**Subscription:** As an alternative to leasing, there are subscription models that allow vehicles to be rented for personal use in return for a regular fee (for example, monthly). In this case, the provider ensures the vehicle's roadworthiness while maintenance, repairs, and loss in the event of theft can also be included in the subscription fee.

4

**Sharing:** In the sharing model, sharing providers make means of transport available to users for individual journeys only. The prices are usually calculated based on a basic fee and the desired rental period. The sharing provider is responsible for the maintenance, storage, and road safety of the means of transport.

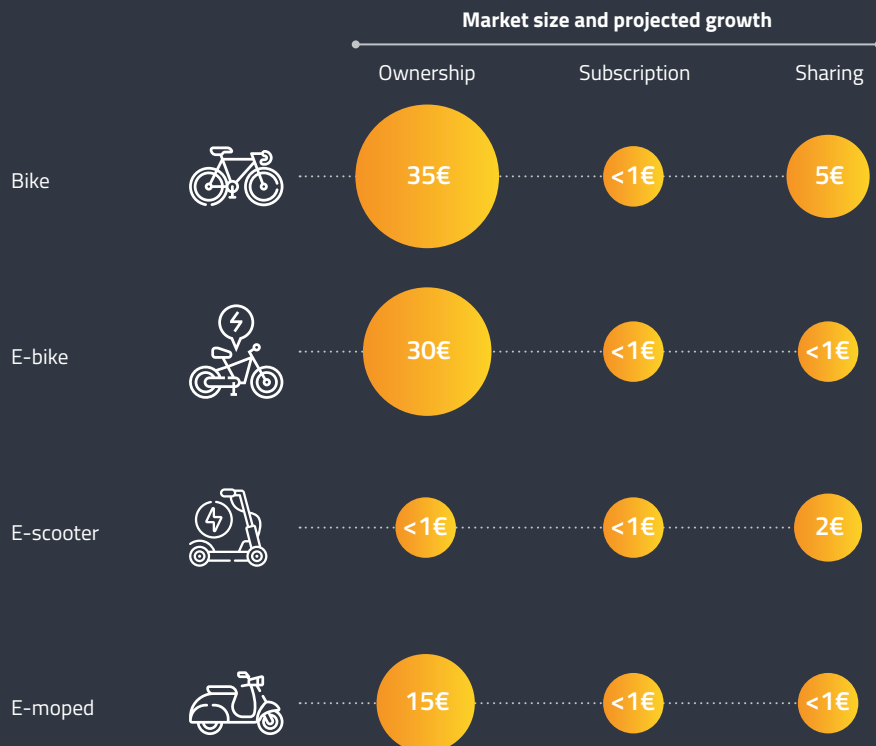


### 3. Market potential

Although individual vehicles such as bikes, which can be summed up under the term micromobility, have a long tradition, the idea of micromobility is recent and the market for related means of transport is in full swing worldwide. Individual developments such as segways have disappeared from the market again, while lightweight vehicles such as monowheels and e-skateboards have not yet advanced beyond the status of being considered niche products.

Bikes, e-bikes, e-scooters and e-mopeds are currently regarded as the primary vehicles on the micromobility market. The following table shows their market potential within the new offering types.

#### The global market for micromobility vehicles (in billions)



Source: BCG

## 4. The challenge

Transport researchers point out that the mere provision of e-vehicles such as scooters or e-bikes in urban areas doesn't automatically improve climate footprint. This is because previous experience shows that for a large proportion of all journeys, electric vehicles simply replace walking or traveling by public transport. In individual cases, sharing services can even lead to a worsening of the climate balance – as a traffic study on the city of Zurich has revealed (source: [ScienceDirect](#)).

For the future, this means that not all forms of micromobility automatically generate the same benefits. Rather, the challenge for the future is to integrate micromobility into urban transport in such a way that it can reap the benefits to the full. To do this, existing transport infrastructure must be better linked to people's actual mobility needs.



# Technology Snapshots

## What technological developments can we expect?

The need for flexible, climate-friendly means of transport has led to a boom in ideas and innovations on the micromobility market in recent years. In particular, developers seized the opportunities opened up by integrating small electric motors combined with wheel hub drives and powerful rechargeable batteries on various types of lightweight vehicles.

In the future, further design and technology improvements are expected in this area. These relate in particular to the durability and efficiency of the vehicles. Batteries will become even more powerful, while innovations in product design will enhance the service life of heavily used sharing vehicles in particular in the coming years.

Beyond that, however, as the experience of recent years has demonstrated, there's still great scope for further innovations that will further augment the practicality of micromobility in the near future:



One of the major obstacles to using light transport is weather conditions. Sharing providers of e-scooters, e-mopeds and e-bikes, for example, experience sharp drops in usage figures when it rains and during winter. For this reason, a major area of innovation is the design of lightweight vehicles that better protect their riders from wind and weather, e.g., through heavier form factors with a closed roof or the ability to close the roof.



Another important area of innovation is safety. This is where advanced driver assistance systems (ADAS) will increasingly find their way into the various lightweight vehicles. To this end, the vehicles – similar to modern electric vehicles – will be equipped with cameras and sensors that analyze the environment around them while in motion. Supported by AI systems, they can automatically initiate emergency braking before imminent collisions or prevent prohibited driving on pavements.



Alternatively, these systems will also be used to solve one of the major acceptance problems of sharing vehicles in cities, namely the issue of parking them in public places in a way that obstructs other road users such as pedestrians or wheelchair users. Tomorrow's smart e-scooter will give drivers guidance as to where it needs to be parked in order to complete the journey in compliance with the rules.



What's more, it would also be conceivable in a few years' time for the data collected by cameras in sharing vehicles to be used beyond the journey itself. For example, this data could be sold anonymously to mapping companies such as Google or provided to municipalities as valuable information on the current quality of public infrastructure.



Another future trend of micromobility lies in connecting vehicles to external services that generate added value for users. For example, it may be possible for micromobility solutions to be integrated into services such as Google Maps, so that a user is shown various options with different sharing providers, means of transport, routes, expected journey times and prices before starting a journey.



Finally, a glimpse into the somewhat more distant future opens up options in which driving micromobility vehicles is linked with virtual reality applications or a future metaverse. To this end, additional information could be superimposed on data glasses or an intelligent helmet, further enhancing the driving experience while also making it safer.

# Micromobility as a Transport Concept



## How can micromobility be integrated into modern transport concepts?

To make transport in metropolitan cities fit for the future, the attractiveness of micromobility must be improved. Adopting a purely technical approach that improves the user-friendliness of vehicles is simply not sufficient. Rather, the major challenge from a transport planning perspective is integrating micromobility more fully into public transport systems. This requires “joint efforts by cities, public transport systems and micromobility providers,” as mobility researchers from the University of St. Gallen have advised decision-makers (source: [BCG](#)). This means:



Cities and municipal transport companies have to create the conditions to make the various services more attractive to transport users. To achieve this, transport planning should be more geared towards users, with planning measures more closely tailored to their needs. This begins with the connections and intervals offered and ends with pricing that is as affordable as possible.

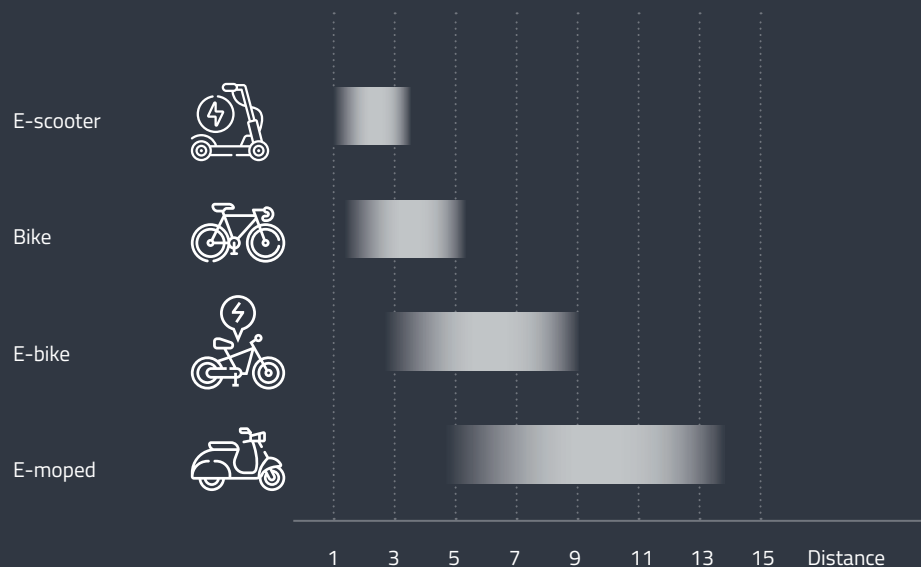
Another priority for municipal transport planners is urban transport infrastructure, which in many places is still too heavily weighted towards car traffic. Metropolitan regions need more traffic spaces that are designed to meet the requirements of micromobility. These include safe, convenient bike lanes, traffic routing that is better adapted to the needs of micro and light vehicles, and a better supply of suitable parking spaces in public places.

Micromobility providers must create offerings that address new user groups that have been underserved by micromobility to date, e.g., commuters. To include this important group, suburbs must be better covered alongside better pricing models better tailored to these user groups.

For policymakers and authorities: transport experts advise cross-subsidizing the use of micromobility services with regard to local public transport. For example, those who use trains, buses, and e-scooters on a route to reach a destination should benefit from discounts for all three means of transport.

In addition, municipalities and micromobility providers must work together to unleash new ways of integrating their offerings. For instance, this could be done through using shared digital platforms that allow users to book the offerings as a package, thereby turning interconnected public transport and micromobility vehicle journeys at all levels into an all-round seamless travel experience.

### Use of urban mobility sharing by distance (in kilometers)



Source: Porsche

# FRIWO: The New Power in E-Mobility

FRIWO is a powerful development partner in the field of e-mobility.

With over 50 years of experience in designing and manufacturing solutions for power supplies and electronic drives, we know that designing the best possible overall system depends on the precise selection and detailed matching of individual components.

We're a highly specialized systems provider with modern, well-equipped engineering teams in Germany with extensive know-how. We provide you with the right e-mobility solution consisting of hardware as well as control and service software as a modern electric powertrain – all from a single source!

As a FRIWO customer, you also reap the benefits of our modular product portfolio. From the display, motor control and drive unit to the battery pack and charger, our components are perfectly tailored to each other. You can also control and monitor them digitally.

In-house software is used that opens up numerous options for changing the behavior of individual components – whether by the vehicle manufacturer or by the end customer via an app.

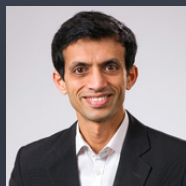
Develop new ideas for the future of e-mobility – and we will make them a reality!





## How Can We Help?

FRIWO offers innovative power supply and drive systems to ensure unlimited mobility. Discuss your ideas and projects directly with our E-mobility expert:



### **Sandeep Achar**

Head of Global Sales E-Mobility  
+49 2532 81 113  
[sandeep.achar@friwo.com](mailto:sandeep.achar@friwo.com)

**FIND OUT MORE**

You can find further information on smart system solutions for sustainable mobility on our website.

[www.friwo.com](http://www.friwo.com)