Bikes and Scooters on the Road to Net Zero?

Yes, with Some 'Ifs'

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Introduction

In late 2021, delegates to the UN Climate Change Conference (COP26) in Glasgow, Scotland, proposed an aggressive shift to zero-emission vehicles in the coming decade. The reasons for this shift are becoming ever clearer: worldwide, the transportation sector produces about 14 percent of all emissions.[1] In the United States and Europe, the transportation sector contributes an even larger proportion of total emissions. At 27 percent in the United States, it is now the single largest contributor to greenhouse gases (GHGs) in the country, surpassing agriculture, power generation, and industry—and the proportion is likely to continue growing as other sectors reduce their carbon footprints.[2] More than half of those transportation emissions come from light-duty vehicles such as personal cars and SUVs. With car vehicle miles traveled (VMT) already surpassing prepandemic levels, decarbonizing the transportation sector is more vital than ever.[3]

Even a total shift to electric cars would not be enough to meet climate goals, as the COP26 declaration on transportation admits. True sustainability must include a wider systemic transformation. This entails shifting more trips away from cars through support for shared and active mobility and reducing VMT for the cars that remain, a process cities can play a central role in shaping.[4]

Where Does Micromobility Fit In?

Micromobility—the use of small, lightweight vehicles such as bicycles and e-scooters with a top speed of 15–30 miles per hour, often deployed in shared fleets—can play a major role in transportation decarbonization, but the potential varies greatly depending on the conditions in which it is deployed. Micromobility's main climate benefit comes from its potential to replace car trips, particularly the relatively short trips that account for a significant portion of all car travel in urban areas. Even in the relatively dense, transit-rich city of Chicago, for example, more than half of car trips are shorter than three miles.[5] Micromobility also has the potential to complement low-emission public transit, making journeys seamless enough to reduce the necessity of car ownership.

Micromobility can reduce GHG emissions—and could make an even greater impact with the right policies, infrastructure, and urban context. Micromobility's main climate challenge comes from the emissions it generates, whether through manufacturing and materials, in operations, or by replacing trips that would otherwise take place via lower-emission modes such as walking or transit (see sidebar "Sources of Micromobility Emissions").[6] Because of these factors, the unregulated, unplanned deployment of e-bikes and e-scooters can generate more CO_2 than it saves.

The extent of micromobility's impact largely has to do with **what modes it replaces**, **what types of trips it serves**, and **where it is operated.** Cities can maximize the benefits of these vehicles with policies and infrastructure adapted to local contexts, making micromobility a complement to transit and a viable alternative to car trips.

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What Conditions Support Mode Shift?

A variety of conditions can set the stage for mode shift to occur.

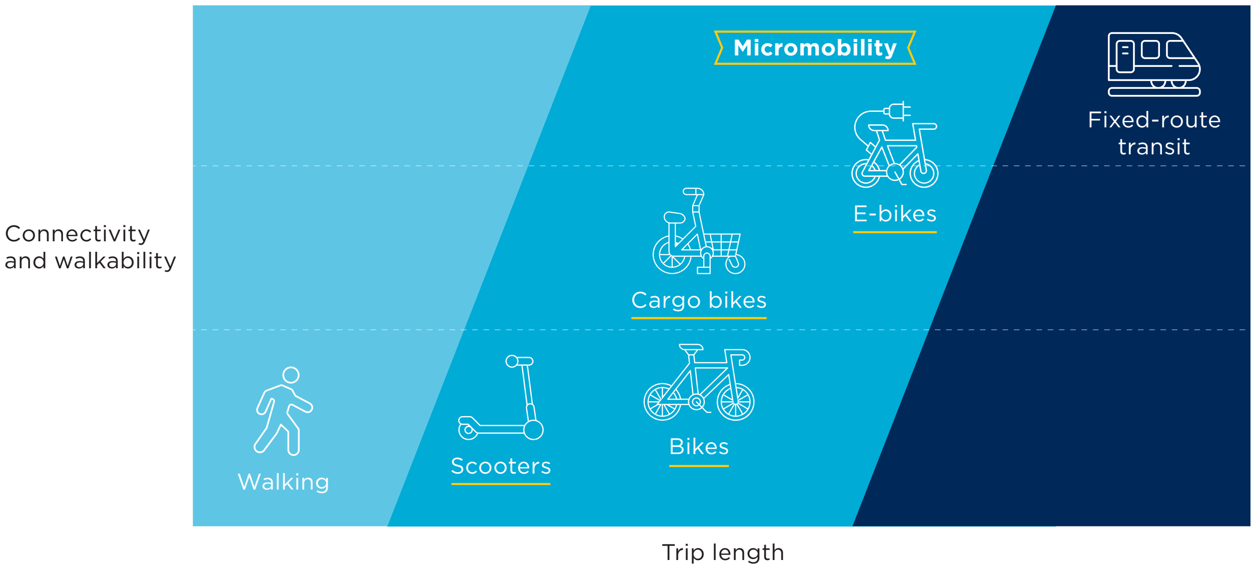
Micromobility's Big Climate Opportunity: Medium-Density Areas

Urban density and the quality of public transportation are key in determining the climate benefits of micromobility (see Figure 1). **In low-density areas, where roads tend to be wider and distances greater, micromobility might be least effective at encouraging mode shift from cars.** Scooters and bike trips are generally good for short distances (less than a few miles) and trips to and from transit. In low-density cities, there may simply be fewer opportunities to reasonably replace a car trip with a bike or e-scooter due to the greater average distance between destinations. Low density often goes hand in hand with higher road speeds and less-developed bikeways, and this type of landscape, which makes little accommodation for safe travel outside a car, discourages travel via micromobility—or even on foot—altogether.

Sources of Micromobility Emissions

Most of the emissions associated with micromobility come from the production phase, rather than from their ongoing use and maintenance. One study found that the largest GHG impact of e-scooters came from material collection and manufacturing.[7] Another found that 75 percent of e-bike CO_2 emissions came from manufacturing; 10 percent from packaging, transportation, and recycling; and only 15 percent from use.[8] This suggests that increasing vehicle life reduces life-cycle emissions. Since the bulk of associated emissions take place before the vehicles are even used, the less time a bike or scooter is operational, the higher the overall emissions are per passenger distance. There is a small trade-off, though, because longer-lasting vehicles require more durable materials (with more manufacturing emissions). But their longer life spans can counteract those extra emissions by replacing more high-emission trips. Additional benefits can come with further decarbonizing the initial manufacturing stage. Micromobility operators appear to understand this and seem to be taking it seriously as they upgrade fleets over time; this is unsurprising given that longer vehicle life also improves their bottom lines.

Figure 1: **Where Mobility Services Work Best**



On the other hand, micromobility in high-density areas with quality transit service is more likely to serve as a substitute for some public transportation trips.[9] **In dense areas, micromobility may offer quicker, more direct, and often cheaper service than fixed-route transit, especially for shorter trips.** Bike share and scooter share still reduce congestion, reduce car trips to an extent, and contribute to a more robust mobility network, but they are likely to replace low-emission modes of travel. Micromobility may also play a role in relieving peak-hour crowding on buses and trains. But depending on the context, micromobility may have less of an impact in reducing emissions because the modes it most often replaces—transit and walking—are already low emission. Considering vehicles' entire life cycles, micromobility may even produce more emissions than the modes it replaces, especially if the bikes or scooters are consumer-grade products not intended for the demand of deployment in public fleets. City policies can serve an important role in ensuring that transit and micromobility are complementary rather than competitive.[10]

Medium-density areas with low-to-medium levels of transit service likely have the greatest potential to reduce carbon emissions through micromobility (see Figure 2). Bike share and scooter share in suburbs and medium-sized cities with relatively sparse public transportation (but that still offer a variety of destinations within reasonable proximity) can provide better access to high-frequency transit and can also serve as the main mode for shorter trips that might otherwise happen in a car (see sidebar "Shared versus Owned"). In a study on bike share in several North American cities, researchers found bike share to be an effective method to bypass unreliable or unavailable feeder lines to get to faster high-capacity transit routes.[11]

Furthermore, a recent user survey found that scooters were most effective at shifting trips from cars in medium-density metros.[12] In these areas, 78 percent of scooter trips replaced trips that otherwise would have been made by cars, versus only 46 percent in low-density cities (where a car is essential for almost any trip) and 55 percent in high-density cities (where fewer trips are taking place in cars in the first place). The report also noted that the most frequent use of scooters to connect to public transit took place in medium-density metropolitan areas.

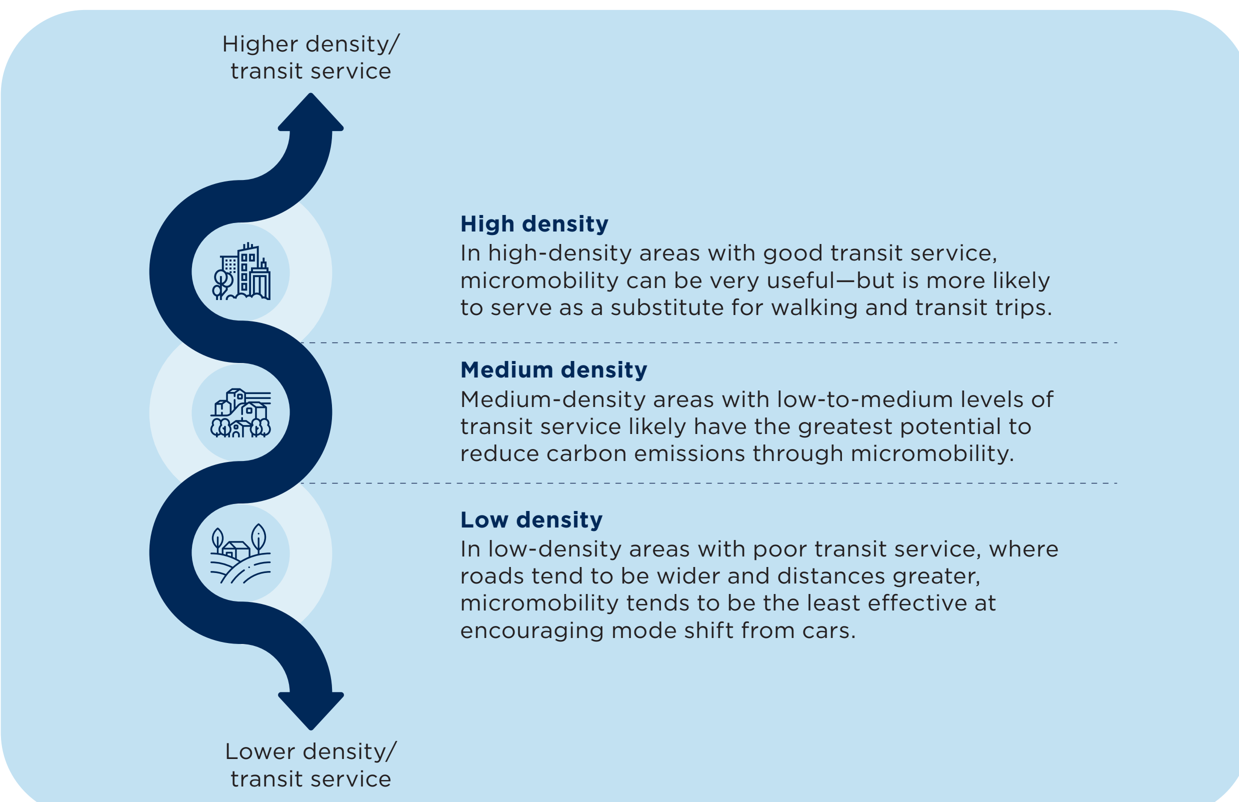
Another study found that medium-density suburban neighborhoods located one to three miles from commercial developments offer especially good opportunities for increased bike ridership.[13] Where public transit is infrequent, bike trips for short-to-medium distances can easily replace car trips.

Infrastructure for Maximizing Climate Benefits

Regardless of the context, micromobility is active, sustainable transportation that can transform a mobility network, adding granular choices where often none existed before. Understanding the conditions where it can be most effective in mode shifting can help make the most out of micromobility projects.

- *Safety.* Cities can play a pivotal role in creating safe environments for micromobility, which is itself a critical factor in drawing travelers out of cars. Cities should

Figure 2: **Micromobility and the Urban Context**



prioritize dedicated street space for bikes and scooters, which is a central determinant of safety. Research shows bike-share ridership grows as the length of bike lanes increases, and adding more robust physical barriers to bike lanes, like planters or curbs, increases ridership as well as perceived safety.[14]

Low-emission and car-free zones, such as those in Barcelona, Oslo, and Nantes, further make for safer and more micromobility-friendly cities.[15] In any context, the more investment is put into safe and extensive infrastructure, the more impact micromobility—whether personal or shared—can have in shifting modes.

Shared versus Owned

One factor at play in determining the magnitude of impact from micromobility is whether a bike or scooter is individually owned or part of a shared system. A recent study on substitution patterns in Zurich found that personal e-bikes and e-scooters have lower lifetime emissions than their shared counterparts.[16] While private micromobility trips replaced car trips much more frequently, shared micromobility trips primarily replaced walking or public transit—modes that are already sustainable.

One potential explanation for this difference is that micromobility users who own their vehicles tend to take longer trips than those who check out vehicles from a shared system.[17] As longer-distance trips are more likely to replace car trips than to replace walking, owned micromobility is more often a substitute for cars. Research suggests that these findings are applicable to most European cities with good transportation infrastructure.

Additionally, maintaining a shared micromobility system naturally involves some level of vehicle rebalancing, redistributing the bikes or scooters throughout a service area to prevent any area from being too saturated or too scarce with vehicles. This process usually uses vans or trucks, adding more operational vehicle miles traveled (VMT) and emitting more GHG than owned micromobility, in which operations are self-contained. There is currently little research on the topic; cities could help shed more light on this by including operational VMT among the reporting required from shared-micromobility operators. In general, owned bikes and e-scooters may reduce greenhouse-gas emissions to a greater degree than shared, but more research has been done on the use of shared bikes and e-scooters, likely because of the ease of obtaining this data.

This is particularly salient for low-income and minority populations, especially in neighborhoods with less developed bike and scooter infrastructure.[18] Scant and poor-quality bike lanes lead riders to make the self-preserving choice of using the sidewalk, which, in turn, leads to a cycle of more police run-ins, more ticketing, and lower ridership, as has been documented in US cities.[19] Prioritizing infrastructure improvements in these communities can be an equitable approach to increasing the use of micromobility.

- *Connections to Transit Services.* Micromobility can either supplement or cannibalize low-emission public-transit ridership. Creating micromobility systems with transit in mind—and making transit improvements with micromobility in mind—can encourage the former. Physical infrastructure such as secure bike and scooter parking, docking stations near transit stops, and mobility hubs increases both micromobility and transit use, as does adding and improving bike lanes leading to transit hubs.

  These improvements should be encouraged everywhere but are especially effective in medium-density metropolitan areas where public transit is less pervasive. Depending on the national context, these improvements may also be paid for with transit capital funds, given that they improve transit connections.

- *Technology.* For operators, data on trip origins and destinations allows for more effective distribution of vehicles, helping to maximize potential users and the emission-reduction benefits they bring as well as lowering the VMT associated with vehicle rebalancing. Cities can use this data to target infrastructure investments where they are most needed and to identify areas where transportation needs might be growing or changing.

  App-based nudges can also encourage users away from car trips. Bolt, a ride-hail and scooter company, piloted a program in Stockholm, Oslo, and other European cities, in which users requesting a car for short trips through the Bolt app were prompted to use micromobility instead.[20] Specifically, when users requested trips of less than three kilometers (1.9 miles), the Bolt app showed the location of a nearby e-scooter, highlighted in green, as the second option on the screen. Through these nudges, an average of 60 percent of users decided to forgo the car and use a scooter instead.

Policies for Maximizing Climate Benefits

Policymakers have tended to overlook micromobility as environmentally friendly transportation; even the COP26 declaration on zero-emission vehicles makes no mention of e-bikes or e-scooters, despite their vastly smaller energy requirements.[21] Yet local policies supportive of micromobility have a large influence on ridership, mode shifting, and the resulting GHG reduction. These include the following:

- *Updating Land Use and Zoning Regulations.* Governments can stimulate the integration of micromobility with transit by updating land-use and zoning regulations to require bicycle or scooter parking in more developments and near public-transit stops. Reducing or eliminating parking for cars can also make the urban environment more conducive to small vehicles.

- *Ensuring Vehicles Are Available.* When planning a bike-share or scooter-share program, instituting equitable rebalancing requirements ensures that vehicles are available and useful to every community.

- *Incentives and Subsidies.* Incentives and direct subsidies for choosing e-bikes, bikes, and e-scooters have proliferated in many cities and countries since the COVID-19 pandemic. Italy, France, and the United Kingdom all implemented subsidies on purchases of e-bikes and other vehicles. In the US, Denver offered a $400 rebate for an e-bike and a $900 rebate for an electric cargo bike, with additional rebates for low-income residents.[22]

  Local governments can also subsidize shared micromobility to reduce rider costs and support a robust market. Subsidization encourages ridership and is especially important in disadvantaged areas. Many cities currently have subsidy programs for bike and scooter share for low-income users, such as the Cincinnati Red Bike Go Pass[23] and Chicago's Divvy for Everyone,[24] which now includes e-scooters in addition to bikes.

  Finally, policymakers can incentivize micromobility commutes by expanding and simplifying commuter tax benefits, which are employer-provided pretax reimbursements for traveling to and from work. Specifically, in the United States, federal policymakers can reinstitute the bicycle commuter benefit that was eliminated in 2017 and extend it to all micromobility.

- *Community Engagement.* Research shows that thoughtful outreach is necessary to increase micromobility and discourage car use, particularly in low-income and minority communities.[25] Cities should include local communities and key stakeholders from the start of planning to fully understand their needs and determine how programs can best be implemented. Alongside community-based planning, group rides (such as the *ciclovías* popular in Latin American cities); targeted marketing campaigns, particularly for commuters; and educational programs are all viable strategies to involve, include, and educate.

Making the Most of Micromobility

Key factors for maximizing the climate benefits of micromobility include the following:

- A good network of bike lanes—the safer and more protected, the better
- Facilities and policies that enable and encourage public-transit integration
- In-app nudges, real-time data on vehicle availability, or other technology solutions to improve ease and convenience
- Incentives for acquiring a bike or scooter, for joining a shared micromobility service, and for using micromobility for more kinds of trips
- Robust community engagement, education, and outreach programs
- Minimizing vehicle life-cycle emissions

Conclusion

Meeting global climate goals cannot be achieved solely through a transition to zero-emission vehicles. It will require a reimagining of the transportation sector as a whole, and micromobility can play a major role in the solution. Micromobility's potential to reduce GHG emissions is not predetermined; it depends on how it is used, what types of trips it replaces, and cities' ability to manage these factors.

Understanding the conditions in which the availability of bicycles and e-scooters influences people to opt out of driving or hailing a car is vital to getting the most benefit from the full menu of modes (see sidebar "Making the Most of Micromobility"). This involves not only examining how micromobility fits into various city contexts but also determining which policies, infrastructure developments, technological advancements, and outreach efforts have the greatest impact on ridership.

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Endnotes

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