

WHITE PAPER



MICROTRANSIT DEFINITIONS, TRENDS, AND APPLICATIONS

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January 2022

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KEY TERMS

Battery-electric vehicle	A type of ZEV powered solely by chemical energy stored in rechargeable battery packs.
Economic/racial equity	An outcome where residents in economically disadvantaged areas receive coverage from transit agencies that helps provide access to economic opportunities (and, in the process, corrects for policies that have historically put people of color at a disadvantage).
First-mile/Last-mile (FMLM)	The distance people need to cover to first walk, drive, or use another means to get to and from the nearest transit station or stop. This is expressed as the “first mile/last mile” of a person’s trip.
Fixed-route	Traditional transit service that operates on a predetermined series of stops.
Flexible-route	Transit service that follows a predetermined overall route but deviates to accommodate on-demand pick-up and drop-off requests at locations off its route. This can be seen as a compromise between fixed-route and point-to-point service.
Fuel cell vehicle (FCV)	A type of ZEV whose motor is powered by a hydrogen fuel cell, sometimes in conjunction with a supercapacitor or small battery.
Jurisdictional equity	An outcome where residents in areas not typically covered by a transit agency receive coverage to justify their tax contributions to the transit agency.
Neighborhood electric vehicle (NEV)	A type of ZEV that typically operates at speeds of 25 mph or less, carrying passengers on local or private roads. NEV is a type of low-speed vehicle (LSV), a category that also includes golf carts.
Paratransit	On-demand bus service offering prescheduled point-to-point trips for individuals with disabilities, in compliance with the Americans with Disabilities Act.
Point-to-point/ Demand-responsive	Transit service that picks riders up at a location of their choosing and drops them off directly at their destination. Also known as on-demand transportation, this is a segment that is expected to reach \$290.3 billion in revenue by 2025.
Zero-emission vehicle (ZEV)	A vehicle, using fuel cells, electric batteries, or another power source, that emits no greenhouse gases contributing to man-made climate change.

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CHAPTER 1

INTRODUCTION

1.1. WHAT IS MICROTRANSIT?

As transit agencies in North America wrestle to serve communities in the face of continued single-occupancy and personal vehicle use, ongoing competition with private rideshare companies, and the challenges and uncertainties surrounding COVID-19, they are looking for ways to innovate and adapt services to assist in increasing ridership. For example, NEORide, a Midwest organization that supports transit agency operations, has recently observed, “Persistent, year-over-year decline in transit ridership is a strong indicator that the industry requires change and adaptation.”¹ One emerging and innovative transportation mode many agencies are considering is microtransit.

The California State Legislature defines microtransit as “IT-enabled multipassenger transportation services that serve passengers using dynamically generated routes, and may expect passengers to make their way to and from common pick-up or drop-off points. Microtransit vehicles include, but are not limited to, large sport utility vehicles, vans, and shuttle buses.”² The U.S. Department of Transportation still defines microtransit as “a privately owned and operated shared transportation system that can offer fixed routes and schedules, as well as flexible routes and on-demand scheduling. The vehicles generally include vans and buses.”³ This definition needs to be revised and expanded to include publicly owned and operated systems.



Credit: Roads & Bridges / Central Ohio Transit Authority (COTA) microtransit vehicle

Microtransit fills a gap in more traditional transit and transportation, between fixed-route transit bus services and private vehicles (including taxis and ride-hailing/ride-sharing vehicles). With microtransit, a user can order a ride in real-time, through a smartphone app or desktop computer or via a landline,

1 Stark Area Regional Transit Authority. (2020). *EZfare: The Gateway Multimodal Strategy and Technology Assessment*

2 California State Assembly Bill No. 149. § 13020 (2021). Available at: https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=202120220AB149

3 U.S. Department of Transportation. Shared Mobility: Current Practices and Guiding Principles APPENDIX B: Glossary. (2020). Available at: <https://ops.fhwa.dot.gov/publications/fhwahop16022/apb.htm>

and be picked up at the location of their choosing within an allocated travel zone and dropped off at another location of their choosing. In this way, microtransit mirrors the functionality of popular ride-hailing/ride-sharing services such as Uber and Lyft, with additional features for the public good including serving all customers in accordance with the Americans with Disabilities Act (ADA), whereas private transportation network companies (TNCs) such as Uber and Lyft are exempt from compliance.

However, the majority of microtransit applications use larger vehicles than cars carrying single passengers. These are often cutaway buses and vans designed to transport several passengers at a time, although fewer than the number that a fixed-route bus would carry. The service, integrated within the existing transit host, can be operated and staffed by the agencies or by private companies specializing in the space.

Microtransit vehicles make use of onboard computers (through iPads, smartphones, or other similar devices) that operate in tandem with apps on smartphones for riders who have them and call center ride scheduling. Using real-time data, an algorithm in the software optimizes the best routes to pick up new riders and deliver them and other riders to their destinations. In this way, microtransit can be seen as a public transit analogue to private vehicle services catering to multiple riders, such as UberPool and Lyft Line.

1.2. WHY USE MICROTRANSIT?

Microtransit, which has been deployed in more than 100 locations across North America from urban centers like Los Angeles to Tribal communities in rural Oklahoma, has been implemented to explore and address some of the limitations of traditional fixed-route bus service. While fixed-route bus service has long been an affordable and effective means of mass transportation, it cannot fulfill many communities' bus service needs.

A great benefit of microtransit is it can be scaled to meet the needs of a community quickly. Most vans and shuttles operating in a microtransit operation offer wifi connectivity, 15 minutes or less wait times, pick up or drop off anywhere with a defined geographic zone, and provide expanded options for seniors.

Most often in practice, microtransit services have been established in areas with lower population density where fixed routes for buses have never been established or have proven too costly to operate efficiently. Areas far from urban cores have not been effectively served by agencies' transit offerings. A dynamically routed approach by microtransit can make bus service more flexible and can extend mass transit's reach into suburban and rural zones. Microtransit can also offer an innovative transit solution within urban cores, reducing congestion in city streets and providing urban and suburban users with an appealing alternative to ride-hailing services, while also addressing the "first mile/last mile" needs of riders.

Microtransit presents an opportunity to address issues of economic and racial inequality. Through on-demand, dynamic public transportation, people whose areas have been underserved by mass transport can have greater access to employment opportunities.

While typically more expensive to operate than a fixed-route bus, microtransit service can be more affordable on a per-person basis than a fixed-route bus would be in areas far outside urban centers. It also adds value in addressing issues of jurisdictional equity, where residents in suburban or rural areas pay taxes to fund transit agencies but receive little or no coverage from them. Beyond this, microtransit presents an opportunity to address issues of economic and racial inequality. Through on-demand, flexible public transportation, people whose areas have been underserved by mass transportation can have greater access to job opportunities, including employment with private microtransit providers, and access to essential needs such as medical appointments and grocery shopping.

1.3. POSITIVE TRENDS IN MICROTRANSIT

Demand-responsive services such as microtransit leverage technology that many riders already possess, as transit agencies can coordinate in real-time with users' smartphones. Using real-time data, microtransit vehicles' on-board computer systems can determine the most efficient routes for picking up and dropping off multiple passengers. This technology also offers riders the option to indicate any necessary mobility assistance at the simple click of a button and gets them the right level of service. Through these advances in technology, microtransit is also lowering the cost per ride to offset the added cost incurred by deviating from fixed routes by increasing the riders per revenue mile. Many transit agencies are also providing phone numbers for those who do not have access to a smartphone so they can call and request a ride.

Microtransit also takes advantage of an emerging mentality among an increasingly tech-savvy public that has grown accustomed to receiving goods and services on-demand. On-demand, flexible private ride-hailing services like Uber and Lyft have taken a bite out of public transportation's rider base. The demand-responsive service of microtransit offers transit agencies an opportunity to meet current riders' expectations for real-time, flexible transportation. This type of flexible transit can increase access to bus service for a wide range of riders, including those from historically underserved communities. A National Academies of Sciences, Engineering, and Medicine report addresses rider expectations directly by commenting, "It is not hard to understand how attractive it is to customers to know the bus can find them versus their finding the bus."⁴

Due to the very nature of microtransit, the service offers workplace development and job opportunities. Microtransit drivers do not need a CDL (commercial driver's license). They can work part-time, getting used to the role, and if they decide to become a fixed-route driver they can do so with on-the-job training and licensing.

The convenience of new, on-demand services can come with higher associated costs. For microtransit, zero-emission vehicles (ZEVs) can help defray the costs and improve operating performance. Battery-electric and hydrogen fuel cell vehicles are well-suited for use in microtransit applications, particularly

⁴ Volinski, Joel. (2019). Microtransit or General Public Demand Response Transit Services: State of the Practice. The National Academies Press. Available at <https://doi.org/10.17226/25414>.

those focused on short trips, because they offer lower energy and maintenance costs⁵ and add to passenger comfort by featuring more usable vehicle space and quieter operations than internal combustion engine (ICE) vehicles.

1.4. LIMITATIONS OF MICROTRANSIT

Microtransit provides innovative new opportunities for public transportation, but is not a blanket replacement for fixed-route service, primarily because in communities where there is adequate density or existing ridership, fixed-line service tends to be the most cost-effective way to serve riders. North American transit agencies, in particular agencies in the United States, widely lack funding to adequately provide robust service for existing fixed-line routes and may dedicate any available funding to improving these services. As such, microtransit should be understood not as a general replacement for future fixed-route transit buses, but rather to address specific use cases for which fixed-route services are not best suited.

Transit operators may turn to ZEVs for total cost of ownership savings and service improvements in microtransit operations but should be aware of technical limitations and ensure that vehicle models are suitable for proposed microtransit duty cycles. With proper planning many of these limitations can be overcome, but in the meantime the ZEV industry is working to resolve and improve these limitations, which include:

- **Vehicle range** (potential distance covered per charge for battery-electric vehicles) could be a limiting factor, which could present a challenge to the length of time a vehicle can be deployed for trips between charges. It should be noted that for hydrogen fuel cell vehicles range is not a limiting factor, as they offer ranges exceeding 250 miles. One fuel cell vehicle could cover the operations of two battery-electric vehicles.
- **Charging** time frames for battery-electric vehicles are not comparable to the time it takes to refuel an ICE vehicle, which could lead to downtime for drivers and a reduction in ride availability for passengers. The refueling time for hydrogen fuel cell vehicles is around 15 minutes, which is comparable to that of ICE vehicles.
- **Cost** for both battery-electric and hydrogen fuel cell ZEVs continue to be at a premium. Fortunately, in some jurisdictions, particularly in California, public incentives are available to buy down the incremental cost of zero emission vehicles for operators. For example, the California Air Resources Board (CARB) funds the Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP)⁶ and Clean Mobility Options Voucher Pilot Program (CMO).⁷

5 Argonne National Laboratory. (2021). Comprehensive Total Cost of Ownership Quantification for Vehicles with Different Size Classes and Powertrains. Available at <https://publications.anl.gov/anlpubs/2021/05/167399.pdf>

6 California HVIP: Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project. Available at: <https://californiahvip.org>.

7 Clean Mobility Options Voucher Pilot Program. Available at: <https://www.cleanmobilityoptions.org>.

As battery-electric and hydrogen fuel cell ZEVs grow in popularity and performance, vehicle and battery manufacturers are expected to fill vehicle model gaps and meet a greater range of duty cycles. Vehicle modifiers and upfitters that developed ZEVs for early-market transit operators will also be critical to meeting new duty cycles and operation needs.

1.5. SUMMARY

Microtransit is by its nature flexible and an important niche in many transit agencies' portfolio of services. At this point there is considerable real-world proof of this concept. One leading microtransit provider, Via, now has over 500 partnerships worldwide. Partners include major municipal transit agencies including Central Ohio Transit Authority (COTA), Capital Metropolitan Transportation Authority (CapMetro), Sacramento Regional Transit District (SacRT), LA Metro, Southeastern Pennsylvania Transportation Authority (SEPTA), and Seattle's King County Metro. These collaborations are also proof points for how public/private partnerships can facilitate successful microtransit implementations for agencies.

Microtransit should be understood not as a general replacement for future transit buses that would have otherwise been used for fixed-line services, but rather to address specific uses cases for which fixed-line services are not best suited.

Microtransit presents a wide variety of transit agencies with a valuable opportunity for first mile/last mile demand needs, thus getting riders to the bus stops they never had access to, on demand. Microtransit's flexible approach has also proven to be a solution that can creatively adapt to fulfill many different communities' unique needs.

Any agency considering implementing microtransit should evaluate its riders' needs and consider what approach (including microtransit) can best serve them.

POTENTIAL BENEFITS OF MICROTRANSIT

Microtransit has the potential to benefit transit operators and the communities they serve. Potential improvements from microtransit deployments include bringing more people into a public transportation system that is less polluting than cars, working with historically underserved communities to design and implement transit solutions, and supporting the creation of healthier and more robust public transportation entities.

2.1. INCREASED EQUITY AND ACCESS

The introduction of microtransit provides new opportunities for transit agencies to serve communities that have been historically disadvantaged in terms of public transportation options. This modality offers a financially practical way to deliver transit that was previously undeliverable due to trip cost per mile and lack of reliable bus or rail access to transit deserts.

Microtransit increases equity and accessibility through multiple mechanisms, such as expanding system coverage by providing mobility for the first time to areas that have low population density or that lack regular fixed routes. Service quality may be improved by reducing headways and call-times for people with few options, working with communities and residents who:

- Take fixed-route transit, but at high cost and stress via long headways, long trips or connection times, or persistent uncertainty or risk of missing critical connections;
- Use cars because of a lack of transportation options, but whose automotive dependency makes their situation tenuous as a result of them spending a disproportionately large amount of their income on vehicles that may not be fully reliable;
- Lack any realistic transportation options altogether to get to and from key destinations, which include bus stops and first and last mile needs; and,
- Are less ambulatory and need ADA-compliant on-demand service.

Transit agencies implement microtransit to increase the extent of their paratransit service ("dial-a-ride"), as well as often to lower the cost of traditional paratransit. They also use microtransit implementations to carry out a new kind of service offering for key communities in need. These agencies can leverage

the nimbleness of microtransit to identify how they can provide the most benefits through more rapid deployments and adjustments. They also gain the ability to provide additional flexible transit services in communities with multipurpose vehicles that "can go anywhere, anytime," with the potential for combined support of critical goods delivery, mobile health support, and rapid evacuation or other emergency response for vulnerable populations.

2.2. CLIMATE, POLLUTION, AND VMT REDUCTION

Vehicles operated by public transportation agencies can reduce climate pollution by taking drivers out of passenger vehicles and instead putting them into shared-use vehicles, which can reduce total vehicle miles traveled (VMT) and climate impacts per mile, per passenger. For example, the average passenger vehicle in the U.S. tends to operate with a single occupant, and in this mode emits more than twice the amount of CO₂ per mile for that passenger on average.⁸ By contrast, a typical transit bus with an average passenger load emits less than 190 grams of CO₂ per mile, per passenger.⁹ These figures are meant as illustrative, since the possible configurations of passenger loads and vehicle types are myriad, but broadly a bus that is operated with the goal of carrying multiple occupants will tend to displace climate pollution.

The routing flexibility of microtransit can be a “force multiplier” to allow more people to use public transit while enabling public transit agencies to further increase the system efficiency—microtransit reduces passenger vehicle VMT while supporting transit agency objectives.

The routing flexibility of microtransit can be a “force multiplier” to allow more people to use public transit while enabling public transit agencies to further increase the system efficiency—microtransit reduces passenger vehicle VMT while supporting transit agency objectives. One way this works is by giving people attractive alternatives to cars for a point-to-point trip. Another is to create a desirable first mile/last mile connection that enables people to initiate trips using fixed bus and train lines when people otherwise would not use such fixed lines—something which has the potential to displace high-mileage trips. VMT is also affected by reducing the per-passenger-mile climate pollution in an existing service area that is not very “productive” by increasing the percentage of passenger seats that are used and/or by reducing the number of miles driven on a fixed route.

8 US Environmental Protection Agency (2018). Greenhouse Gas Emissions from a Typical Passenger Vehicle. Note: Accounts only for tailpipe emissions while the car is driving and does not account for manufacturing and other impacts. Tailpipe emissions are a function of Co2 emissions from the content of gasoline (8,887 grams Co2/gallon) divided by average miles per gallon (EPA assumes approximately 22).

9 Assumptions: Diesel fuel (10,180 grams Co₂/gallon, per EPA) divided by fuel efficiency of 6 miles per gallon divided by average of 9 passengers.

2.3. MORE ROBUST AND HEALTHIER TRANSIT ORGANIZATIONS

Microtransit supports better-functioning public transportation that is more financially efficient, operationally effective, and complete. It helps agencies offer more service for less cost, providing greater utility/amenities for the same dollars or by doing what it currently does more cost-efficiently. Microtransit reduces the cost of providing transit to less dense or less productive routes (Note: For high-capacity areas, fixed-route buses are the most cost-effective way to offer transit; however, for lower-capacity areas where transit is still needed, microtransit offers a way to provide service).

This modality serves more trips in the same amount of time as fixed-route service, enabling transit to cover more ground and be more responsive in rural communities, as well as provide a more cost-effective alternative to paratransit. Microtransit also allows transit agencies to compete with demand-responsive services by providing an Uber-like service which also offers pooled rides. It also ensures that transit is at the table with tech as more ride-hailing companies come online and suburban sprawl continues unabated, and serves to increase transit agencies' overall ridership due to multimodality.

With more productive transit, agencies can see resources freed up, creating more effective operations for public transportation. This is critical for giving agencies the power to make choices to invest in a greater number of strategies and services for improving climate and equity. Microtransit creates a more adaptable service network through modes that help an agency swiftly respond to unexpected needs and changes in their operating model. It provides a critical enabler that allows people to start to live without a car or go "car lite," which would have a longer-term positive effect on their transit ridership. Introducing microtransit makes roads safer for all users by reducing the overall number of motor vehicles and increasing the share of drivers who are professionals and part of an accountable fleet. Finally, microtransit expands a transit system's operations, creating more jobs and increased economic activity.

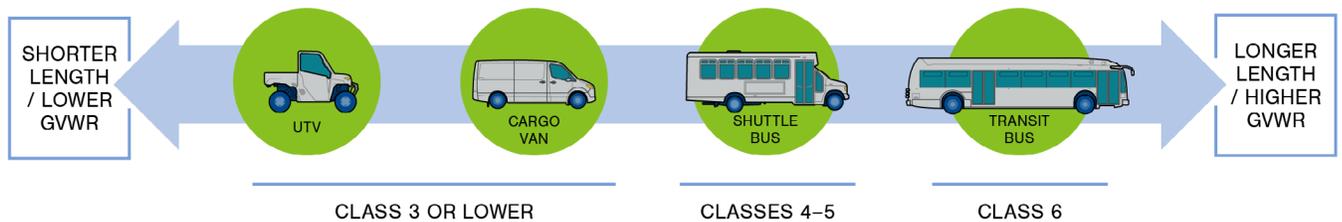
CHAPTER 3

OPPORTUNITIES AND CONSIDERATIONS FOR ZERO EMISSIONS MICROTRANSIT

3.1. LANDSCAPE OF ZERO EMISSION VEHICLES

At a time when climate change is accelerating, transit agencies can contribute to the solution to this problem by converting their fleets to battery-electric or hydrogen fuel cell-powered vehicles. Microtransit presents a prime opportunity for agencies to increase adoption of transit vehicles powered by renewables while expanding their portfolio of services. The marketplace for ZEVs has matured and current offerings can meet the duty cycles of microtransit applications. Figure 1 below shows the types of ZEV that are currently available to support most microtransit operations.

Figure 1. Classification of available zero emissions microtransit vehicles



These vehicles may be available at reduced costs through programs such as California's HVIP and New York's NYTVIP. For more on available ZEV models, see Appendix 2.

3.2. BENEFITS OF ZERO EMISSION VEHICLES

Zero emissions vehicles present many advantages for microtransit operations over comparable ICE vehicles. Where ZEVs meet microtransit route and duty cycles, microtransit operators may expect the

following benefits:

- GHG Reductions:** Using a battery-electric microtransit vehicle Instead of an ICE microtransit vehicle can reduce greenhouse gas emissions by around 50-70% in a general average U.S. case, and 85-90% in the case of regional leadership (assuming the same-sized vehicle and same number of passengers for full-speed motor vehicles). Beyond this, neighborhood electric vehicles (NEV) with a top speed of 25 MPG can be used to reduce emissions by 85% and 95%. See the table below, which provides detailed emissions reductions by class for vehicles currently in use.
- Pollution Reduction:** Switching to ZEVs in place of ICE models effectively eliminates emissions of nitrogen oxide (NOx), a deadly creator of smog, from tailpipes. With battery-electric vehicles, the emission of fine particulate matter (PM2.5) is also significantly reduced.¹⁰ Both of these air pollutants have severe adverse effects on people's health. In the case of microtransit, this would especially be true in residential areas where microtransit vehicles serve communities.
- Reduced Operating Costs:** Zero-emission microtransit vehicles offer a lower total cost of ownership (TCO) versus ICE microtransit vehicles. Zero-emission microtransit vehicles typically have lower maintenance costs because battery-electric vehicles have fewer moving parts and require less maintenance over the lifetime of the vehicle. On top of this, ZEVs eliminate the need for fossil fuel use, lowering fuel costs.
- Improved Passenger Experience:** The layout of zero-emission microtransit vehicles is advantageous to ride-sharing services, as ZEVs offer more space versus ICE models. Unlike ICE vehicles, ZEVs do not need a drive shaft which offers a low/flat floor which is especially important for those with mobility issues. ZEVs also make significantly less noise and zero exhaust fumes compared to their ICE counterparts, offering a more pleasant riding experience for passengers.

Table 2. Potential to reduce greenhouse gas emissions of microtransit vehicles through electrification

	NORMALIZED CLIMATE IMPACT (GCO ₂ /MI)	RELATIVE CLIMATE IMPROVEMENT OF BEV (APPROXIMATE)	
	DIESEL/GASOLINE	US TYPICAL	REGIONAL LEADER
Class 6	1700 gCo ₂ /mi	45-49%	82-86%
Class 5	1250 gCo ₂ /mi	69-73%	89-93%
Class 4	850 gCo ₂ /mi	50-54%	83-87%
Class 3 and lower	650 gCo ₂ /mi	59-63%	86-90%
		<i>Neighborhood electric vehicle (up to 25 MPH)</i>	
		83-87%	93-97%

¹⁰ Argonne National Laboratory: The Greenhouse gases, Regulated Emissions, and Energy use in Technologies (GREET) Model. Available at: <https://greet.es.anl.gov>.

3.3. WHAT'S NEXT FOR ZERO-EMISSION VEHICLES

The adoption of ZEVs is growing right alongside the increased deployment of microtransit services, and for ZEVs to be the vehicle platform of choice there are several key areas in which they can improve to better fulfill microtransit operations that are also evolving to meet the public's changing transit habits, such as sharply increased use of on-demand transportation. To start, vehicle costs which are driven up due to the current cost of batteries. Though the costs of batteries are dropping, making ZEVs more affordable over time, current-generation models are still, on average, typically more expensive than ICE vehicles. At present, many ZEVs have a higher list price than comparable ICE vehicles, a hurdle that can be overcome through use of incentive funding, installment payment plans for the vehicles' batteries, as well as rebate offers from government agencies (see box on "Finding Funding to Support ZEV Adoption" for greater detail).

Despite significant improvements, battery-electric ZEVs still face the challenge of range limitations and slow charging times. As technology improves, a leading microtransit operator anticipates that ZEV microtransit vehicles will offer a range of 150 miles or substantially greater per charge and attain charging speeds of 30-60 minutes for a full charge.¹¹ Several ZEV shuttle bus models found in the Global Commercial Vehicle Drive to Zero campaign's Zero-Emission Technology Inventory advertise 150 miles of range with a maximum of 200 miles for an SEA Electric model (Global Drive to Zero, 2021). Additionally, hydrogen fuel cell vehicles can offer ranges exceeding 250 miles and 15 minute refueling times, with cost being the greatest limitation. For many microtransit applications, well-suited ZEVs already exist, and there are more vehicles coming out to meet microtransit operators' needs.

¹¹ ADAC. (2021). Kostenvergleich Elektro, Benzin oder Diesel: Lohnt es sich umzusteigen? Available at: <https://www.adac.de/rund-ums-fahrzeug/auto-kaufen-verkaufen/autokosten/elektroauto-kostenvergleich>

Finding Funding to Support ZEV Adoption

Microtransit operations will require investments in new vehicles and management technologies. Today's zero-emission technologies typically carry an incremental cost that makes their purchase or lease more expensive up-front, even though their lower operational costs may result in reduced total cost of ownership. External funding sources help bridge the gap of adding new equipment, associated infrastructure, and management systems.

Federal Funding

The Federal Transit Administration provides funding for public transit agencies to lease or purchase qualifying low-carbon transit vehicles. This competitive grant program has increased available funding annually from \$50 million in 2016 to approximately \$182 million in 2021.

Regional Funding

State agencies across the country offer varied programs that offset the costs of qualifying low-carbon transit vehicles and associated infrastructure. The examples below list only a few programs; transit agencies should seek out funding sources in their regions:

- **Dedicated Climate Funding:** The California Air Resources Board manages the Hybrid and Zero-Emission Truck and Bus Voucher Incentive Program (HVIP) that provides point-of-sale vouchers to reduce the cost and simplify the finances of commercial ZEV acquisitions. The Clean Mobility Options Voucher Pilot Program (CMO) provides voucher-based funding for zero-emission carsharing, carpooling/vanpooling, bikesharing/scooter-sharing, innovative transit services, and ride-on-demand services in California's historically underserved communities. Both of these programs are supported by California's Climate Investments program that invests the state's Cap and Trade proceeds.
- **Energy Offices:** The New York State Energy Research and Development Authority's New York Truck Voucher Incentive Program (NYTVIP) uses the same voucher method to support clean low-carbon commercial vehicle deployments in New York state. The California Energy Commission's recently announced EnergyIIZE program will adapt the voucher method to financially support zero-emission infrastructure deployments.
- **Departments of Transportation:** Ohio's Department of Transportation (ODOT) has funded more than \$74 million in transit-related projects from 2020-2021, with \$5.5 million allocated for microtransit. Funding for microtransit has supported 11 unique projects across six cities and agencies, with a maximum investment of \$2.1 million in a single project. ODOT has released a survey for its eight large urban transit agencies to share their microtransit plans and associated funding needs.

- **Utility Investments:** In California, large investor-owned utilities have developed large-scale transportation electrification programs that will invest over \$1 billion into the state's economy, including programs that are focused on commercial vehicle charging. Utilities are also experimenting with off-bill financing, such as Dominion Energy's electric school bus program in Virginia that offsets the higher purchase costs of the buses for the added electric load and the potential to manage load through vehicle-to-grid technology.

Several reference sites track programs that reduce the costs of zero-emission technologies. CALSTART's Funding Finder tool tracks programs for ZEVs and infrastructure in California (<https://fundingfindertool.org>), and the U.S. Department of Energy's Alternative Fuels Data Center tracks federal and state programs for clean vehicles and infrastructure (<https://afdc.energy.gov/laws>).

CHAPTER 4

MICROTRANSIT USE CASES

Flexible by its very nature, microtransit can serve as an asset used in many different ways. As described in a report generated by NEORide on multimodal transportation, “Microtransit can be thought of both as a part of multimodal transportation and a standalone option that brings public transit directly to the riders that need it.”¹² As further detailed, microtransit deployments have helped transit agencies and other operators achieve a wide variety of desired outcomes for the organizations and the communities they serve. Below are four beneficial innovations that microtransit can provide for transit agencies and other potential operators.

MULTI-MODAL CONNECTOR

Public transit agencies face what some have called the first mile/last mile issue: even in densely populated urban areas, many people do not live close enough to fixed-route bus stops to make convenient use of them, and some have mobility issues that prevent them from easily accessing these same bus stops.

With its flexible routing, microtransit can step in as a solution by bridging the first mile/last mile barrier. In urban areas, microtransit buses can serve as a feeder into transit agencies’ trunk lines. The buses pick up riders where they want and bring them to fixed bus stops, making use of established bus lines. The issue of first mile/last mile mobility goes far beyond access to bus stops—many potential riders would save money choosing microtransit over personal vehicle use to make quick runs to local establishments like grocery stores, appointments, and pharmacies.

This use of microtransit benefits transit agencies by increasing utilization of existing vehicles while also increasing overall ridership numbers. With greatly improved access to bus lines, people who would otherwise take a car for their trips may consider public transportation. In this application, microtransit also works as a climate change mitigation solution and reduces overall VMT by putting more people on vehicles that are already operating daily.

¹² Stark Area Regional Transit Authority. (2020). *EZfare: The Gateway Multimodal Strategy and Technology Assessment*.

POINT-TO-POINT SERVICE

Private transportation network companies like Uber and Lyft successfully compete against transit agencies by offering on-demand point-to-point service. Uber and Lyft's popularity comes at an additional cost to the public's well-being, as these services increase the total number of cars operating on the road, through Uber and Lyft drivers idling and circulating between trips. These private companies also put their interests first, with inconsistent fares that vary wildly depending on the demand for rides at any given time.

Using microtransit, agencies can offer riders point-to-point service in a way that prioritizes the public good.

Agencies can provide service comparable to Uber and Lyft but at a reliable, fixed low price. On-demand, flexible rides through microtransit also work as a climate change mitigation solution, as it emphasizes shared rides with overlapping routes (maximizing vehicle utilization, minimizing the number of cars on the road) instead of low occupancy rides.

With its flexible routing, microtransit can step in as a solution by bridging the first mile/ last mile barrier. In urban areas, microtransit buses can serve as a feeder into transit agencies' trunk lines. The buses pick up riders where they want and bring them to fixed bus stops, making use of established bus lines.

URBAN LOW-SPEED

Agencies can use microtransit to provide "urban low-speed" travel as an option to riders. In this use, an operator deploys neighborhood electric vehicles (NEVs), light electric vehicles (a category that also includes golf carts) driven on local roads at speeds of 25 miles per hour or less.

Inexpensive to both purchase and run, NEVs are a very cost-effective solution to transporting groups of people across short distances. The cost barrier to deploying NEVs for urban low-speed use is so low that their operators can be municipalities or employers, not just transit agencies. The smaller size and reduced cost also afford the operator great flexibility with how the operator manages the vehicles' routes, whether flexible or fixed.

Urban low-speed works as a climate change mitigation solution by reducing the number of cars on city streets and by providing transportation in a carbon efficient way using battery-electric engines instead of ICEs.



Polaris / Polaris Gem e6 urban low-speed vehicle

BEACHHEAD TRANSIT FOR RURAL AREAS

With the goal of broadening and strengthening the services transit agencies can provide, agencies can

take advantage of new opportunities to establish a “beachhead” that they can build upon. The word “beachhead” as mentioned here “derives from military usage and connotes beginning a new advance by securing a small strip of influence to expand opportunities in less accessible regions.”¹³ One way transit agencies can gain this “beachhead” foothold to create and grow service in rural areas is with microtransit.

Many rural areas are not served (or poorly served) by public transportation, as the low population density makes these areas prohibitively expensive to cover using traditional fixed-route buses. Rural municipalities cannot justify the cost of supporting regular transit, and as a result their residents have no access to bus lines.

Microtransit can reshape rural America’s relationship to public transit. Through flexible routes, microtransit can give extensive public transit coverage to rural residents in a cost-effective way. Microtransit can be seen as “beachhead transit” for rural areas, providing the first opportunity to bring public transportation to small towns. This use promises to broaden the demographics of people who use transit and to enlarge the constituency that uses transit overall.

Rural microtransit works as a climate solution by reducing the number of long-distance car trips taken and acts in the interest of the public good by fulfilling rural residents’ unmet transportation needs. The microtransit buses (which in this instance would need to be optimized for high mileage) could also be flexibly deployed or used as general-purpose community vehicles.

4.1. INDUSTRY EXAMPLES/CASE STUDIES

Table 3. List of transit agencies represented in real-world case studies achieving a benefit from microtransit implementation.

AREA OF FOCUS	TRANSIT AGENCY	PROJECT TITLE	WEBSITE / CONTACT
Operational Efficiency	Denver Regional Transportation	FlexRide	rtd-denver.com/services/flexride 303-299-6000
	Orange County Transportation Authority (OCTA)	OC Flex	octa.net/OCFlex 714-560-OCTA

¹³ Welch, Dan and Cristiano Façanha. (2020). The Beachhead Model: Catalyzing Mass-Market Opportunities for Zero-Emission Commercial Vehicles. CALSTART. Available at: https://globaldrivetozero.org/public/The_Beachhead_Model.pdf

AREA OF FOCUS	TRANSIT AGENCY	PROJECT TITLE	WEBSITE / CONTACT
Economic Opportunity	Houston METRO	Community Connector	ridemetro.org/Pages/Acres-Homes-Community-Connector.aspx 713-635-4000
	Fresno County Rural Transit Agency (FCRTA)/Inspiration Transportation	REV-UP (Rural Electric Vehicle Utilization Project)	itransportev.com/projects 855-612-5184/800-425-1524
Ambulatory Services	San Joaquin Regional Transit District (SJRTD)	Van Go!	sanjoaquinrtd.com/van-go/ 209-943-1111
	City of Newton, MA/ Via	Newton in Motion (NewMo)	newtonma.gov/government/seniors/transportation 617-655-8019
Jurisdictional Equity	Salem Area Mass Transit District (Cherriots)	The Connector	cherriots.org 503-588-2877
	Sacramento Regional Transit District (SacRT)	SmaRT Ride	sacrt.com/apps/smart-ride/ 916-321-BUSS
Zero Emissions	Anaheim Resort Transportation (ART)	FRAN (Free Rides Around the Neighborhood)	rideart.org/fran/ 888-364-2787
	Porterville Transit System	transPORT	http://www.ci.porterville.ca.us/depts/PortervilleTransit/TransPortMicrotransitService.cfm 559-791-7800

OPERATIONAL EFFICIENCY

Many transit agencies are presented with the challenge of serving areas with greatly differing population densities and changing needs:

- A transit system might encompass a densely populated urban area as well as sparsely populated suburban and rural zones outside of the city.
- Agencies face the dilemma of how to maximize operational efficiency while still effectively serving

the transit needs of people throughout its area.

- Transit systems are also facing the limitations of traditional fixed-route buses – riders are increasingly acclimated to setting their pick-up and drop-off locations rather than planning trips around established bus route stops, reducing ridership.

Budget limits mandate that transit systems must operate in as efficient a way as possible to achieve their goal of serving the public’s transit needs. Many systems have turned to microtransit to lower cost per rider in some applications. Microtransit can effectively serve members of the public outside the reach of fixed bus routes and lower the number of fixed routes running at sub-optimal capacity.

Denver Regional Transportation District (RTD), FlexRide

Denver’s Regional Transportation District (RTD) helped pioneer the microtransit space, having established its demand-responsive Call-n-Ride (since rebranded as FlexRide) public transit service in 2008. The program was created to improve operational efficiency by more effectively covering the lower-density suburban areas (such as the city of Brighton, where it was first implemented) that surround Denver. FlexRide covers areas where there was no preexisting transit service or where the preexisting fixed-route bus service was performing poorly.



Denver RTD

RTD uses the same type of cutaway bus for both its FlexRide and ADA paratransit services. It owns the buses and contracts out maintenance and operation. The service uses an entirely automated scheduling service that riders can access through their phones or computers.

RTD boasts having an extensive set of performance metrics and other data that it believes demonstrates how FlexRide has boosted the agency’s operational efficiency by better serving its customer base at a reasonable cost per ride (for both transit system and rider).

Orange County Transportation Authority (OCTA), OC Flex

In 2016, OCTA created the OC Bus 360° initiative to determine ways that the agency could increase its operational efficiency and at the same time adapt to changing ridership habits. In 2018, OCTA launched OC Flex, a microtransit service providing on-demand trips to two separate zones (one directly on the coast and one in an inland suburban area) in the style of similar offerings from the increasingly popular Uber and Lyft. OC Flex was planned as a one-year pilot program.



Los Angeles Times

The agency employed an outside firm to help develop the program, conducting market research and service zone analysis. OCTA deployed cutaway buses with OC Flex branding.

Tracking ridership, OCTA determined that it had positively contributed to the overall system’s operational efficiency through microtransit in its inland pilot zone. It ultimately suspended service in

its underperforming coastal zone pilot and tweaked its inland zone's service to maximize effectiveness.

ECONOMIC OPPORTUNITY

Reliable, affordable transportation is needed for residents in many communities to access economic opportunities. For people living in rural areas surrounding cities, for example, the cost of owning and using a car may be prohibitive to working in the city due to the long commute. Also, many of these same people may not be served by traditional fixed bus routes in a way that would allow them to use the bus to commute.

Microtransit can provide a solution to this issue of connecting people in rural or suburban areas with job opportunities. Microtransit buses can offer these residents a commuting option more affordable than car ownership or ride-hailing services such as Uber. By increasing rural and suburban residents' access to economic opportunities, microtransit can also deepen the worker talent pool available to businesses.

Houston METRO, Community Connector

In Houston's sprawling metropolitan area, the region's transit authority conceived its microtransit system as a means of addressing areas where fixed-route bus service was costly or did an ineffective job connecting residents in outlying areas to Houston's urban core.



RideCo Blog

To launch its Community Connector microtransit service, METRO narrowed its focus to Acres Homes, a predominantly African American neighborhood on the city's outskirts. The agency believed that this economically disadvantaged zone would be receptive to a demand-responsive transit service. METRO partnered with RideCo for this program.

The Community Connector picks riders up at any requested location within Acres Homes and drops them off at their intended destination. In terms of increasing economic opportunities, Community Connector functions as a first mile/last mile service enabling residents to reach hubs where they can transfer to other bus lines leading to the city's core. The service uses cutaway buses and cargo vans, both types of which accommodate wheelchairs.

Community Connector has since expanded to two other zones in Houston, increasing METRO's footprint in helping connect residents in areas like Acres Homes to greater opportunities.

Fresno County Rural Transit Agency (FCRTA)/Inspiration Transportation, REV-UP (Rural Electric Vehicle Utilization Project)

The city of Fresno has more than 500,000 people but is encircled by a rural area predominantly used for agriculture. Residents of these outlying areas, containing some of the most disadvantaged communities in California, are often shut out of economic opportunities due to the lack of transit connections to Fresno. Due to low population density, these areas have very limited fixed-route bus service and virtually no coverage from ride-share services such as Uber and Lyft.



Walker Consultants

Additionally, the area has some of the worst air pollution in the nation, and the Fresno County Rural Transit Agency (FCRTA) made it a priority to reduce the number of emissions-producing vehicles on the county's roads.

FCRTA worked with an outside consulting firm to develop its first microtransit program, called REV-UP. Using funding from the Measure C ballot initiative, the agency created a joint rural rideshare/carshare system using both vans and sedans.

The vehicles help rural residents avoid long walks to fixed-route bus stops and connects them with opportunities in Fresno. The vehicles are also electric, satisfying the agency's goal of curbing car emissions.

ELDERLY AND LESS AMBULATORY

While microtransit constitutes a distinct category from paratransit, it has precedent in the paratransit systems established by agencies to comply with the Americans with Disabilities Act of 1990 (ADA). In these "dial-a-ride" programs, elderly or disabled patrons can call in to request a pick-up at a location of their choosing.

Many microtransit systems, while separate from paratransit, can accommodate elderly or disabled passengers in a similar way. Some microtransit buses have the same equipment as paratransit buses, and some transit agencies do, in fact, use microtransit to double as its paratransit service. Other agencies also use microtransit to serve the more general population of seniors. Microtransit can function as an asset to provide a useful transportation for those who, through age or infirmity, cannot make use of traditional fixed-route bus service.

San Joaquin Regional Transit District (SJRTD), Van Go!

The San Joaquin Regional Transit District (SJRTD) sought a way to better connect the communities in its largely rural area in central California. It additionally wanted to create an innovative service that functioned both as effective transportation for the general public and as ADA-compliant paratransit.



Escalon Times

SJRTD launched Van Go!, using professionally-trained drivers and cutaway vans with distinctive branding featuring the image of painter Vincent van Gogh. The vans all have accessibility features mandated for paratransit.

SJRTD experimented with its service, altering zones and collecting extensive ridership data in an attempt to optimize efficiency. The result has been deemed a success by the district, and the Van Go! pilot program has been extended. Looking to the future, the district sees its Van Go! program as a means to keep up with community trends as riders, including the general public and those with special accessibility needs, seek more autonomy with their travel.

City of Newton, MA/Via, Newton in Motion (NewMo)

The City of Newton, a Boston suburb, previously maintained an inefficient transit program for its seniors. Newton offered seniors a voucher for private taxi service, and all trips needed to be reserved at least 72 hours in advance. The City of Newton decided to use microtransit to develop an improved transit option for its seniors.



OurNewton.org

Together with private company Via, the City of Newton created NewMo (Newton in Motion) to pick up residents aged 60 and above anywhere within the city. Using an app on their phones, seniors could make a reservation only 30 minutes in advance.

NewMo succeeded in offering Newton seniors on-demand, flexible service with a maximum of 30 minutes spent in the van, increasing the quality of life for the city's elderly residents. NewMo has since been expanded to serve everyone and can now drop off its riders at any location within Newton. NewMo's service has also contributed the City of Newton's effort of reducing the number of passenger vehicles on Newton's roads.

JURISDICTIONAL EQUITY

Many transit agencies encounter the problem of jurisdictional equity when choosing what form of service to provide and for what locations. In these instances, some members residing within a transit agency's jurisdiction pay into the agency's funding but receive little or no coverage in their area from the

agency. Establishing a microtransit program can serve as a way for agencies to correct this imbalance.

For example, a suburban area outside a densely populated urban core may be poorly covered by public transportation relative to the city's hub. Traditional fixed-route bus service may not be effective in covering this suburban area due to the zone's low population density. By contrast, microtransit buses can cater to potential riders in these areas by reaching them where they live, which may be well out of the reach of any traditional bus service's fixed routes. Microtransit can be deployed to these areas to allay any concerns about transit agencies covering them.

Salem Area Mass Transit District (Cherriots), The Connector

Salem Area Mass Transit District (Cherriots) serves a population of fewer than 250,000 residents centered around Oregon's capital, Salem. In 2015, Cherriots sought an opportunity to improve their system in West Salem, an affluent residential area. Many of the hilly neighborhood's streets lack sidewalks, leading to mobility limitations for residents. To increase jurisdictional equity for the poorly covered area, Cherriots decided to initiate a microtransit pilot program called the Connector, consisting of one bus (with another bus as contingency).



Oregon Department of Transportation

The program was funded and operated out of the agency's existing paratransit service and made use of retired paratransit buses that required extensive upkeep. The Connector did not provide curb-to-curb service but offered to pick up and drop off riders on demand at 26 designated locations. The Connector did not have a dedicated app, instead being accessed through the Cherriots' website.

The service proved to be popular, but Cherriots decided to suspend the pilot program, citing the need for purchasing an additional bus. This situation was problematic to the agency because it would have depleted funds allocated to paratransit. The project was ended in 2017 and replaced with fixed-route service. Cherriots cites greater knowledge about rider needs and usage as positive takeaways from the pilot.

Sacramento Regional Transit District (SacRT), Smart Ride

Sacramento is characterized by sprawl, with many communities with low population density surrounding the city. Sacramento Regional Transit wanted to test out ways they could better serve these communities and increase jurisdictional equity other than just maintaining fixed-route bus service. They also wanted to learn more about how to use advances in technology, such as those used by ride-hailing services and other demand-responsive transit operators.



SmartCitiesWorld

SacRT already had a demand-responsive transit program in place in the suburb of Citrus Heights, where they provided a "dial-a-ride" shuttle service called CityRide

using cutaway buses. In 2017, after reviewing simulation data about microtransit service from software provider TransLoc, they decided to transition CityRide into a more advanced microtransit program called SmaRT Ride, to be run as a pilot for six months in Citrus Heights. SmaRT Ride used the same equipment and staff as CityRide, with same minibuses rebranded. The biggest difference was the use of Uber-style software that permitted riders to schedule trips through a dedicated app.

Through an extensive marketing effort, SacRT succeeded in migrating a satisfactory number of CityRide users over to SmaRT Ride. The transit agency also achieved its goal of gaining knowledge about new technology, to give it a better understanding of how to complement its existing bus services. The agency decided to extend the pilot into a permanent program, now powered by Via. SmaRT Ride now has 45 vehicles, covers over 100 square miles, and is the largest U.S. microtransit deployment. SacRT has also become a leader in zero-emission microtransit vehicle deployment, with nine ZEVs currently used in its SmaRT fleet. SacRT is eager to share its experiences with other agencies interested in launching their own microtransit service.

ZEV TECHNOLOGIES

With the increased interest in providing funds for zero emissions vehicles, transit agencies are considering microtransit as way to implement zero emissions technology within their fleets. Implementing microtransit service can be used as a means for a transit agency to innovate and test out this new technology before it converts the bulk of its fleet.

Anaheim Resort Transportation (ART), FRAN (Free Rides Around the Neighborhood)

The city of Anaheim is home to Disneyland and has built a public transit system called Anaheim Resort Transportation (ART) specifically geared toward serving the city's many visitors. The city's roads are still clogged, however, with cars headed to Disneyland and other destinations in the area. ART and the City of Anaheim sought a way to decrease the number of cars on the road by offering an easy, quick transit option.



Briton Saxton

ART created a microtransit system called FRAN (Free Rides Around the Neighborhood) to serve its unique needs as a major tourist destination. Using a small fleet of 2-5 electric Gem buses made locally in Anaheim, FRAN transports passengers to points across Anaheim's Center City Zone in under 10 minutes. FRAN also attempts to be a memorable experience rather than just a ride, with each FRAN car named after a prominent woman in Anaheim's history.

ART and the City of Anaheim consider FRAN a success, and plan to make it an enduring and attractive part of the city's set of transit services.

Porterville Transit System, transPORT

The City of Porterville, CA saw room for improvement in its transit agency's offerings, hoping to better serve rural areas outside existing bus routes and enhance mobility overall. It also looked to improve its sustainability efforts by supporting reduction in greenhouse gas emissions.

Porterville Transit System launched transPORT, which uses battery-electric vans that can be fast charged. The vehicles, which can seat 10-16 passengers, are also ADA compliant.



Lightning eMotors

The agency is pleased with the rate at which transPORT has been adopted by Porterville residents, with ridership steadily increasing. In particular, disabled and elderly riders who previously used the agency's "dial-a-ride" paratransit system have been migrating away from that program and toward transPORT, which offers more flexibility. The city recently added 12 more vans to the transPORT program and looks to expand further in a move to cater to customers increasingly interested in using Uber-style on-demand services.

4.2. LANDSCAPE OF MICROTRANSIT OPERATORS AND OPERATIONS

In addition to the public microtransit operators, private microtransit operators are also operating in various locations across the continental United States and Canada (Via, for example, operates in more than 25 states), with truly no geographic mean. Current microtransit operators can date their work in the overall transit industry as far back as 1955, with others being established as recently as 2020. Below we are sharing examples of the geographic diversity of private microtransit providers' bases of operation.

Note: The Denver Regional Transportation District originated the contemporary concept of microtransit service (which it has called demand-responsive transit, or DRT) in 2008, before private microtransit operators.

MICROTRANSIT OPERATORS

Table 4. Sample list of microtransit operators in North America.

OPERATOR	HEADQUARTERS	OPERATING SINCE
Circuit	West Palm Beach, FL	2011
Demantrans	Chicago, IL	1994
Electric Cab of North America	Austin, TX	2008
First Transit	Cincinnati, OH	1955
Labyrinth Smart Mobility	St. Louis, MO	2020
RideCo	Waterloo, ON (Canada)	2013
TransLoc¹⁴	Durham, NC	2004
Via¹⁵	New York, NY	2012

MICROTRANSIT OPERATIONS

According to the Shared-Use Mobility Center, there are over 100 microtransit operations in the United States,¹⁶ distributed widely across the lower 48 U.S. states and some Canadian provinces. Every region in the United States is home to microtransit operations, with most deployments clustered in or near cities, as seen in the map below. The dots, which represent locations of current microtransit projects, underscore a few interesting stories and trends in microtransit:

- The clustered projects in eastern and central Oklahoma represent the 21 rural communities where curb-to-curb microtransit service is offered by PICK Transportation, a collaboration between four local transit agencies and the region's economic development association.¹⁷ PICK Transportation's combined fleet of 41 ADA-compliant vehicles serve areas where fixed-route transit is limited or unavailable, including the communities of the Cherokee, Shawnee, and Miami tribes.¹⁸ These

¹⁴ Owned by Ford

¹⁵ Owns Remix; Operates in more than 35 countries and more than 25 U.S. states plus Washington, D.C.

¹⁶ Shared-Use Mobility Center. (2021). Available at <https://learn.sharedusemobilitycenter.org/search/?keyword=&topics=&doc-types=&resourcetypes=&modes=536&partners=&orderby=relevance&tab=map>

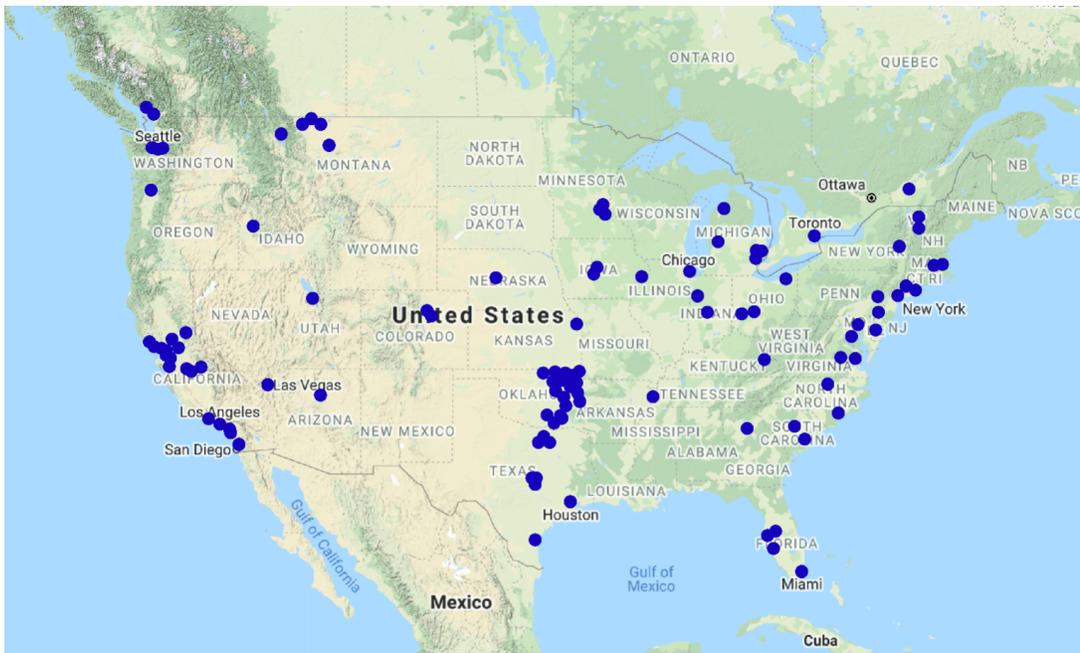
¹⁷ PICK Transportation. (2021). Available at <http://okpicktransportation.com/>

¹⁸ Shared-Use Mobility Center. (2021). "Rural Agencies Launch Mobility On-Demand Pilot, 21 Counties, OK, 2021." Available at <https://learn.sharedusemobilitycenter.org/overview/rural-agencies-launch-mobility-on-demand-pilot-21-counties-ok-2021/>

projects serve and uplift historically disadvantaged native communities.

- Microtransit projects are geographically diverse, represented in communities across the United States. Though projects are clustered in regions with larger population centers, such as coastal corridors in California and the mid-Atlantic, microtransit applications are also supporting transit operations in areas along the Central plains, the upper Midwest, Appalachia, the Rocky Mountains, and elsewhere.

Figure 2. Locations of current microtransit implementations in North America



Software Logistics

A growing number of software logistics companies are supporting microtransit operations and helping to grow the segment. These companies manage vehicle procurement, payment integration, route logistics, and other operational planning considerations. However, this report will not explore this segment in detail since these software and logistics companies operate in a rapidly shifting market and provide specific, bespoke services for each microtransit contract.

A previous report released by CALSTART for SARTA's NEORide Multimodal and Technology Assessment identified Via, Circuit, and RideCo as three nationally distributed companies that can provide microtransit services. The report is available at:

<https://calstart.org/ezfare-the-gateway-multimodal-strategy-and-technology-assessment>

CONCLUSIONS AND RECOMMENDATIONS

Microtransit brings a “force multiplier” that can help public transportation agencies better serve their communities, increase ridership, strengthen their operations, and be stronger force for reducing climate pollution. The technology represents an innovative approach to public transportation that merits serious consideration for wider implementation by policy makers, manufacturers, and transit agencies.

For policy makers, CALSTART recommends the following:

- Provide dedicated new funding streams for microtransit vehicles and operations for use in the target applications as described in this report;
- Create financial and other incentives to lead to greater commercialization of ZEVs designed specifically for microtransit, such as investments through the HVIP or NYTVIP programs;
- Integrate microtransit—and ideally zero-emission microtransit—as a key target for mode shifting in regulatory and planning goals for VMT reduction and transit ridership; and
- When considering zero-emission bus requirements, target microtransit as a solution that can potentially accelerate adoption timeframes.

For transit agencies, other operators, and manufacturers, CALSTART recommends the following:

Funding for Microtransit

Funding for microtransit vehicles, software, and marketing may come from a variety of sources, including at the federal level. Since 2016, the Federal Transit Administration (FTA) has recognized microtransit as public transportation, opening up formula funds and numerous grant opportunities for procurements of vehicles, technologies and planning each year. Other departments, such as the Department of Energy (DOE), may provide funding as well.

Additionally, state governments, local utilities, and community action groups may also have funding opportunities within various departments. For example, the Clean Mobility Options Voucher Pilot Program in California provides financial subsidies for transit agencies pursuing transportation initiatives, such as EV microtransit deployment, that can help meet environmental goals in disadvantaged communities throughout the state. In Alabama, the Community Foundation of Greater Birmingham nonprofit collaborated with the City of Birmingham to fund a microtransit pilot program aimed at serving residents in economically challenged communities.

- Pilot and explore microtransit in the use cases outlined in this report as a way to provide residents new alternatives to single occupancy vehicles; and
- Ensure that the needs of microtransit applications are met when using ZEVs. For example, ZEVs must satisfy range requirements and must be sufficiently supported by on-site charging as well as fast charging, if needed.

CALSTART supports transit operations in leading regions across the United States and administers voucher programs to make ZEVs more affordable and easier to purchase. The following CALSTART contacts are available to facilitate corresponding interests in microtransit deployment:

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APPENDIX A

Table 5. Potential to reduce greenhouse gas emissions of microtransit vehicles through electrification (expanded)

Converting a microtransit transit vehicle from internal combustion to battery-electric can reduce greenhouse gas emission by around 50-70% in a general average US case, and 85-90% for in the case of regional leadership, assuming the same sized vehicle and same number of passengers for full-speed motor vehicles. Further, neighborhood electric vehicles with a top speed of 25 MPG can be used to reduce emission by 85% and 95%. The table below provides detailed by class for vehicles currently in use.

	NORMALIZED CLIMATE IMPACT (GCO ₂ /MI)		RELATIVE CLIMATE BENEFIT OF BEV (APPROXIMATE)	
	DIESEL/ GASOLINE ^A	BEV ^B	US TYPICAL ^C	REGIONAL LEADER ^C
Class 6: gross vehicle weight rating (GVWR) 19,501- 26,000 lbs.	1697 gCo₂/mi Assumptions: Diesel w/ 6 (+/- 2) MPG; Co ₂ in diesel 10,180g per gallon	898 gCo₂/mi (US typical) 274 gCo₂/mi (regional leader) Assumptions: BEV efficiency of 2.0 kWh/ mi with reference to 2.0 for Lion (160 kWh/80 mi); Co ₂ in electricity 449 gCo ₂ (US typical) and 137 gCo ₂ (regional leader)	47%	84%
Class 5: GVWR 16,001- 19,500 lbs	1273 gCo₂/mi Assumptions: Diesel w/ 8 (+/- 2) MPG; Co ₂ in diesel 10,180g per gallon	359 gCo₂/mi (US typical) 110 gCo₂/mi (regional leader) Assumptions: BEV efficiency of 0.8 kWh/ mi with reference to 0.8 kWh for Lightning (128 kWh/160 mi); Co ₂ in electricity 449 gCo ₂ (US typical) and 137 gCo ₂ (regional leader)	71%	91%

	NORMALIZED CLIMATE IMPACT (GCO ₂ /MI)		RELATIVE CLIMATE BENEFIT OF BEV (APPROXIMATE)	
	DIESEL/ GASOLINE ^A	BEV ^B	US TYPICAL ^C	REGIONAL LEADER ^C
Class 4: GVWR 14,001- 16,000 lbs.	848 gCo₂/mi Assumptions: Diesel w/ 12 (+/-3) MPG; Co ₂ in diesel 10,180g per gallon	404 gCo₂/mi (US typical) 123 gCo₂/mi (regional leader) Assumptions: BEV efficiency of 0.75- 1.0 kWh/mi with reference to 0.78 kWh for Greenpower: (118 kWh/150 m), 0.88 kWh for Microbird (88 kWh/100 mi), 0.97 kWh for BYD (121 kWh/124 mi), and several for Phoenix Motorcars within the above range; Co ₂ in electricity 449 gCo ₂ (US typical) and 137 gCo ₂ (regional leader)	52%	85%
Class 3 and lower: GVWR 14,000 lbs. or lower	634 gCo₂/mi Assumptions: Gasoline w/ 14 (+/-3) MPG; Co ₂ in gasoline of 8,887g per gallon	247 gCo₂/mi (US typical) 75 gCo₂/mi (regional leader) Assumptions: BEV efficiency of 0.5-.0.6 kWh/mi with reference to 0.53 for Ford E-Transit (67 kWh/126 mi) and 0.61 for Lightning (86kWh/140mi); Co ₂ in electricity 449 gCo ₂ (US typical) and 137 gCo ₂ (regional leader).	61%	88%
		<i>Neighborhood electric vehicle (up to 25 MPH)</i> 90 gCo₂/mi (US typical) 27 gCo₂/mi (regional leader) Assumptions: BEV efficiency of 0.20 with reference to Polaris GEM E6 (8.9kWh/42 mi); Co ₂ in electricity 449 gCo ₂ (US typical) and 137 gCo ₂ (regional leader).	85%	95%

Notes

A. Carbon dioxide from gasoline is 8,887 g co₂/gallon and diesel is 10,180 g co₂/gallon (EPA; [source](#)).

B. Carbon dioxide from ZEVs is based on carbon intensity of the vehicle's electricity source over the

APPENDIX A

vehicle lifetime (assume 11 or slightly more years), which varies by location, is trending becoming cleaner (but at different rates by region), and is significantly impacted by regulations which are uncertain. For simplicity, we assume the following cases:

- **“US typical” of 449 gco₂/kWh.** Today’s US grid average assuming no change over time. This a middle-of-the road case for considering the US on average broadly. The impacts could very likely be much reduced, for example with Biden targets of 80% clean power by 2030 ([source](#)). On the other hand, a serious strategy led federally requires legislation that is not certain, and indeed a serious faction of policymakers are working to push back against and reverse regulations ([FAS](#)). The range of outcomes is large ([Energy Innovation](#))
- **“Regional leader” path of 137 gco₂/kWh.** Represents 2020-2036 grid average for both California and New York, two of the country’s leaders, in terms of current progress and expected continued progress under current binding commitments as of June 2020, according to analysis by [RMI](#). Note One pound is equal to 453.592 grams; therefore 303 lbs/MWh = 137 gco₂/kWh.

APPENDIX B

MICROTRANSIT VEHICLE CATEGORIES: ZEV AVAILABILITY

Microtransit applications can be served by different types of vehicles, depending on the need. Many EV options are already available within the listed categories.

Below, you can find examples of battery-electric and hydrogen fuel cell vehicles found in the Zero-Emission Technology Inventory (ZETI) directory. You can reach out to see what is available in your jurisdiction.

LOW FLOOR TRANSIT BUS



Lion Electric Co. offers the LionM Paratransit Bus and Shuttle Bus midi/minibus. The LionM can carry up to 31 passengers plus driver.

CUTAWAY BUS



Micro Bird Commercial offers the Micro Bird D-Series Electric Specialty, MD Edition, and DLX bus and DS-Series Para-Transit bus, all on the Ford E-450 Platform. These buses can carry up to 28 passengers and come in a wide variety of seat options to accommodate wheelchairs.



GreenPower Motor Company offers the EV Star and EV Star+ buses, both on the EV Star chassis. The EV Star bus can carry up to 21 passengers and the EV Star+ bus can carry up to 25 passengers. Both buses are 25' long.



Motiv offers the Epic E-450 Shuttle Bus on the Ford E-450 platform. This bus carries up to 18 passengers (accommodating 1 wheelchair) plus driver and ranges between 23' to 26' in length.



US Hybrid offers the H2Ride Fuel Cell Shuttle Bus. This bus, powered by hydrogen fuel cells, carries up to 12 passengers (accommodating 2 wheelchairs) plus driver and is a 22' in length.



Lightning eMotors offers the E-450 Shuttle Bus on the Ford E-450 platform and F-550 Bus on the Ford F-550 platform. Both buses use the Lightning Electric Powertrain. The E-450 bus can carry up to 22 passengers (accommodating 2 wheelchairs) plus driver. The F-550 bus can carry up to 32 passengers (accommodating a customizable number of wheelchairs) plus driver. The E-450 and F-550 can both accommodate 2 lifts.





Phoenix Motor Cars offers the Zeus 400 Transit Bus, Shuttle, and Passenger Shuttle. All versions carry between 12 to 23 passengers (accommodating 2 wheelchairs) plus driver and are 22' to 24' in length.

VAN



Lightning eMotors offers the Electric Transit passenger van, built on the Ford Transit 350HD Passenger Van chassis. The van can carry up to 15 passengers including the driver, and is also offered in an ADA-compliant option.

Note: **EVT**, **Chanje**, and **Ford** (in a 2022 edition) are offering all-electric vans, but only as cargo vans.

NEIGHBORHOOD ELECTRIC VEHICLE



Polaris offers the GEM e6, which seats 6 passengers. It is just under 14' long and has a top speed of 25 mph.



MotoEV offers the Electro Bubble Buddy LSV 6 Passenger Forward Facing Hard Door vehicle, which seats 6 passengers and is 12.3' long. It has a top speed of 25 mph.



STAR EV offers the M-Series Shuttle Bus, the Enclosed Bus, and the AP-Series vehicle. Depending on the version, the M-Series Shuttle bus can seat between 8-23 passengers. M-Series buses range from just over 12' in length to 18.4', and can all reach a top speed of 18 mph. The Enclosed Bus can seat 14 passengers. The Enclosed Bus ranges from 15.5' to 16.9' in length, and can reach a top speed of 18 or 19 mph. The larger version of the AP-Series vehicle can seat 6 passengers, is 12.8' long, and can reach a top speed of 20-25 mph.



Club Car offers the Villager vehicle. Depending on the version, the Villager can seat 6 or 8 passengers and can reach a max speed of 16-17 mph.



Note: The low price point of NEVs precludes them at present from HVIP incentives. Electric versions are fully mature for the NEV category.