

Rural Resilience: The Role for Innovative Public Transportation

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ABSTRACT

Access to employment, education, health care, and shopping is essential for any community. In rural communities, these destinations typically require access to a private vehicle or public transit given the distances involved and the lack of sidewalks, bike lanes, and other active transport systems. Rural communities can be particularly vulnerable to climate change as they may lack the human adaptive capacity to plan for and respond to climate-related natural disasters and generally possess more rigid transport systems. Our work reviews the provision of rural public transit in Maine and similar rural states and makes recommendations on how innovative public transit can enhance mobility and add to rural resilience. In addition, we explore applied and theoretical applications of on-demand transit and microtransit. We note that ongoing, stable funding for public transit and rural public transit continues to be a challenge.

INTRODUCTION

Access to employment, education, health care, and shopping is essential for any community. For those living in rural communities, these destinations typically require access to a private vehicle or public transit due to the distances involved and the lack of sidewalks and bike lanes. Compounding these difficulties are the increases in extreme weather events, which highlight the need for a better understanding of how environmental change affects transportation systems and the ability of communities to prepare for and recover from the impacts of such events (Chandrasekhar et al. 2022). In addition, rural communities can be particularly vulnerable to climate change as they may lack the human adaptive capacity to plan for and respond to climate-related natural disasters (Levesque et al. 2021a, 2021b).

Public transit provides access to essential services for individuals and households with limited access to a private vehicle, yet research into rural public transit is often overlooked. Our paper highlights lessons learned from Maine, Vermont, and New Hampshire to help better plan for resilient communities given our changing climate. We also look at innovative solutions including on-demand transit, community-based organizations, and

volunteer networks that can enhance rural resiliency.

Historical Context

Technological advances in the early 20th century led to the decline of public transportation in the United States. Car ownership reached a point of one per five people, making it difficult for public transportation options to compete. Automobiles could convey individuals to their destination much faster than horse-drawn carriages, and American society responded to the economic opportunity these vehicles provided by designing infrastructure to better enable travel by automobile. These infrastructure

changes especially boomed after the Second World War, when post-war economic prosperity led to an increased demand for housing outside cities. By 1960, many transit providers were going bankrupt (Giuliano 2011).

The federal government attempted to revitalize public transportation in 1964 with the Urban Mass Transportation Act, which authorized capital subsidies to rehabilitate mass transit. It was expected that capital investments would increase efficiency while attracting passengers. However, rising operating costs and stagnant to declining fares would lead to the introduction of federal subsidies in 1974. At the same time, federal funding for highway construction, in competition with funding for the Urban Mass Transportation Act, began to falter due to the high cost and controversial nature of the remaining projects (Giuliano 2011).

The Highway Trust Fund (HTF) was created in 1956 to fund the creation of the interstate highway system and is comprised of the highway account and the mass transit account. Nominally, the HTF's annual revenue has increased since its establishment in 1956, with increases occurring in 1959, 1983 (with 1 cent of the \$0.09 per gallon allocated to the new mass transit account, the rest to the newly created highway account), 1990, and 1993.

However, these increases have been offset by inflation, increases in the average vehicle fuel economy of gas vehicles, and the increase in electric vehicles that do not pay fuel taxes. According to a Congressional Research Service report, since 2001, highway account “expenditures have exceeded revenue by amounts ranging from \$430 million in FY 2006 to \$16 billion in FY 2016 (in 2023-adjusted dollars)” (Lohman 2025: 11), with the balance expected to approach zero in FY 2028 if current trends continue. Maine’s State Highway Fund is similarly overspending relative to its revenue stream, with “a projected Highway Fund structural gap (revenues less than allocations) for the 2026–2027 biennium of \$312,539,996” (Stewart 2024: 1). However, this was before the recent revisions by Maine’s Revenue Forecasting Committee, which estimates the Highway Fund will generate approximately \$513 million in 2025, \$503 million in 2026, and \$504 million in 2027, all decreases from the earlier forecast (Rector et al. 2025). These budgetary constraints put the infrastructure supporting fast, efficient mobility at risk, jeopardizing a community’s ability to respond to adverse events. This issue is especially important in low-income communities, which may have fewer automobiles available during such events due to the expense of ownership and maintenance (Sandvig 2017).

What is Rural?

The US Census Bureau defines urban and rural areas based on population and population density. An urban area comprises “a densely settled core of census blocks meeting minimum housing unit density.” For the 2020 census, an urban area “must encompass at least 2,000 housing units or have a population of at least 5,000” people and include adjacent territory containing nonresidential urban land uses.¹ In contrast, rural areas encompass all population, housing, and territory that are not urban. While useful as a measuring exercise, this definition does not describe the wide variation in rurality. In practice, *rural* can have different meanings to both the people who live in and those providing services to a particular area.

Over the last 15 years, population in rural America has experienced a decline (Cromartie 2017), recently followed by a modest increase (Davis et al. 2023). Rural public transit ridership, however, grew over 30 percent between 2010 and 2019, from 95.6 million trips to 125.5 million trips (FTA 2019). While there was a fall in ridership during the pandemic, levels are recovering and given the larger population of older Americans in rural

communities, the growth in need and ridership for rural transit is likely to continue.

Rural households on average travel 50 percent more vehicle miles than urban households (TRIP 2024), though the average number of trips decreases with increasing rurality (Pucher and Renne 2005). Among the challenges facing rural transportation systems are road safety (affected by driver behavior), emergency response times, and road conditions and design. In 2022, 52 percent of major rural roads were in good condition and 12 percent were in poor condition, and the remaining were rated as either mediocre or fair (TRIP 2024). The American Society of Civil Engineers recognizes that Maine’s roads have improved over the last decade, but they still receive an overall grade of C- due to crash history, pavement rutting, paved roadway width, and bridge reliability. Despite the improvements, Maine still faces an estimated \$100 million in annual unmet funding needs (ASCE 2024). Across the country, 40 percent of rural counties do not have a public transportation service and an additional 28 percent of rural counties have limited service (TRIP 2024). Quallen et al. (2023) found respondents in rural areas struggled with traveling long distances to reach services, whereas urban respondents were more focused on traffic-related concerns.

PUBLIC TRANSPORTATION CHALLENGES IN RURAL AREAS

Mobility in rural environments presents several challenges. In a study conducted by Henning-Smith et al. (2017), key stakeholders across all 50 states were asked what they viewed as the largest challenges to establish reliable rural transportation. They identified six overarching themes: infrastructure, geography, funding, accessibility, political support and public awareness, and socio-demographics. Infrastructure was the most cited challenge, with concerns about roads, vehicle, transportation equipment quality, and sufficient personnel, particularly regarding options for affordable non-medical transportation. Furthermore, lower population density in rural areas decreases ridership for fixed transit routes, and a smaller tax base creates challenges to funding and maintaining transportation systems.

Similarly, a 2023 travel study aimed at assessing transportation behaviors and challenges in Vermont found infrastructure and access to be key considerations for how rural respondents choose to travel (Quallen et al. 2023). Road conditions and distance to services were the

most common transportation challenges for rural respondents. Fuel costs are less likely to affect the travel behavior of rural respondents as 66 percent reported that fuel prices had no effect on their travel. Meanwhile, public transportation and electric vehicles are not widely used due to costs, lack of awareness, and accessibility related reasons. The low usage rate of public transit is due to the relative difficulty in using it and the inability to reach the intended destination. As a result of the transportation limitations in rural areas, driving alone is cited as the primary mode of travel.

Another challenge of transportation in rural areas is the higher travel burden that rural residents face in terms of time, cost, access, and unmet need. A study by Espeland and Rowangould (2024) found that people living in dispersed areas are 9 percent more likely to report financially burdensome travel compared to their urban counterparts. Similarly, unmet need is more common among dispersed and small-town residents with limited or no vehicle access, which highlights the dependence on personal vehicles in rural areas where residents face a tradeoff between higher travel costs associated with vehicle ownership and mobility due to limited public transit.

TRANSPORTATION RESILIENCE

Resilience is defined as the ability of a system to absorb and adapt to disturbances while retaining essential functions and structure (Schulz et al. 2015). Strategies to increase the resilience of vulnerable infrastructure include considering climate change impacts on asset management, strengthening existing infrastructure, raising standards for new infrastructure, incorporating redundancy into the system, and implementing disaster-recovery policies in vulnerable areas. In Maine, extreme weather can also damage coastal infrastructure and recent record-setting storms have damaged homes, buildings, roadways, piers, and wharves along Maine's working waterfronts (Maine IRRRC 2025).

MAINE DEMOGRAPHICS AND TRAVEL PATTERNS

Maine is considered one of the most rural states in the nation with an estimated population of 1.4 million people as of 2024 (population density of 44 people per square mile). Maine's 2024 median household income was \$76,442, and 10.6 percent of the population live below the poverty level.² Additionally,

approximately 23 percent of Maine's population is 65 or older, and this is projected to increase to 29 percent by 2040 (Edris et al. 2020). Commuting is a major contributor to driving needs, and the most popular means of transportation to work in Maine as of 2023 was driving alone (73 percent), followed by working from home (14.1 percent), carpooling (8.3 percent), and 3.7 percent from other means such as public transportation or biking.³ A John T. Gorman Foundation report estimates that there are 40,000 zero-vehicle households in Maine and that approximately 9 percent of Mainers aged 65 and older do not have a vehicle. Average annual transportation costs for a family of four in Maine is \$17,408, while Mainers in more rural counties face higher costs on average and more difficulties reaching essential destinations or employment. Statewide, there was a total of 28 million unmet trips over a five-year average (2018–2022), and Maine's transit providers were only able to cover 11 percent of the need (Reilly 2025). The economic implications of the lack of access, costs of transportation relative to incomes, and older population make communities, especially in northern, central, and eastern Maine, more vulnerable to transportation infrastructure disturbances and extreme weather events.

PEER STATES DEMOGRAPHICS AND TRAVEL PATTERNS

Vermont

As of 2024, Vermont had an estimated population of 648,493 (population density of 70 people per square mile), a median household income of \$82,730, and 9 percent of the population was living below the poverty level and 22.8 percent was age 65 or older.⁴ As of 2022, Vermont had the highest percentage of its population, 64.9 percent, living in rural areas (US Census Bureau 2022). The most common means of transportation to work as of 2023 are driving alone (71.1 percent), working from home (15.1 percent), and carpooling (8.1 percent), with less than 6 percent using other means.⁵

Funding for local transit providers comes from a mix of federal, state, and local sources, as well as directly generated funding, which includes farebox revenue, contract and advertising revenue, donations, and other direct revenue sources (Mattson and Mistry 2024). Federal assistance provides for the majority of operating expenses for rural transit providers in Vermont. State and local sources have varying levels of significance, depending on the transportation provider (see Figure 1).

New Hampshire

As of 2024, New Hampshire had an estimated population of 1,409,032 (population density of 156.6 people per square mile), a median income of \$95,628, with a 7.2 percent poverty rate and 21.5 percent of residents being 65 years of age or older.⁶ As of 2020, 37 percent of the population and 84 percent of the landmass was considered rural (NHDPHS 2020). The most common means of transportation to work in 2023 were driving alone (74.2 percent), working from home (15 percent), and carpooling (7.1 percent), with less than 4 percent using other means.⁷

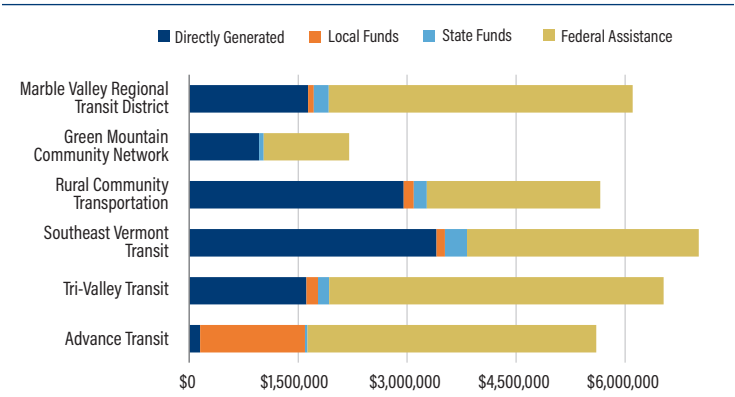
In the 2024 fiscal year, New Hampshire spent \$508,578 on state operating match for local public transit systems (State of New Hampshire 2025). However, state funding is a minor contributor in the operational funding of New Hampshire’s rural transportation providers, covering only 7.2 percent of their operating expenses in 2023, compared to 61.1 percent from federal assistance; directly generated funding covered 14 percent of operating expenses in 2023, and local funding covered 17.8 percent of operating expenses (FTA 2023).

COMPARISON OF PEER STATES PUBLIC TRANSIT

Through the aggregation of service metrics for rural transportation providers, Maine can be compared against its peer states. Vermont is the largest rural service provider (Table 1). In 2023, riders in Vermont took almost three times more trips than riders in Maine did. New Hampshire is the smallest rural transit service provider based on unlinked trips, vehicle revenue miles, and vehicle revenue hours.

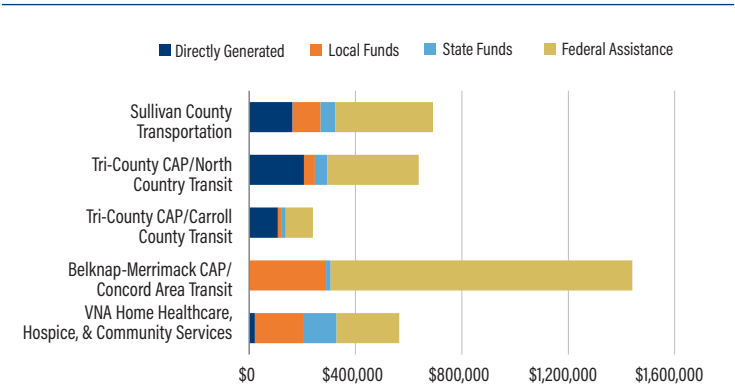
Comparing absolute operating expenses does not account for the number of passenger trips, vehicle hours, or vehicle miles. In Table 2, the operating expense per unlinked passenger trip is broken down by funding sources. Based on our funding calculations extrapolated from data provided by the Federal Transit Administration, all three states have a substantially higher per trip operating expense in 2023 than in 2019. Maine’s average operating expense per unlinked passenger trip is the highest across the three states at \$30.55, a significant increase from 2019 (\$12.27). This increase is likely due to ridership

FIGURE 1: Funding Sources for Operating Expenses of Vermont Rural Transit Providers, 2023



Source: Figure created by authors, based on data from the National Transit Database (FTA 2023)

FIGURE 2: Funding Sources for Operating Expenses of New Hampshire Rural Transit Providers, 2023



Source: Figure created by authors, based on data from the National Transit Database (FTA 2023)

TABLE 1: Aggregation of Service Metrics for Rural Transportation Providers by State, 2023

State	Annual unlinked trips	Annual vehicle revenue miles (VRM)	Annual vehicle revenue hours (VRH)
Vermont	2,091,633	11,552,483	463,372
New Hampshire	214,011	779,909	50,404
Maine	733,350	4,029,534	201,354

Source: FTA (2023)

declines and higher operating costs following the COVID-19 pandemic. The amount of federal assistance per unlinked passenger trip in Maine increased from \$2.25 to \$9.50, while the contribution of local funds

TABLE 2: **Operating Expense per Unlinked Trip of Selected Transit Providers by Funding Source, 2023**

State	Directly generated	Local funds	State funds	Federal assistance	Total
Vermont	\$5.13	\$0.93	\$0.45	\$9.77	\$16.28
New Hampshire	\$2.34	\$2.96	\$1.20	\$10.20	\$16.70
Maine	\$18.77	\$1.40	\$0.87	\$9.50	\$30.55

Source: FTA (2023)

TABLE 3: **Efficiency Metrics of Rural Transit Providers, by State, 2023**

State	Annual unlinked trips	Total operating expense	Operating expense/ trip
Vermont	2,091,633	\$34 million	\$16.28
New Hampshire	214,011	\$3.5 million	\$16.70
Maine	733,350	\$22.4 million	\$30.55

decreased from \$3.02 to \$1.40. In comparison, Vermont’s rural transit providers, with an average operating expense per unlinked passenger trip of \$16.28 (an increase from \$12.09 in 2019), receive a smaller percentage of funding from directly generated sources than Maine, 31.5 percent compared to 61.45 percent. Federal assistance and directly generated funding are generally more substantial than local and state funding for rural transit providers across the three peer states.

When looking at average efficiency metrics, Maine’s rural transit providers have the highest operating expense per trip, while the data for Vermont and New Hampshire are comparable (Table 3). Although Vermont’s rural transit providers receive more funding for operating expenses than Maine, they provide more rides, while New Hampshire’s providers have lower expenses and provide fewer trips.

LESSONS LEARNED FROM PEER STATES

Funding for Public Transit

Despite the variation in funding across the states we examined, we see that most operational funding—in the case of some rural providers 70 percent or more—comes from federal sources. However, a combination of dwindling federal relief funds granted to

public transit providers across the country during the COVID-19 pandemic and lower ridership numbers since the pandemic began (Rogin 2025) demonstrate the need for rethinking the long-term stability of funding sources and priorities.

In conjunction with funding shortfalls, Maine’s public transit providers face challenges with workforce shortages (PTAC 2025). Among rural transit providers, 61 percent of agencies responding to a national study indicated that their services have been affected by workforce shortages, causing 56 percent of affected agencies to turn down ride requests and 40 percent of agencies to reduce service hours. Driver shortages stem from lack of adequate compensation, tight labor market, drivers reaching retirement, COVID-19 related issues, poor work hours, and unfriendly passenger interactions (Peterson and Molina 2024).

Passengers Worry About Being Stranded

For many commuters, a barrier to using shared transit or alternative transportation is the fear of getting stuck. Go! Vermont, Vermont’s statewide transportation information clearinghouse, attempts to solve this with the Guaranteed Ride Home program, which ensures a ride home for bus riders, carpoolers, and vanpoolers. Similarly, GO MAINE members whose employer is a participating member of the program, can use the emergency ride home program for qualified emergencies.⁸

Rural Public Transit Is Essential for Vulnerable and At-Risk Populations

Access to transportation can be a barrier to receiving nonemergency medical care. Patients may miss or avoid scheduling appointments because of their lack of affordable and reliable transportation (Lorber and Falbel 2018). Maintaining nonemergency medical transportation services is challenging due to financial strain and a decline in volunteer drivers. In Maine, Downeast Community Partners recently discontinued their program as the lack of volunteer drivers coincided with a significant reduction in the number of rides served by the organization since the pandemic (Tracy 2025).

To address the need for access and support for these transportation services, Vermont’s Recovery Transportation Working Group identified access to support groups, recovery centers, drug testing sites, job training, and medical appointments as critical needs. Three Vermont programs seek to provide such services.

Rides to Wellness is a pilot program in Vermont that is a partnership between the Vermont Agency of Transportation (VTrans) and local transportation providers. The program started with two pilot sites and has since expanded to five. A Rides to Wellness report shows that the program provides rides through gas cards (47 percent), volunteer drivers (33 percent), taxis (17 percent), and bus/vans (2 percent) (Steadman Hill Consulting 2023).

Vermont's Recovery and Job Access Rides Pilot Program was initiated based on the needs identified by the Recovery Transportation Working Group for rides to recovery centers, medical appointments and job training. The working group estimated that transit providers could provide 800–1,000 trips per month, with costs ranging from \$17–36 per trip (Baker et al. 2018). VTrans received an initial federal grant of \$170,000 to fund this program combined with \$160,000 in state match funds, and an additional \$400,000 in federal and state funding was invested in the program in FY2023. By December 2022, over 6,000 trips had been provided through the program (VAT and VAHS 2022).

The Community Rides Vermont is a nonprofit organization launched by Capstone Community Action. The service is partnered with Green Mountain Transit and is available in rural Washington County and three towns in Orange County (Gopher VT).⁹ The program initially offered subsidized EV rides as part of a mobility-for-all transportation program with a focus on prioritizing citizens lacking sufficient transportation access. In its first 16 months, the program provided 6,088 rides; 31 percent of which were related to employment and 26 percent of these trips were for childcare/school (Carlson 2024). However, funding reductions from VTrans and GMT have caused Community Rides to limit their services to market rate rides and a discounted rideshare program as of July 2025 (Gopher 2025).

INNOVATIVE SOLUTIONS TO PUBLIC TRANSIT AND RURAL RESILIENCY

Beyond government initiatives, there are important advances both in terms of social approaches such as volunteer driving programs, new technologies such as on-demand, and locally based solutions that are important parts of the rural public transportation landscape.

Volunteer Driving Programs

Volunteer drivers provide critical access to medical care, shopping services, social activities, and more by helping to fill transit gaps. Volunteer driving programs are often the lowest-cost mode of transportation, especially in rural areas (Zhao 2017). In New Hampshire, only 33 out of 244 communities have regular public transit services. However, volunteer driver programs operate in 197 out of 244 towns. They provide 65,000 trips/year, many of which would not have happened without the volunteer drivers. These trips provide 4 percent of the total estimated transportation needs for older adults and individuals with disabilities (NHDOT 2019).

The Independent Transportation Network (ITN) is a community-based organization, specializing in the transportation of older adults and individuals with visual impairments. ITN uses private vehicles, in conjunction with both volunteer and paid drivers, to create a community transportation network (Freund 2015). ITN volunteer drivers can donate their transportation credits to the ITN Road Scholarship program, which in turn provides funds to older adults in need of affordable rides. In 2019, the ITN affiliate network provided 100,927 rides. However, the demand for these services is greater than the supply, in part, because of the lack of volunteer drivers (Freund et al. 2019). Driver shortages are especially prevalent in rural locations. Volunteer incentives, such as mileage reimbursement, and rideshare service awareness and knowledge are necessary, particularly as technology improves.

Green Raiteros

The Green Raiteros is a ride share program in Huron, California. The population is made up of mostly farmworkers and the median household income is \$25,060 (SUMC 2020). Huron lacks many critical services, most of which are located in Fresno, 50 miles northeast. About 25 percent of residents do not own a car (Godavarthy and Hough 2019). Green Raiteros was created in December 2018 and provides a round-trip ride to Fresno in an EV for about \$25, a 75 percent decrease from the traditional paid private transport rate of \$100. Green Raiteros is looking for increased funding to expand into new towns and counties. The successful implementation of this program demonstrates the value and power of rural and environmentally friendly transit options and supplies a method of incorporating such a system into one's own state.

Microtransit, On-Demand, and Resiliency

Microtransit is small-scale, on-demand public transit that uses dynamic routing software to operate similarly to on-demand ridesharing services with no predetermined route. Users can request a ride using a phone call or app. Routes are then generated in real-time in response to user requests (Koh et al. 2018). Microtransit services have been deployed in many urban areas. Arlington, Texas, became the first city to rely solely on microtransit when they launched a rideshare public transportation services in December 2017, replacing their fixed-route bus. Arlington On-Demand provides service to a 24-square-mile operating zone, which includes the University of Texas at Arlington, AT&T Stadium, and the entertainment district. Since its launch, Arlington On-Demand has grown, increasing the service area and public transit ridership citywide (Schrock 2023).

Microtransit has seen more limited deployment in rural areas. In Vermont, Green Mountain Transit, Sustainable Montpelier Committee, and VTrans launched a two-year pilot program called MyRide in January 2021 (White 2020). The service replaces three fixed-routes while serving most of Montpelier, as well as destinations in nearby Berlin. Rides can be scheduled either through the MyRide app, an internet browser, a kiosk, or through Green Mountain Transit's call center. As of 2022, the service had recorded a total of 41,000 rides, 1,309 active riders, 97 percent of demand met, and 91 percent of riders collected within five minutes of scheduled pickup time (VTrans 2022). While the transition from a fixed route to an on-demand system was difficult for some riders, new riders appreciated the increased flexibility. Since the establishment of MyRide in Montpelier, microtransit programs in Vermont have expanded to Manchester, Middlebury, Morrisville, Windsor along with other communities (Via Mobility 2023).

Despite microtransit's limited deployment in rural areas, representatives from the Via mobility platform believe that their platform may be one of the best-use cases for such dynamic routing (Godavarthy and Hough 2019). Sending vehicles directly to the rider saves gas, miles traveled, and wear and tear on the vehicle relative to low-density fixed routes. Furthermore, on-demand transit programs could increase a community's resiliency by introducing flexibility to an otherwise rigid system. Such a system could either take advantage of or replace existing infrastructure. On-demand multimodal transit systems (ODMTS) use on-demand shuttles to provide first- and last-mile connections to existing trains and

buses. The on-demand shuttles respond to a decrease in ridership by scaling down the number of shuttles or frequency of buses while continuing to serve the passengers close to where they reside. A study by Auad et al. (2021) predict an ODMTS would provide identical performance during a pandemic as it would in nonemergency times by maintaining rail and bus services while reducing the number of on-demand shuttles available, decreasing the cost of the system to make up for lost revenues. Beyond disastrous events, the combination of an on-demand service and scheduled service offers better mobility and greater service coverage (Campisi et al. 2021).

Non-pandemic related resilience from on-demand and micro-transit, though, still needs more empirical validation. Yu and Korp (2024) suggest that on-demand transportation systems have a flexibility that allows them to provide transportation for not only civilians, but essential personnel and supplies, and the prenegotiated contracts between public agencies and on-demand fleet companies have the possibility of ensuring swift mobilization during disasters.

Despite their appeal, many microtransit programs have been discontinued, the reasons for which are often not publicly stated. However, a few trends have been identified (Coutinho et al. 2020), the most prominent being the lack of a sustainable business model. The programs are often cost-intensive compared to individual-trip offerings, as vehicles must be rented, and employee drivers paid. Private microtransit companies must compete with subsidized public transportation, which is difficult to do in low-demand areas. Low-demand areas make ride-sharing programs difficult, as these programs rely on having multiple passengers on one trip. Furthermore, the systems can have low patronage attraction. Successful microtransit programs need to have a sufficient advertising budget and meet the needs of the target population in terms of service area, ride requests, and reliable and acceptable wait times.

FINAL COMMENTS AND POLICY RECOMMENDATIONS

Rural transit providers face unique challenges due to low demand, low population density, infrastructure and equipment issues, and funding. The COVID-19 pandemic highlighted vulnerabilities in transportation systems across the country and amplified many of these difficulties, negatively affecting at-risk populations and prompting public and private transit providers to search

for alternatives to traditional transportation methods to increase resilience.

Aware of the critical need to adapt to extreme weather events exacerbated by our changing climate, the Governor’s Office of Policy Innovation and the Future has taken a lead through the Maine Climate Council, the Community Resilience Partnership, and the Infrastructure Rebuilding and Resilience Commission.¹⁰ Each of these groups has their own set of recommendations, which we generally support. Additionally, MaineDOT has revised their bridge and culvert design standards to minimize risks to this infrastructure.¹¹ Proactively adapting to these challenges is critical to mitigating road infrastructure collapses as outlined in Maine Climate Council’s Vulnerability Mapping and Risk Assessment tool. This tool identifies areas most at risk of climate-related damage in conjunction with social, economic, and infrastructure vulnerability and municipal resilience planning capacity (ERG 2020). Additionally, the Maine Governor’s Office announced the establishment of the Maine Infrastructure Adaptation Fund in 2021 to secure funding for municipalities to protect public infrastructure from climate impacts. This fund distributed \$25.2 million in 2024 to stabilize roads, upgrade culverts, and strengthen storm drainage infrastructure following severe storm damage across the state (Office of Governor 2024).

As sustainable funding for rural transportation providers is uncertain, the Maine Public Transit Advisory Council has recommended increasing the state contribution of operating funding for Maine’s 16 local transit providers to \$8.9 million annually to match locally raised funds. As of 2023, the state provides \$3 million, only 2 percent of total operating expenses (PTAC 2025). Furthermore, PTAC recommends continuing to make \$2 million available in discretionary funding for innovative transit projects, while also establishing a dedicated source for this funding and ensuring that the funding allocation process is transparent.

In the Maine State Transit Plan, the Maine Department of Transportation lists strategies to improve access to public transit systems in Maine. These strategies aim to remove barriers to using public transit by improving service, expanding service to specific areas, improving accessibility and safety of transit facilities, strengthening volunteer driver programs, addressing driver shortages, and transitioning to more fuel-efficient vehicles (Cambridge Systematics 2023). Additionally, the transit plan also identifies demand and accessibility needs related to limited technology access and internet availability, as well

as mobility challenges associated with an aging population. These barriers could be reduced by implementing multiple options for payment and booking, ensuring all vehicles and transit infrastructure are ADA compliant, and increasing multimodal options, while helping with rural resilience by enhancing access and affordability.

These are all important and necessary steps to increase Maine’s resiliency to impacts that are here now and will likely worsen in the near future. In support of these initiatives, we suggest the following:

1. Address spatial and temporal gaps in rural transportation systems. A microtransit feasibility study for towns in rural Maine could identify what types of microtransit would work in the context of each location (i.e., similar to a 2023 Via Mobility study conducted in Vermont). Microtransit is flexible and can be designed to fit the differing needs of rural or urban areas. Rural settings can benefit from a service that uses prebooking to accommodate a smaller fleet over a larger area, while microtransit in small towns is ideal for connecting to existing regional and commuter services (Via Mobility 2023). Microtransit also has the benefit of being able to replace underperforming fixed routes and connecting with specialized mobility services.
2. Improve coordination between service providers, state agencies, and employers. Real-time tracking across services would make travel easier for riders. MaineDOT has identified the statewide GO MAINE trip-planning platform as a mechanism for achieving a more comprehensive network. By including employers in the coordination efforts, economic security for rural residents with limited vehicle access may be improved by incentivizing carpooling and ridesharing systems. The passage of LD 1451—An Act to Strengthen Coordination of Community Transportation—in June 2025 supports this coordination effort by facilitating the development of a mobility management approach to improve efficiency, accessibility, and sustainability of transportation in Maine. For context, New Hampshire’s statewide mobility management network established in 2022 has already seen successful coordination efforts, including the introduction of a regional call center, the expansion of volunteer driving programs, the implementation of “backstop

transportation programs,” and the development of public information toolkits (Bogle et al. 2025).

3. Identify specific aspects of the innovative case studies described in this paper to tailor to rural Maine. For instance, rural providers in Maine communities could implement mobility-for-all programs to fulfill gaps in existing transportation systems through flexible and equitable service delivery.

Many solutions rely on some form of on-demand transit, which can supplement or replace existing programs to increase rural transportation resilience. These systems add flexibility to existing networks to more effectively meet negative shocks in demand and supply in the form of fewer first- or last-mile shuttle connections or an organic scaling back of supply with a decrease in demand. It is important to note, however, that most research on on-demand transit in relation to disasters comes from the COVID-19 pandemic, which differs from many human-made and natural disasters in terms of its longevity. We leave the discussion of rural on-demand transit resilience and other disasters to future research. Outside of this, challenges include passenger costs that tend to be more expensive than transit (Weigl et al. 2022), and small ridership limits market opportunities for private-public partnerships (Rodman et al. 2016). Thus, on-demand transit is not a magic bullet to solve all rural transit issues, but merely a tool that can be used by specific communities to increase the resilience of their transportation systems.

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NOTES

- 1 “Urban and Rural,” US Census Bureau, <https://www.census.gov/programs-surveys/geography/guidance/geo-areas/urban-rural.html>
- 2 “Maine, Census Bureau Profile,” US Census Bureau, <https://data.census.gov/profile/Maine?g=040X00US23>.
- 3 “Means of Transportation to Work by Vehicles Available,” US Census Bureau, American Community Survey, ACS 5-Year Estimates Detailed Tables, Table B08141
- 4 “Vermont, Quick Facts,” US Census Bureau, <https://www.census.gov/quickfacts/fact/table/VT/BZA010220>.

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- 6 “New Hampshire, Quick Facts,” US Census Bureau, <https://www.census.gov/quickfacts/fact/table/NH/PST045224>
- 7 “Means of Transportation to Work by Vehicles Available,” US Census Bureau, American Community Survey, ACS 5-Year Estimates Detailed Tables, Table B08141
- 8 “Guaranteed Ride Home” Vermont Agency of Transportation, <https://www.connectingcommuters.org/programs/guaranteed-ride-home-benefit/>; “Emergency Ride Home Benefit,” Go Maine, <https://gomaine.org/emergency-ride-home-benefit/>
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