

Summary of Approved Research Projects

Project A-49 *Fare Policies, Structures, and Technologies – 2022 Updates*
Research Field: **Operations**
Allocation: **\$300,000**
TCRP Staff: **Stephan Parker**

TCRP Report 10: Fare Policies, Structures, and Technologies, published in 1996, provides a review of fare payment and collection techniques at transit agencies across the United States and selected other countries. This report includes case study analyses and a review of technology trends. *TCRP Report 94: Fare Policies, Structures and Technologies: Update* was published in 2003.

In the 18 years since 2003, TCRP has performed research and published reports covering a variety of targeted fare payment policies and questions, including *TCRP Synthesis 101: Implementation and Outcomes of Fare-Free Transit Systems* published in 2016; *TCRP Synthesis 144: Multimodal Fare Payment Integration* in 2020; and *TCRP Synthesis 160: Fare Capping: Balancing Revenue and Equity Impacts* in 2022. However, no major study to assess the state of fare policies, structures, and technologies has been performed or published, although the transit fare payment landscape has changed since 2003.

Agencies need guidance and best practices on new ways of thinking about fares and fare products, including innovative new concepts unlocked by the latest in fare payment technologies. Since *TCRP Report 94*, transportation network companies (TNCs) have started offering mobile application-based shared or private rides with frictionless fare payment, upping the bar for increased ease of transit fare payment. Technological innovation in open payments, mobile technology, near-field communication (NFC) and Bluetooth, and cashless transactions has changed how customers want to pay for their services. The COVID-19 pandemic forced bus operators to eliminate fare collection due to operator health and safety concerns, providing agencies an opportunity to reevaluate fare collection. Perhaps most importantly, the recent national discourse about social justice and equity has agencies looking for best practices for equitable fare enforcement, with many considering eliminating fares.

This research aims to provide an updated look at fares: structures, products, payment technologies, integrations, and equity. This would take the form of another update to past TCRP reports on fare policies, structures, and technologies.

Project A-50 *Practical Considerations for Developing Transition Plans to Zero-Emission Fleets*

Research Field: **Operations**

Allocation: **\$250,000**

TCRP Staff: **Stephan Parker**

Transit agencies in the United States are significantly shifting from predominantly fossil fuel-powered vehicles to zero-emission vehicles. While many transit operators are introducing these types of vehicles into their fleets, there are concerns about how to meet agency commitments pragmatically during the transition period. Research is needed to answer questions such as: What are realistic timelines for developing access to necessary electric power-generating capacity? What is the current reliability and availability of service of zero-emission sub-fleets? How can agencies determine the appropriate mix of sub-fleets to meet agency and community expectations during the transition period to stated agency goals? What are the best ways to frame and communicate realistic timelines for long-term procurements to the public? Are there additional uncertainties for shorter buses and cutaways? What are the labor and training transition timelines to prepare the needed workforce? How is competition for charging infrastructure with private vehicles to be handled?

This research should build on but not replicate *TCRP Research Report 219: Guidebook for Deploying Zero-Emission Transit Buses* (2021). The guidebook is organized into these key deployment phases: providing information and suggestions for assessing needs and requirements, selecting and specifying technology, determining capital costs and funding opportunities, developing and deploying fueling infrastructure, accepting and validating buses to ensure they meet specifications, evaluating training program considerations, establishing operations and maintenance practices, and monitoring and evaluating deployment performance.

Project A-51 *Innovative Practices for Technology Implementation at Rural, Small, and Mid-Sized Transit Agencies*
Research Field: **Operations**
Allocation: **\$350,000**
TCRP Staff: **Stephan Parker**

The past decade has seen a proliferation of advanced technology used in delivering public transportation services, such as mobility-on-demand mobile applications, real-time bus arrival information, driver-assist/autonomous vehicle functions, and security-related surveillance software. Each of these technologies addresses the real needs of public transportation providers, such as providing increased safety and security or reducing harmful vehicle emissions. However, with each new technology implementation, public transportation agencies face multiple challenges, such as integrating new systems into legacy technology platforms, staff training to utilize new technology capabilities fully, and the ongoing maintenance of the full technology infrastructure at the agency. Additionally, each new technology implementation increases the complexity of the technology ecosystem, adding to the risk of cascading systemic failure from one piece of technology to another (famously described in the 1984 book *Normal Accidents: Living with High-Risk Technologies* by Charles Perrow).

While agencies of all sizes have technology-related challenges, rural, small, and mid-sized agencies are significantly constrained by smaller staff, limited access to technical skills in the workforce, and funding capacity for technology implementation, utilization, and maintenance. Many of these agencies work in close collaboration with state departments of transportation (DOTs), which typically administer, at a minimum, 49 U.S.C. 5311 funding for non-urbanized transportation and the state Rural Technical Assistance Programs. However, not all state DOTs have the on-the-ground operational expertise to support these smaller agencies as they explore new and innovative technologies.

Smaller transit agencies' lack of technical capacity can result in underinvestment in technology. On the opposite end of the spectrum, these agencies can become overinvested in technology that they struggle to utilize fully or that hurt operations due to system failures or incompatibilities. There is a need to understand how rural, small, and mid-sized agencies can "right size" the technology suite to meet operational needs and organizational capacity.

The objective of the research is to develop a report for public transportation officials at state DOTs and rural, small, and mid-sized transit agencies to act as a guide for facilitating a clear-eyed assessment of transit technologies as well as the resources needed to manage the full systemic impact of implementing them. This will include a review of best practices related to specific technologies, a state DOT and operators survey, interviews with technology vendors, and follow-up transit operator interviews to better understand the practitioners' perspectives. A key focus will be the concept of "right sizing" the suite of technologies to avoid situations where overly complicated or expensive systems meet relatively simple needs at smaller agencies.

Project B-51 *Floating Transit Stops and Passengers with Vision Disabilities*
Research Field: **Service Configuration**
Allocation: **\$400,000**
TCRP Staff: **Stephan Parker**

Floating transit stops require pedestrians to cross the bikeway, thus causing potential conflicts between pedestrians with visual disabilities, who are typically unable to hear bicycles, and moving bicyclists.

Construction of protected bicycle facilities is proceeding apace across the United States, and numerous design guidelines are available, such as the Massachusetts DOT's *Separated Bike Lane Planning & Design Guide* and the National Association of City Transportation Officials' *Urban Bikeway Design Guide*. It is acknowledged that protected bike lanes impact the safety of vision-disabled pedestrians [*Getting to the Curb: A Guide to Building Protected Bike Lanes That Work for Pedestrians* (2019), San Francisco Vision Zero Coalition]. However, bike design guidelines that include specific treatments, supported by research, for enhancing the safety of vision-disabled pedestrians have not yet been identified. Of particular concern is safe access to "floating" transit stops, where transit passengers must cross protected bicycle lanes to reach in-street bus or light rail stops. A class action case in Victoria, British Columbia, on floating bus stops was recently resolved; the tribunal of British Columbia ordered that audible flashing signals must be installed at the site while ceasing installation of any further floating bus stops.

People with vision disabilities are disproportionately pedestrians and transit riders. Making public rights-of-way, including bike facilities, safely accessible to people with vision disabilities is required by ADA legislation and is supported by special funding in the Infrastructure Investment and Jobs Act for transportation safety programs to reduce crashes and fatalities, with a particular focus on bicyclists and pedestrians. Safety for pedestrians with vision disabilities in the vicinity of bike facilities is impacted by the fact that bicycles are largely inaudible, especially in the relatively noisy environments of public rights-of-way. *Planning and Designing Streets to be Safer and More Accessible for People with Vision Disabilities—A Toolkit for Montgomery County and the Metropolitan Washington Region* (2021) contains a number of suggested treatments to improve safety and wayfinding for pedestrians with vision disabilities, but their effectiveness is not validated by human factors research and there are no treatments suggested for improving the safety of pedestrians with vision disabilities when crossing bike lanes. Human factors research is urgently needed to address a number of issues related to bicycle yielding and detection of drop-offs where there is grade separation between pedestrians and bicycles.

Results of the research, or validated treatments to enhance safety for pedestrians with vision disabilities, will be included in a guidance document on making access to separated bike lanes, including floating bus stops, safe and accessible to pedestrians with vision disabilities. The treatments may be included in bicycle design guides, as they are updated, and may have implications for updates of the FHA's *Manual of Uniform Traffic Control Devices* and the U.S. Access Board's *Public Right-of-Way Accessibility Guidelines*.

Project B-52 *Intercity Bus: The State Role Updated*
Research Field: **Service Configuration**
Allocation: **\$450,000**
TCRP Staff: **Stephan Parker**

There is an urgent need to update and refine guidelines on the state’s role in administering the Section 5311(f) program of the Federal Transit Administration (FTA). The recent passage of the The Coronavirus Aid, Relief, and Economic Security Act, which provided funding to the states to address the crisis in ridership, revenue, and funding for transit services resulting from the COVID-19 pandemic, presented many states with an obligation to follow the requirements of the Section 5311(f) program with regard to the 15% set-aside requirement, including the need for a federally compliant consultation process. The requests to the states by the intercity bus carriers for financial aid during this pandemic have raised major questions about the role of the intercity bus service; the unsubsidized network and how it relates to Section 5311(f) funded services overseen by the states; the FTA program and its requirements (and flexibility); the state role; the consultation requirements; the in-kind match and how it works; and the planning, performance evaluation, and options for program management. Many state departments of transportation are interested in knowing what other states are doing and what works.

However, many of the key reference documents regarding the state role and intercity bus service were completed decades ago and need to be updated. Since the key reference documents were created, an entirely new model for intercity programs has developed, initially in the state of Washington, changing the role of the state to that of a grant recipient contracting for specified services and using the value of connecting unsubsidized intercity bus service as the match. Initially, this was an FTA Pilot Project, which began in 2007, but the in-kind match has since been codified, and the value of each connecting mile increased to 100% in the Fixing America's Surface Transportation Act. This change has allowed many more states to implement rural intercity bus programs and has changed the options for program design, as it requires a high degree of connectivity with the unsubsidized network because of its requirement for supportive documentation from the carrier operating the unsubsidized service being valued as the match.

Various states are now expanding this role with branding and marketing for state-funded or state-operated services and developing models that include both contracted services and grants to rural operators for feeder routes. At the same time, the industry has changed significantly, first with a major restructuring of Greyhound routes in 2005-06, then with the growth of “curbside” bus companies operating point-to-point services between major cities and university towns, then with a decline in ridership associated with low gasoline prices, and now finally with the major impact on ridership and revenue resulting from the COVID-19 pandemic. The intercity bus network is on the verge of being reinvented and the state program managers need to fully understand all options available to them and have tangible examples of successful scenarios and best practices.

The previous research efforts need to be updated to address a number of key questions that states are now asking:

- The certification alternative—what is the process, how does it relate to the consultation, and when is it appropriate?

- How to conduct the FTA-required consultation process to obtain useful information for program planning and development?
- Alternative models of program management—providing grants to carriers to operate services they define, granting solicitations for particular services, the state as grantee issuing RFPs for third-party contractors to operate particular services, or some combination?
- Regarding in-kind match—what are the FTA requirements, how does it work, and how to develop projects using this form of match?
- How to plan for a connected intercity network? How to identify existing services, recognize unmet needs, estimate potential ridership, and prioritize investments?
- What is the national intercity bus network and how should services be designed to maintain these needed connections?
- Alternative intercity service designs, such as intercity services, feeder services, regional routes—how to make meaningful connections with the national intercity network and how to meet regional needs?
- How to develop and apply performance measures to ensure cost-effectiveness?
- Branding of services, and marketing—what have other states done, and what works?
- Program management and oversight—contracts, grants, compliance, contractor oversight.

This research project would involve a review of the FTA program requirements, a comprehensive survey of the states regarding their intercity programs, a compilation of an inventory of both the program attributes and the services funded, analysis of their responses, and development of recommended models.

Project B-53 *Planning for the Travel Needs of Women*
Research Field: **Service Configuration**
Allocation: **\$300,000**
TCRP Staff: **Dianne Schwager**

The intent of this research is to evaluate data collection, analysis, and planning practices with respect to women's travel needs among American public transit agencies. Although there have been several media reports that highlight this topic (e.g., <https://www.wired.com/story/making-public-transit-fairer-to-women-demands-data/> and <https://newcities.org/the-big-picture-transport-is-not-gender-neutral-womens-mobility-and-accessibility-for-better-economic-opportunities/>), there has not been a recent examination of the extent to which transit agencies collect data regarding women or consider their travel needs when planning services.

In transportation planning, gender has recently been emphasized as an issue to be featured on the agenda of sustainable and inclusive transport systems. An important barrier to including women's needs in public transit planning can potentially be attributed to a lack of gender-specific data. With an absence of data collection practices designed to capture gender differences in public transit use and travel demand, little gender-specific insight can be generated. This is problematic as data are applied in several aspects of transit planning, such as developing service standards, fare policies, and business cases for major public transit projects. So, if public transit agencies lack an understanding of how, when, and why women travel, how can service be designed and delivered in a way that works for women?

In this proposed knowledge research, we seek to understand (1) the differentiated transport needs and experiences of women and (2) the current practice of considering women's distinct travel needs in public transit planning, including available data that are collected by public transit agencies and methods to analyze these data.

Project D-23 *Guide for Planning and Constructing a Small and Rural Tribal Transit Facility*
Research Field: **Engineering of Fixed Facilities**
Allocation: **\$400,000**
TCRP Staff: **Stephan Parker**

There are no resources for small rural and tribal transit providers who want to build transit facilities under \$1 million. Currently, they must rely on manuals that are directed at larger multi-million-dollar facilities and attempt to “weed out” unnecessary information or requirements.

Many small rural or tribal transit managers neither have the expertise nor the time, as many wear multiple hats, to read manuals in the hundreds of pages, which don’t apply to their project. Some may rely on DOT staff, who also may lack the expertise to oversee these projects. In most instances, the projects are not attempted or fail before the initial phase is started. Tribal transit managers are unclear if they should write multiple Invitation for Bid (IFB) or try and hire one contractor for all work.

The manual would assist project managers to make better choices on which strategies will bring them a better project that is completed on budget and by the predicted completion date. With small projects, some project management techniques are not worth the time and funds invested.

The objective of this project would be to develop a manual, which would outline the process; provide regulatory requirements; and include sample document templates, such as IFB, advertisements, checklists, and explanations on how to anticipate and address change orders. This manual would be a streamlined guide which would allow transit managers and boards to determine if they have the expertise to handle a facility construction project or if they need to hire ad hoc personnel. It will provide necessary documents with the required federal language to meet regulations. It will also act as a training manual for DOT staff. Documents should be in a format that would allow for easy insertion of state regulations or policies related to unique situations that might be encountered, such as surveyors hired to determine geological conditions which could compromise a facility structure or a reasonable drilling depth and gallons per minute on a well.

Project D-24 *Determination of Actual Derailment Loads on Transit Bridges*
Research Field: **Engineering of Fixed Facilities**
Allocation: **\$300,000**
TCRP Staff: **Mariela Garcia-Colberg**

Derailment loads in nearly all U.S. transit design criteria documents are similar but not based on any rational foundation. The loads have been modified numerous times by different agencies between 1985 and 2005 with no documented or defined basis. Currently, vertical impact is defined as 100% acting on any truck in the train consist, while horizontal derailment load is taken as 40% of a single car load acting on one truck. Lateral excursion in both cases is taken as a maximum of 3 ft, which assumes that a vehicle will not travel farther after derailment. Neither of these loads has been experimentally verified and appears to be based on an arbitrary definition that has become the norm in the U.S. industry. It is not known if this load is reasonably accurate, over-conservative, or even unconservative. [Lobo and MacNeill (“Dynamic Amplification of Transit Loads due to Derailment Impact,” Joint Rail Conference Proceedings, ASME, April 2022) show that derailment loads may be significantly higher than 100% impact with reported values ranging from 500% to 700% for derailment impact factor.]

Research is needed to formulate a rational load that is within acceptable limits of accuracy to ensure the efficient and safe design of bridges. The transit vehicle industry has the available tools to simulate the entire vehicle derailment and use these models to check the safety of the vehicles. It will be relatively simple to leverage their expertise and knowledge and extend their models to determine the loads on the bridge in both vertical and lateral directions.

This research will determine a load that is accurate and representative of actual transit vehicle loads. It will be defined in a manner that permits the efficient and safe design of structures. This research will also develop load factors and load combinations for derailment load conditions in line with the safety and reliability levels that underpin Load Resistance Factor Design (LRFD) design for bridges.

AASHTO has developed a notional load for transit vehicles in their The AASHTO LRFD Bridge Design Specifications (2019). An approach to tie the derailment load to the same notional load may be developed along with the train-specific loads. This will reduce extraneous analysis and maintain a consistent approach to these loads as the AASHTO load becomes the national norm for U.S. transit design.

Project F-31 *Modernizing Transit Station Staffing Management*
Research Field: **Human Resources**
Allocation: **\$250,000**
TCRP Staff: **Stephan Parker**

Many transit staffing practices are a legacy continuance of pre-modern technology practices. Staffing of transit stations is a good example, with agencies continuing to staff stations with stationary agents based in enclosed booths. Technology has been introduced to station management in the form of fare payment, customer information, security, and customer service. These introductions, however, have not changed the practice of stationary agents in booths. Some agencies have added staff to handle security and fare evasions and even to sell fare payment options like commuter checks and discount passes.

Staffing stations is very costly and needs to be revisited and reengineered. With cameras and modern communications tools, the opportunity exists to redefine how stations are staffed and how best to use technology. What staffing functions are needed at modern transit stations? Do these differ from busy downtown stations to lower volume suburban stations with regular riders? How does stationary staffing better serve ADA assistance needs and emergency incident response? Would staffing resources be better used as roving ambassadors rather than in stationary booths? How might evolving technology be used to better manage stations?

Public transit systems, at their core, are customer service systems with FTA's "placing the customer first" a good example of this prime function. Transitioning station staffing to meet modern needs should also be sensitive to disruptive labor impacts.

The objectives of this research are to (1) review current station staff management practices; (2) compare these practices to current and foreseeable future needs of riders, neighboring communities, and transit agencies; and (3) identify how current and manifesting new technologies might be used to better deploy staff resources at transit stations.

Project *Future of Commuter Rail*
J-11/Task 45
Research Field: **Special Projects**
Allocation: **\$100,000**
TCRP Staff: **Dianne Schwager**

Shifts in where people live and how they work due to the COVID-19 pandemic have had a major impact on commuter rail. Reorientation toward work from home, in particular, has had a negative impact on commuter rail ridership. The reduction in demand for commuter rail has had a negative impact on transit agency budgets, as fare collections decrease and a reallocation of resources to serve new types of demand is required.

Commuter rail is facing challenges that are similar to other urban transit modes. Ridership has increased since April 2020 but is still significantly below pre-pandemic levels. As of the second quarter of 2022, commuter rail ridership has seen an 83% year-over-year increase. Despite the increase in ridership from the lows of the pandemic, monthly pass purchases, previously a significant component of fare income, are well below the pre-pandemic level. The question remains that if the work-from-home culture persists and there is a corresponding decline in monthly pass sales, how can agencies adjust to the revenue loss? However, agencies are noticing a potential shift in demand away from traditional commute hours into weekend and off-peak hours. A change in performance metrics analyzing the total unique riders, more than the raw total ridership, might prove more beneficial in the coming demand adjustment.

Agencies are also reimagining how their commuter rail networks will operate in the future. SEPTA has begun the SEPTA Forward project, which aims to rethink how their commuter rail will be utilized. SEPTA Forward's approach is to take a more holistic understanding of transit and mobility, with commuter rail operating in stronger coordination with other transit modes to expand transit's geographic reach.

NJ Transit, like SEPTA, has released its first 10-Year Strategic Plan with a similar focus on rebuilding key rail infrastructure and integrating commuter rail with other transit modes. Virginia Railway Express likewise is in progress with their System Plan 2040 to provide for the needs of workers who often work outside of 9 to 5 hours. Baltimore is also debating creating its own transit agency to focus on Baltimore specifically, with potential ramifications for the MARC network.

Other discussions as to the future of commuter rail include greater regional integration. As agencies deal with shifting demand, a proposal named Trans-Regional Express (T-REX) has been discussed to unify the trains connecting New Jersey, Long Island, Mid-Hudson, and Connecticut. T-REX has the potential to transform not only the rail network of the tri-state area, which is the most extensive metro center in the world by landmass, but also provide a model for regional rail cooperation in multi-agency regions.

The US DOT has recognized the aging passenger rail infrastructure across the country. On August 18, 2022, the Biden administration announced over \$233 million in grant funding under the Federal-State Partnership for State of Good Repair Program (Partnership Program) to repair

and invest in intercity rail networks. The investment will have net positive impacts on commuter rail operations but is not exclusively commuter rail investment as Amtrak receives a sizable portion of the funds. Almost all of 2022's grants fund projects on the Northeast Corridor, with some going to California and smaller stations in the Midwest.

The objective of this study is to research and project potential future shifts in commuter rail demand and examine how agencies can accommodate new demands. Analysis should focus on the following areas:

- Examination of changes in commute patterns and potential future trends,
- Analysis of how traditional factors' weight against demand has shifted,
- Summary of factors that traditionally contributed to rail demand,
- Examination of how commuter rail networks have reallocated resources since the recovery from the pandemic,
- Changes in use patterns by time of day or day of week,
- Examination of other available service models from the United States or other countries, and
- Exploration of how changes in development around stations could increase commuter rail ridership.

Project *New Tech, New Skills, New Jobs*
J-11/Task 46
Research Field: **Special Projects**
Allocation: **\$100,000**
TCRP Staff: **Dianne Schwager**

Automation J-11 gave us information on how the automation of transit vehicles would impact the transit industry workforce. Other technological advances in the transit industry have the potential to impact the workforce as well and require the transit workforce to take on new skills. The Infrastructure Investment and Jobs Act (IIJA) has dramatically increased funding for low- and no-emission buses. Communication technologies like 5G will enable vehicle communication, more information for transit customers, and improved data availability. Fare technology will continue to advance and incorporate elements of mobile technology.

Public transit agencies will need a future-ready workforce to make the most of these technological advances.

The objective of this research is to identify new and changing skill sets and jobs in the transit industry that will be arriving in the coming decade. The study should address the following:

- Technological advancements happening in the transit industry in the coming years;
- New skillsets that will be required of existing jobs due to new technologies;
- New job types that may emerge;
- What investments will be needed in training to adapt to changing job requirements;
- What sources of funding are available for industry training programs;
- Ways in which the industry can partner with non-transit organizations to reach workers with the required skills; and
- Apprenticeships, school programs, or other programs that could be used to train potential workers.

Project *Affordable Housing and Transit*
J-11/Task 47
Research Field: **Special Projects**
Allocation: **\$100,000**
TCRP Staff: **Mariela Garcia-Colberg**

Affordable housing is quickly becoming a hot-button issue for cities across the country. The provision of affordable housing is of particular interest to public transit agencies with a focus on equity. With the relatively quick reversal of the COVID-19-induced urban flight from cities, rental prices are quickly rising. Manhattan in June of 2022 saw a historic high in average rent prices. Nationally, June's median asking rent price was more than \$2,000 monthly for the first time. Many communities are facing increasing financial pressures from the rent hikes, and affordable housing policies remain the most important for many municipalities. Transit agencies are uniquely positioned to assist in alleviating the growing crisis by supporting and even directly constructing affordable housing units. Doing so can also help transit agencies with increased ridership.

A study by a small team of professors and graduate students at the University of Utah and presented by HUD analyzed 85 transit-oriented developments (TODs) across the country. Of these, one-third were found to have no affordable housing at all. Of all the affordable housing units apart from TODs, 16 were responsible for 40 percent of all the units, indicating greater disproportionality with which agencies are constructing affordable units on their properties. The study concludes that currently, "TODs are generally unaffordable for low- and moderate-income households. A lack of city- and state-level policy has left affordability in TODs fragmented because the production relies on nonprofit developers."

More creative solutions are being proposed instead of relying on nonprofit funding or tax credits. Sound Transit, which operates in Seattle, is building 318 affordable housing units near light rail stations in collaboration with Amazon. The project received \$42.5 million from Amazon through low-interest loans and grants. Future renters will earn 30% to 80% of the area's median income. Amazon plans to follow up with 1,200 affordable housing homes on Sound Transit property. The public-private partnership between Sound Transit and Amazon may provide a guideline for how other transit agencies can support the communities they serve apart from traditional transportation. They also will increase ridership demand for transit.

NJ Transit has ambitiously begun several TOD initiatives across the state encompassing several transit modes. Funding was partially secured with FTA grants to develop affordable housing alongside Bus Rapid Transit stations. Plans are in progress to construct TODs next to Metropark Station, Newark, and Jersey City and surrounding other major commuter rail stations. NJ Transit is leading the nation in the number of new TOD communities. There is no data yet indicating how many of these new units will be classified as affordable housing, but some will be.

BART is launching several TOD developments specifically for affordable housing units and is seeking partners to develop several locations alongside existing stations. Partners are primarily local nonprofit charities with significant funding. The Port Authority of Allegheny County released new guidelines in 2021 for best practices when implementing TODs, hoping for induced

demand leading to new construction. This has led to several communities reexamining their zoning codes in support of affordable housing in TODs. One of the most ambitious projects features a multi-modal transit station and mixed-use development. Financing of almost \$160 million for the total project comes from local, state, and federal investments alongside other unfinalized means.

The objective of this study is to identify strategies and tools public transit agencies can use to increase the provision of affordable housing in their regions. The study should:

- Examine the varying definitions of affordable housing,
- Identify the strengths and weaknesses of various funding methods,
- Identify the strengths and weaknesses of various development methods,
- Identify critical development decisions that impact transit access,
- Examine impacts on public transit ridership and demand from affordable housing development,
- Examine best practices for successful affordable housing in TODs with recommendations, and
- Identify agencies and regions with successful synergy between affordable housing and transit.