FUNDING STRATEGIES REPORT

NCTCOG Intermodal Transportation Hubs for Colleges and Universities Study

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01 Introduction: Funding as Building Blocks

Funding a mobility hub is rarely a simple equation. Most funding sources can only be used for specific mobility hub elements, such as capital improvements, operations and maintenance, planning and design, or community engagement. Furthermore, mobility hubs are rarely built all at once since mobility needs, customer preferences, and technology change over time. The funding equation can be even less straightforward for hub locations that are not connected to frequent transit service or underserved by other shared mobility options. Given the siloed nature of funding sources, phased development, and ongoing mobility service and amenity adjustments, mobility hubs rely on a combination of incremental funding sources.

This report summarizes the wide variety of funding, partnership, and policy opportunities available to pilot, build, and operate on-campus and off-campus mobility hub infrastructure, services, and amenities. The funding strategies are intertwined with the various implementation pathways highlighted in the forthcoming Implementation Strategy report.

Funding Mobility Hubs Requires Strategy

In most cases, campuses and their partners will make concentrated investment for years before they achieve their built-out mobility hub vision. Campus mobility hub partners should build a long-term funding and partnerships plan for capital and operating investments for each hub element. Hub partners should always build site-specific and phased funding strategies that coordinate across a variety of partners, implementors, and eventual operators. Funding strategies should be practical and reflect the competitive nature of funding sources, while ensuring investments meet the needs of a variety of campus travelers and local stakeholders.

Likewise, town-and-gown funding coordination between campus, city, transit agency, business, and community partners is essential to successfully fund mobility hubs within the campus context. University and campus environments are a complex mix of institutional, City, state, and private property. Thus, developing mobility hubs might pull from multiple funding sources.

Town-and-gown coordination is important to accelerate and test new ideas, as government and campuses can be complementary when it comes to procurement. Campuses can often efficiently fund mobility elements and technologies that government cannot. This ethos should pervade the physical design, implementation experience, and funding strategy for on-campus and off-campus mobility hubs.

Campus Mobility Hub Funding Principles

Campus mobility hub partners should consider the following funding principles when identifying and securing hub funding:

- **Tap into low-cost hub investments,** testing new mobility and hub user experiences before making more permanent investments.
- **Embrace incrementalism,** building out your hub vision over time through continual improvement.
- **Prioritize equity and affordability,** ensuring that funding reduces mobility barriers and alleviates cost burdens for BIPOC, indebted, low-income, and foreign-born campus affiliates.
- **Be opportunistic,** leveraging larger projects and capitalizing on new funding opportunities and partnerships that advance incremental improvement.
- **Lean into town-and-gown coordination,** aligning shared objectives and building the case for collaborative funding applications across partners.

02 Funding Opportunities

While funding is competitive and requires deep coordination across partners, campus mobility hub partners have a diversity of funding options at their disposal. Depending on the mobility needs being addressed and the services being integrated at each mobility hub, planning, design, implementation, installation, and turnkey costs could range between $250,000 and $5 million. Major street reconstruction and active transportation connections can drive costs even higher. Capital and operating costs can be supported by a range of funding sources, including campus funding sources, local sales tax funds, grant awards, economic development funding sources like community development block grants, foundation support, and more. However, campus mobility hub implementors should assess considerations for long-term financial sustainability. While many funding sources, particularly federal funding sources, are not eligible for university or college applicants, there are opportunities for partnerships between academic institutions, local governments, and transit agencies to apply for grant funding.

Federal Resources

While federal sources expand the resources available to mobility hubs, you may find it more challenging to seek out this funding as many federal grants are competitive, have local match requirements, and require dedicated staff to manage grant administration and reporting requirements.

Likewise, funding shortfalls across the country related to the COVID-19 pandemic have increased competition in federal grant processes. Strategies like collaborative funding applications across many partners and cities and nesting mobility hub elements into larger project applications can increase the competitiveness of projects. For example, building in mobility hubs into larger transit, highway, or street corridor projects can be attractive to application evaluators seeking to fund multimodal projects that establish connections well beyond the project boundaries.

As of 2022, several new funding sources have become available that can be used to fund your mobility hub.

US Department of Transportation (USDOT)

Nationally Significant Multimodal Freight & Highway Projects (INFRA) Grants Program

The USDOT's INFRA Grants Program is focused on providing funding towards freight and highway projects, but money can go towards multimodal and commuter improvements that provide connections to mobility hubs if there is an overlap with freight or highway infrastructure. As an example, improvements to the Trinity Railway Express (TRE) commuter rail line are eligible for INFRA funding because it also hosts freight railroad operations. Intersections with highways are likely eligible for INFRA funding as well – where there may be a need for bicycle and pedestrian improvements that connect to off-campus mobility hubs. Relevant eligible applicants include MPOs for urbanized areas such as NCTCOG, local governments, and state governments, among others. Universities and colleges are not eligible but could partner.

Quick Facts

Type: Competitive
University Eligible: No
Fund uses: Planning, capital, and operations

Strengthening Mobility and Revolutionizing Transportation (SMART) Grants Program

The SMART Grants Program supports projects that use technology and automation to improve safety, reliability, equity, access, and climate resiliency in the transportation system. Many of the project types eligible for SMART funding tend towards data collection and usage – mobility hub elements such as traffic signal improvements, sensors for usage data collection, and dashboards that show shared mobility availability would be eligible. Relevant eligible applicants include public transit agencies, MPOs including NCTCOG, and state governments. Universities and colleges are not eligible but could partner. For example, a campus might be a sub-recipient to support mobility hub implementation on campus property, or even offer a letter of support if the project application will benefit campus mobility (but is not on campus property).

Quick Facts

Type: Competitive
University Eligible: No
Fund uses: Planning, capital, and operations

Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Grant Program

Previously known as TIGER and BUILD, RAISE grants are available to fund the planning, pre-construction, and construction of public transportation projects, intermodal projects, and roadway projects, among others. The grant covers 80% of project funding in urban areas and 100% of funding for projects in rural areas and for planning grants in Areas of Persistent Poverty. Universities and colleges are eligible to apply as a sub-recipient in partnership with state governments, local governments, transit agencies, or NCTCOG.

Quick Facts

Type: Competitive
University Eligible: Yes, with government partnership
Fund uses: Planning, capital, and operations

Federal Highway Administration (FHWA)

Congestion Mitigation and Air Quality Improvement (CMAQ) Program

The CMAQ Improvement Program is a non-competitive long-standing grant program that aims to improve air quality and reduce traffic congestion, particularly in areas of the country that do not attain national air quality standards. Examples of CMAQ projects include signal coordination, intersection improvements, park-and-ride facilities, sidewalks, non-recreational bicycle and pedestrian facilities, and transit investment, among others. Many of these project types directly apply to specific mobility hub elements and related local infrastructure. TxDOT distributes CMAQ funds to local MPOs, and government entities are eligible to apply.

Quick Facts

Type: Non-competitive
University Eligible: No
Fund uses: Planning, capital, and operations

Advanced Transportation Technologies and Innovative Mobility Deployment (ATTIMD) Program

The FHWA's ATTIMD Program, like the USDOT SMART Grants Program, awards grants for safety, mobility, and efficiency improvements gained by advanced transportation technologies and data-driven implementation. Innovative transportation solutions are the focus for this funding source, but goals of the program are to reduce traffic-related fatalities and injuries, improve access to transportation alternatives, and provide public access to real-time integrated traffic, transit, and multimodal transportation information, among others. Mobility hub elements such as digital wayfinding or transit information signage, shared mobility availability dashboards, and shared mobility docks are likely eligible for ATTAIN Program funding. Colleges and universities are eligible to apply as part of a partnership with a local government, transit agency, or NCTCOG.

Quick Facts

Type: Competitive
University Eligible: Yes, with government partnership
Fund uses: Planning, capital, and operations

Surface Transportation Block Grant (STBG)

The STBG Program has superseded the FAST Act funding program and is funded through 2026. The STBG funding is non-competitive – a formula is used by FHWA to apportion STBG funds to each state. The funds are then sub-allocated to NCTCOG from TxDOT using a population-based formula. Transportation Alternatives, or bicycle, pedestrian, transit, and other small-scale multimodal projects, are required to make up 10% of STBG funds. STBG funds are intended for public roadways where bicycle and pedestrian improvements, transit connections, and other mobility hub improvements can be supported. Universities and colleges are not eligible recipients, but funding can funnel down to local agencies from NCTCOG to support improvements on local roadways that impact universities.

Quick Facts

Type: Non-competitive
University Eligible: No
Fund uses: Planning, capital, and operations

Federal Transit Administration (FTA)

The FTA provides many resources to help fund transit services to and amenities at your mobility hub. Tapping into these funding sources typically requires partnership and alignment with area transit providers. Transit providers in the NCTCOG region that are eligible for partnership include Via Rideshare and Handitran in Arlington, Via Rideshare and Grand Connection in Grand Prairie, City and Rural Rides (CARR) Transit, City/County Transportation (Cletran), Dallas Area Rapid Transit (DART), Denton County Transit Authority (DCTA), Northeast Transportation Service (NETS), Public Transit Services in Weatherford, Senior Center Resources and Public Transit (SCRPT) in Hunt County, Span Transit, STAR Transit, Texoma Area Paratransit System (TAPS), The Transit System in Granbury, and Trinity Metro. Historically, larger transit agencies like DART, DCRA, and Trinity Metro have the capacity to pursue these more complex partnerships. In general, transit agencies across the country are realigning their service and capital priorities around mobility rather than simply operating traditional bus service. This shift is more conducive to funding mobility hubs, mobility services, mobility information, and digital ticketing and mobility wallets, among others. Agencies applying for FTA grants are encouraged to think beyond traditional transit services in ways that can best impact their communities.

Public Transportation Innovation - 5312

The Public Transportation Innovation – 5312 grant is a competitive funding source that supports research activities that advance the interests of public transportation. Transit agencies, non-profit organizations, and universities are eligible to apply for funding. The grant encourages applicants to demonstrate or evaluate innovative approaches to transit, particularly when emerging technologies are incorporated. This could apply to campus mobility hubs in the form of demand-responsive shuttles, digital signage, or innovative transit integration. This is one of the few federal grant opportunities that is explicitly eligible for university applicants.

Quick Facts

Type: Competitive
University Eligible: Yes
Fund uses: Planning

Areas of Persistent Poverty (AoPP)

The Areas of Persistent Poverty (AoPP) Program focuses on providing funding for improving transit service and facilities in locations designated as Areas of Persistent Poverty. This competitive grant program offers a maximum grant award of $850,000 and requires a 10% match of the project cost. Public transportation systems, employee shuttle services, state or local government entities, and university transportation systems are eligible to apply. As of 2022, 44% of the census tracts in the NCTCOG region are considered historically disadvantaged communities. This webmap provided by the US DOT can help you identify if your community or university is eligible for this funding source. With university transportation systems as an eligible recipient, this funding source could be used to make access improvements to campus mobility hubs, as well as instituting a campus shuttle system, making improvements to bus stops, among other transit improvements.

Quick Facts

Type: Competitive
University Eligible: Yes, university transportation systems in disadvantaged communities
Fund uses: Planning, capital, and operations

Accelerating Innovative Mobility (AIM)

The Accelerating Innovative Mobility (AIM) Program aims to support innovative transit projects with an additional emphasis on strategies that promote equitable access to transit. Transit projects can include transit subsidies, planning, system design, and service. Eligible recipients include public transportation agencies and state and local government DOTs. Universities are eligible to apply through partnerships with transit and government agencies. For on-campus and off-campus mobility hubs, applicable projects could include multimodal trip platforms to integrate campus shuttles with existing transit systems, creating on-demand shuttle systems, integrating software to provide real-time transit information to display in mobility hubs, among others.

Quick Facts

Type: Competitive
University Eligible: Yes, with government partnership
Fund uses: Planning, capital, operations, administrative costs

All Stations Accessibility Program (ASAP)

The All Stations Accessibility Program (ASAP) offers competitive funding for capital projects to make rail stations more accessible for people with disabilities, including those who use wheelchairs. This can be achieved by increasing the number of stations or making modifications to existing stations. In the NCTCOG region, this funding source can be used to make accessibility improvements to DART stations, TRE stations, TEXRail stations, and DCTA A-Train stations. This funding source can improve accessibility to or at off-campus mobility hubs served by commuter rail. Government agencies that provide funding to rail transit systems are eligible to apply.

Quick Facts

Type: Competitive
University Eligible: No
Fund uses: Capital

Enhancing Mobility Innovation (EMI)

The Enhancing Mobility Innovation (EMI) program is a competitive funding source that focuses on projects that improve mobility and enhance the rider experience, support innovative transit solutions, or include software integration into on-demand public transportation. Eligible applicants include public transportation agencies, state or local government DOTs, shared-use mobility providers, and institutions of higher education, among others. This funding source gives priority to higher education institutions with Minority Serving Institutions status, of which there are 6 in the study area as of 2020, including Paul Quinn College, Southwestern Adventist University, Tarrant County College District, Texas Woman's University, UT Arlington, and UNT Dallas. This funding

Quick Facts

Type: Competitive
University Eligible: Yes
Fund uses: Planning, capital, operations

source can apply to on-campus and off-campus mobility hubs by providing improvements such as general transit service improvements, the integration of on-demand shuttle services and other shared mobility services, and transit stop wayfinding improvements.

Pilot Program for Transit-Oriented Development Planning – Section 20005(b)

The Pilot Program for TOD Planning provides funding to local communities to invest capital into providing transit amenities that are integrated with a complementary land use. Complementary land uses are those that improve economic development and transit ridership, such as mixed-use developments and job centers. Eligible applicants include partnerships between transit agencies and entities with land use authority—including universities and colleges. For campuses with land use authority, this funding source creates the opportunity to plan and fund transit capital improvements to on-campus mobility hubs and provide better integration with the existing land use.

Quick Facts

Type: Competitive
University Eligible: Yes, in partnership with a transit agency if the university has land use authority
Fund uses: Planning, capital

Expedited Project Delivery (EPD) Pilot Program - Section 3005(b)

The EPD Pilot Program provides funding to streamline delivery of capital transit projects through public-private partnerships. The FTA website lists eligible projects as new fixed guideway capital projects, small start projects, or core capacity improvement projects that have not entered into a full funding grant agreement with FTA. Eligible recipients must be state or local government authorities who partner with a private entity. Private entities that could impact mobility hubs include private universities, on-demand transit companies, ridehail companies, shuttle providers, car share companies, and other shared mobility companies.

Quick Facts

Type: Competitive
University Eligible: No
Fund uses: Planning

Department of Energy (DOE) Office of Energy Efficiency and Renewable Energy (EERE) Vehicle Technologies Funds

The Department of Energy offers program-wide funding opportunities to explore community projects that provide renewable energy options that could benefit mobility hubs. This includes innovative solutions to improve mobility options in underserved communities such as mobility hub connectivity improvements, community engagement to accelerate clean transportation options for underserved communities, and cost-effective deployment of EV charging that could provide a benefit for mobility hubs with EV carshare options. Local governments, non-profit entities, for-profit entities, and institutions of higher education are eligible to apply.

Quick Facts

Type: Competitive
University Eligible: Yes
Fund uses: Planning

State Resources

State-level funding opportunities for mobility hub amenities and infrastructure are limited compared to federal and local opportunities. The vast majority of state funding through the Texas Department of Transportation (TxDOT) is allocated for tolled and non-tolled highways. However, TxDOT and the Texas Commission on Environmental Quality (TCEQ) offer funding programs eligible for mobility hub projects in Texas.

Texas Department of Transportation (TxDOT)

Rural Public Transportation Grants Program

This grant program is intended to provide public transportation in rural areas and small cities with populations over 50,000. Grant recipients must be in a rural transit district in Texas, and funds can be used for capital, planning, or operating and administrative costs for public transportation. Federal funding makes up 80% for this grant program, with a state or local match of 20% on most projects. ADA and clean air projects may receive up to 90% of federal funding. For operating costs, the funding ratio is 50% federal, 50% state/local match. Colleges and universities are not eligible recipients – this grant program is limited to state agencies, local public bodies, private nonprofit organizations, and public transportation operators. For public transportation operators that manage or contract with on-demand services, this grant could be used to extend service to university locations.

Quick Facts

Type: Non-competitive
University Eligible: No
Fund uses: Planning, capital, operations, administrative costs

Unified Transportation Program (UTP)

TxDOT denotes funding for a variety of projects within the state of Texas through its 10-year plan known as the UTP. While 80% of the funds in this program come from federal sources, this program makes up the remaining 20% for urban areas (the local government takes on the 20% share for non-urban rural areas). NCTCOG distributes UTP funds to eligible recipients in the North Central Texas area. For urbanized areas with populations over 200,000, NCTCOG selects projects in consultation with TxDOT. TxDOT's Public Transportation Division administers funds for urban and non-urban areas with populations lower than 200,000.

Quick Facts

Type: Non-competitive
University Eligible: Yes
Fund uses: Planning, capital, operations

Category 9 of UTP funding, known as the Transportation Alternatives Set-Aside (TASA) program, concerns construction of sidewalks, bicycle infrastructure, pedestrian and bicycle signals, traffic-calming techniques, lighting and other safety-related infrastructure, and Americans with Disabilities Act compliance projects.

Colleges and universities are eligible entities as project sponsors for TASA funds, however entities with limited federally-funded construction experience and entities without right-of-way ownership are encouraged to partner with local governments on construction-related mobility hub projects. Funding is therefore eligible for many mobility hub amenities and services at hubs on campus.

Texas Commission on Environmental Quality (TCEQ)

Texas Emissions Reduction Plan (TERP): Governmental Alternative Fuel Fleet (GAFF) Grant Program

The Governmental Alternative Fuel Fleet (GAFF) grant program offers a non-competitive, first-come first-served funding source for purchasing or leasing new vehicles that operate primarily on alternative fuels. The NCTCOG region is located within a priority area for the program, which allows projects in that region to score higher on the grant application. Eligible applicants include state and local government agencies, school districts, junior college districts, or transit provider that operates a fleet of more than 15 motor vehicles. While community college districts are eligible to apply, universities and colleges themselves are not eligible. Vehicles purchased with grant monies are not required to replace older fleet vehicles and can be used to complement the existing fleet. As a result, this grant program can be used to fund the expansion of a transit fleet to provide

Quick Facts

Type: Non-competitive
University Eligible: No
Fund uses: Capital for fleet

more frequent service to mobility hubs, or even fund specialized/off-peak car share programs that intersect with campus vehicle fleets.

Foundation and Sponsor Opportunities

Campuses and other hub implementors can partner with non-profit and foundations to fund mobility hub projects. While most opportunities are competitive and funding awards are typically smaller than those from government funding sources, they often have fewer eligibility restrictions governing use of funds. Often, foundational and sponsor opportunities require applicants to be non-profit organizations and for funds to go primarily towards low- to moderate-income communities, but depending on your mobility hub location and partnership availability, these funding opportunities can go towards on-campus and off-campus mobility hubs. Campus mobility and affordability are an underfunded project type in non-profit and foundation circles.

Local foundations like the Dallas Foundation, Meadows Foundation, North Texas Community Foundation, Fikes Foundation, and Sid W. Richardson Foundation are well known for funding projects and programs that address regional issues that mobility hubs can solve, such as neighborhood infrastructure (e.g., transportation, broadband access, sidewalks, etc.), environmental sustainability, access to parks and recreation, racial equity and inclusion, affordability and eliminating poverty, public health, and more. The King Foundation offers community grants in Collin, Dallas, Denton, Rockwall, and Tarrant counties that support transportation improvements for aging populations. The Communities Foundation of Texas is unique in that they connect a range of civic and private funders to entities that need funding for impactful community ideas. This is an under-tapped resource to fund mobility hub and campus mobility investments focused on the needs of primarily low-income campus affiliates.

National organizations also fund mobility hub and campus access projects. The PeopleForBikes: Community Grant Program offers funding for capital bicycle infrastructure improvements. Local governments and non-profit organizations are typical recipients, but there is nothing to suggest that universities and colleges would not be eligible to apply.

In partnership with the Global Designing Cities Initiative (GDCI), Bloomberg Initiative for Cycling Infrastructure (BICI) provides grants of $400k to $1 million to fund safe, connected cycling infrastructure projects. The grant program is competitive and states that the most viable applications will bring together government agencies, community members, and other resources. Universities and colleges are open to apply, but the most successful applicants will apply in partnership with municipal agencies.

Local and Campus Resources

Beyond allocating general funds, local communities have several funding sources at their disposal to support mobility hub capital improvements and ongoing operation and maintenance.

Local

Local fees and tax revenue fund the majority of municipal transportation infrastructure and mobility improvements. Tax revenue can be used to fund a variety of hub investments, but fee revenue must recover costs related to program the administration, management, and regulation from which the fee is extracted. Examples of these types of funding sources that may be available to support off-campus mobility hub development include curb parking revenue, commercial parking taxes, ride-hail taxes, and shared micromobility permit fees. For example, Dallas's shared micromobility permit fee requires each permitted vendor to pay $35 per scooter per year, which supports the installation of new racks for bike and scooter parking and other related infrastructure.

An off-campus hub could be located near potential development sites. Affected off-campus mobility hub could benefit from **development requirements, impact fees, and Transportation Demand Management (TDM) requirements** that can support site-specific or even public benefit investment in mobility services and/or infrastructure to reduce reliance on single occupancy vehicle (SOV) travel. Consider working with these partners to integrate mobility hub elements into their TDM plan, which typically includes investments in a range of micromobility, transit, car share/carpooling, infrastructure, mobility information systems, and ridership incentives.

Many municipalities in the NCTCOG region have adopted **Capital Improvement Programs (CIPs),** which detail the university's projection of major new construction and repair and rehabilitation projects over a typical timeline of five to six years. CIPs are typically reviewed and updated annually. Universities or municipalities can work with policymakers to include mobility hub infrastructure and amenity projects into the local CIP.

Campus

Long-Term Improvements

Like municipalities, many larger university campuses in the North Central Texas region have established their own **Capital Improvement Programs (CIPs).** To have a project included in a university's CIP, there is typically a minimum total project cost cutoff.[1] Projects on the CIP are often primarily funded by the university's **Designated Funds** – revenue derived from student tuition. Consider the scale of your campus mobility hub project – projects within the CIP are often large-scale and with a long-term implementation timeline. Depending on the university's cost threshold for inclusion in the CIP and the scale of the mobility hub being considered, your project may or may not be included in the university CIP. Possible approaches to ensure mobility hub projects meet CIP cost thresholds are to integrate them into broader mobility or on-campus infrastructure projects (e.g., an element of a new building or parking structure), or, for campuses with multiple on-campus hubs, fund the entire hub network as a holistic mobility hub capital and operating program.

Funding can also come from bonds issued by the State of Texas. Some universities in the North Central Texas region are eligible for **Higher Education Fund (HEF) bonds**, which can be used to fund permanent improvements on university campuses, but rarely include transportation projects. **Tuition Revenue Bonds (TRBs),** now known as **Capital Construction Assistance Project (CCAP) bonds** are bonds reimbursed by the State of Texas general revenue for public universities and colleges in the state of Texas to fund structures, facilities, roads, and related infrastructure on or for the campus. These bond sources are typically reserved for large capital improvements and are unlikely to apply to individual mobility hubs or small-scale infrastructure elements.

Short-Term Improvements

Campus mobility hubs may be able to source funding from some of the municipal funding sources listed previously, but funding for smaller on-campus infrastructure and mobility improvements are likely to primarily come from revenue generated by university parking and other transportation revenue – the scale of projects eligible to use this funding source will vary from university to university. Additionally, student tuition can include a "**Green Fee**," which is pooled funding allocated to support sustainability-related projects and initiatives on campus. Green Fees will be an attractive source of funding for mobility hub elements, infrastructure components, and short-term implementation. In the case of UNT's **We Mean Green Fund,** funding for projects is managed and approved by a student-led committee. Projects funded by the We Mean Green Fund typically have a budget of $20,000 or less, which can fund minor hub amenities like shelters and seating, micromobility parking, curb enhancements, and activation, among others. UT Arlington voted to establish its own **Green Fund** in Spring of 2022. This fund is proposed to fund programs that include bike racks, a Bike Barn, and bike repair stations, but any project that promotes sustainability is eligible to be funded.

Eligibility for funding mobility improvements varies from university to university. Often, improvements to parking and transportation infrastructure on university campuses are ineligible for state bond funds and must be funded through local revenue sources. On some universities, such as UNT and TWU, campus roadways are considered City right-of-way, and therefore a partnership with the local municipality is needed for any improvements to be constructed. Similarly, any transit or shuttle stops on UNT or TWU campuses must involve a partnership with the

[1] Total project cost thresholds for inclusion in a university's CIP will vary by institution, but some examples include: UT system - $10 million, TWU - $100,000, UNT system - $1 million for new construction, $2 million for renovations.

Denton County Transportation Authority (DCTA), and funding or implementing these improvements is out of the hands of the university alone. For universities with this type of relationship with the municipality, a Memorandum of Understanding can be established with the municipal agency to clarify funding responsibilities on campus roadways.

How to create your own funding stream?

One approach to apply local funding would be to establish or leverage an existing tax district, such as **Tax Increment Financing (TIFs)** or **Community Benefit Districts (CBDs).** TIFs redirect property tax revenues to fund infrastructure, other public facilities, and affordable housing. CBDs, also known as **Public Improvement Districts (PIDs)** in Texas, are tax districts established through a partnership between the City and the community that allow communities to raise money for local infrastructure investments and services.

The Green Fee program mentioned in the previous section is an attractive option for mobility funding. Green Fee funding comes from a small contribution from student tuition by semester. For example, the We Mean Green Fund at UNT and the Green Fund at UTA consist of a $5.00 contribution from student tuition. For schools with large enrollments, that money adds up quickly and can be used to fund a variety of mobility hub projects.

Three Metropolitan Transportation Authorities (MTAs) in the NCTCOG region — Dallas Area Rapid Transit (DART), Denton County Transportation Authority (DCTA), and Trinity Metro — have the authority to levy local sales taxes through a bond vote in order to fund transit improvements and maintenance, which can be used to strengthen the transit component of mobility hubs or provide access to an area via transit that did not have access prior.

Implementation Matrix

The implementation matrix below summarizes the funding options listed in this chapter and provides a viability rating for each funding source. Viability ratings were determined by university eligibility, the breadth of eligible mobility hub projects, the likelihood of securing funding, and the degree of regional and national competition.

Level	Agency	Opportunity	Eligible Mobility Hub Projects	University Eligible?	Viability
Federal	US DOT	INFRA Grants Program	Highway and freight related projects, e.g., off-campus bicycle and pedestrian infrastructure that intersects with highways, commuter rail line improvements that also host freight operations	No	●○○○○ [very competitive]
Federal	US DOT	SMART Grants Program	Technology and automation projects, e.g., traffic signal improvements, data usage sensors, online mobility dashboards	No	●●●●○ [very competitive]
Federal	US DOT	RAISE Grants Program	Transit projects, intermodal projects, roadway projects, e.g., transit integration, transit improvements, bicycle and pedestrian infrastructure, shared mobility infrastructure	Yes, with government partnership	●●●●○ [very competitive]
Federal	FHWA	CMAQ Program	Air quality improvement and traffic reduction projects, e.g., signal coordination, intersection improvements, park-and-ride facilities, bicycle and pedestrian infrastructure, transit improvements	No	●●●○○ [very competitive]

Federal	FHWA	ATTIMD Program	Technology and automation projects, e.g., digital wayfinding, transit information signage, shared mobility dashboards, shared mobility docks	Yes, with government partnership	●●●●○ [very competitive]
Federal	FHWA	STBG Program	Transportation alternative projects, e.g., bicycle and pedestrian infrastructure, transit connections, shared mobility infrastructure	No	●●●○○ [very competitive]
Federal	FTA	Public Transportation Innovation - 5312	Innovative transit projects, e.g., demand-responsive shuttles, digital signage, innovative transit integration	Yes	●●●●● [very competitive]
Federal	FTA	AoPP Program	Transit projects in disadvantaged communities, e.g., access improvements to mobility hubs, campus shuttle system, bus stop improvements, other transit improvements	Yes, university transportation systems in disadvantaged communities	●●●●○
Federal	FTA	AIM Program	Innovative and equitable transit projects, e.g., multimodal trip platforms, on-demand shuttle systems, real-time transit information	Yes, with government partnership	●●●●○
Federal	FTA	All Stations Accessibility Program	Rail transit accessibility projects, e.g., accessibility improvements at rail stations	No	●●○○○
Federal	FTA	Emerging Mobility Innovation Program	Innovative transit projects and rider experience improvement projects, e.g., transit service improvements, on-demand shuttle service and shared mobility integration, transit stop wayfinding improvements	Yes	●●●●○
Federal	FTA	Pilot Program for TOD Planning	Transit amenity projects that integrate with land use, e.g., benches and shelters, transit wayfinding, real-time transit information	Yes, in partnership with a transit agency if the university has land use authority	●●●●○
Federal	FTA	EPD Pilot Program	Capital transit project planning, e.g., planning improvements for mobility hubs in partnership with private entities	No	●●●○○
Federal	DOE	EERE Vehicle Technology Funds	Renewable energy planning projects, e.g., mobility hub connectivity improvements, EV charging deployment, community engagement	Yes	●●●○○
State	TxDOT	Rural Public Transportation Grant Program	Rural public transportation projects, e.g., transit service improvements, transit stop improvements, on-demand shuttle system creation	No	●●○○○
State	TxDOT	Unified Transportation Program – TA	Transportation alternatives projects, e.g., bicycle and pedestrian infrastructure,	Yes	●●●●●

State	TCEQ	TERP: Governmental Alternative Fuel Fleet	New alternative fuel fleets: e.g., electric transit buses, electric shuttle systems, EV charging for electric fleets	No	●●○○○
Foundation	--	Local and National Foundation Grants	A range of services, amenities, and subsidies	Yes	●●●●○
Local	City gov't	Curb Parking Revenue	Any mobility hub infrastructure or amenity, unless there are local restrictions	Varies by local government	●●●●○
Local	City gov't	Commercial Parking Taxes	Any mobility hub infrastructure or amenity, unless there are local restrictions	Varies by local government	●●●○○
Local	City gov't	TNC/Ridehail Taxes	Any mobility hub infrastructure or amenity, unless there are local restrictions	Varies by local government	●○○○○ [regulatory barrier]
Local	City gov't	Shared Micromobility Permit Fees	Varies by jurisdiction, but eligible projects typically include limited bicycle and pedestrian infrastructure and amenities	Varies by local government	●●●○○
Local	City gov't	Development Requirements	Any mobility hub infrastructure or amenity, unless there are local restrictions	Varies by local government	●●●○○
Local	City gov't	Development Impact Fees	Any mobility hub infrastructure or amenity, unless there are local restrictions	Varies by local government	●●●○○
Local	City gov't	TDM Requirements	Any mobility hub infrastructure or amenity, unless there are local restrictions	Varies by local government	●●●●○
Local	City gov't	Capital Improvement Programs	Any mobility hub infrastructure or amenity, unless there are local restrictions	Varies by local government	●●●●○
Campus	--	Designated University Funds	Varies by university, but projects with auxiliary funding (e.g., parking) are often restricted	Yes	●●●○○
Campus	--	Higher Education Fund (HEF) Bonds	Varies by university, but projects with auxiliary funding (e.g., parking) are often restricted	Yes	●●●○○
Campus	--	Capital Construction Assistance Project Bonds (CCAP)	Varies by university, but projects with auxiliary funding (e.g., parking) are often restricted	Yes	●●●○○
Campus	--	Green Fee	Any project with that promotes sustainability, e.g., bicycle and pedestrian improvements, transit improvements, shared mobility improvements	Yes	●●●●●

DIY	City gov't	Tax Increment Financing (TIF) Districts	Any mobility hub infrastructure or amenity, unless there are local restrictions	Varies by local government	●●●○○
DIY	City gov't	Public Improvement Districts (PIDs)	Any mobility hub infrastructure or amenity, unless there are local restrictions	Varies by local government	●●●●○
DIY	Transit	Transit Bond	Transit system improvements, transit amenity improvements, on-demand transit	Varies by local government	●●●○○

03 How Competitive are Mobility Hubs for Grant Funding?

Factors Affecting Competitiveness of Mobility Hubs for Grant Funding?

This section analyzes the competitiveness of campus mobility hubs for grant funding by identifying the potential public benefits to be generated by these facilities and conducting a sketch benefit-cost analysis (BCA) of a proposed mobility hub in a selected location in the NCTCOG region. The sketch BCA is conducted in accordance with the benefit-cost methodology outlined by U.S. DOT in the Benefit-Cost Analysis Guidance for Discretionary Grant Programs, released in March 2022 (Revised).[2]

The content of this section is organized in subsections which present the following:

- The general objectives of a BCA.
- A **methodological framework** to measure the potential public benefits of campus mobility hubs.
- Estimation of the **public benefits** to be generated by the hypothetical campus mobility hub.
- Estimated **capital, operations, and maintenance** (O&M) costs of the hypothetical campus mobility hub.
- Detailed **results** of the BCA of the hypothetical campus mobility hub.
- Results of **sensitivity tests** that identified how changes in key inputs/assumptions affect the BCA results of the hypothetical campus mobility hub.
- **Key takeaways** for entities seeking Grant funding for mobility hubs, and how BCAs can be used to evaluate the opportunity cost of alternative investments.

Objective(s) of Benefit-Cost Analyses

A Benefit-Cost Analysis (BCA) is an evaluation framework to assess the economic advantages (benefits) and disadvantages (costs) of an investment. Benefits and costs are broadly defined and are quantified in monetary terms to the extent possible. The overall goal of a BCA is to assess whether the expected benefits of an investment or project justify the costs from a national perspective. The BCA attempts to capture the net welfare change created by the project over a specific period, including cost savings and increases in welfare (benefits), as well as disbenefits where costs can be identified (e.g., project capital costs), and welfare reductions where some groups are expected to be made worse off because of the proposed project.

Scenarios

The BCA involves defining a Baseline or “No Build” scenario, which is compared to the “Build” scenario, where the Project is built as proposed. The BCA assesses the incremental difference between the “Build” scenario and the “No Build” scenario, which represents the net change in welfare. BCAs are forward-looking exercises which seek to assess the incremental change in welfare (benefits) over the expected useful life of the Project. The importance of future welfare changes is determined through discounting, which is meant to reflect both the opportunity cost of capital as well as the societal preference for the present.

Analysis Period

The BCA also involves defining the analysis period. The analysis period should reflect the expected useful life of the Project and includes the implementation period and the operating period. The implementation period covers the full development and construction of the Project during which the initial costs are incurred. The operating period

[2] Benefit Cost Analysis Guidance for Discretionary Grant Programs.

corresponds to the expected useful life of the Project and starts when the Project is complete and open to the public. During the operating period public benefits accrue as well as any ongoing costs to preserve the Project so that it continues to provide acceptable services and achieves its expected service life.

Methodological Framework to Measure Public Benefits of Campus Mobility Hubs

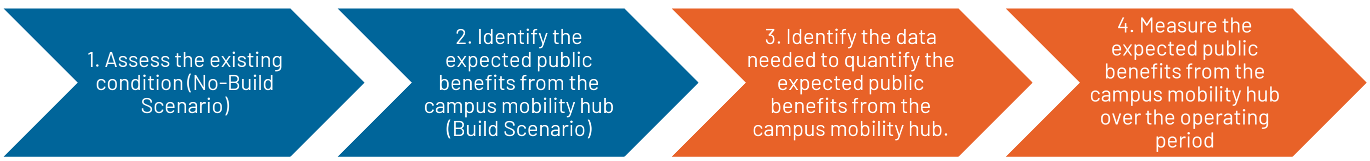
The general methodological framework to assess the public benefits to be generated by a campus mobility hub (i.e., the Project) is depicted in Figure 1. The framework encompasses the following main steps:

1. **Assess the existing conditions (or No-Build Scenario)**. This step compiles performance data on the baseline or existing condition such as quality or comfort of trips made by active transportation users (e.g., cyclists and pedestrians) measured by the amenities offered by the existing pedestrian, cycling and transit facilities and historical crashes involving active transportation users. The No-Build Scenario assumes that the campus mobility hub would not be built, and current conditions and operations would continue without the proposed hub.
2. **Identify the expected public benefits to be generated by the proposed campus mobility hub (or Build Scenario)**. This step identifies the types of public benefits to be generated by the campus mobility hub and potential metrics to quantify these benefits. Potential benefits to be generated by a campus mobility hub include:
    a. **Congestion relief** when the Project includes improvements to transit operations and services making public transportation more attractive to private auto users, which in turn results in auto users switching to transit and reducing auto trips & vehicle miles traveled.
    b. **Increased/Affordable Mobility** when the Project (a) makes public transportation and active transportation modes more attractive to private auto users, which in turn results in lower transportation costs. This is particularly important for low-income and disadvantaged commuters and students who have to drive to campus and pay parking fees and spend money on vehicle ownership and fuel and non-fuel vehicle operating costs and (b) reduces accessibility barriers to education. This is particularly important at campuses that are inaccessible to students without a car.
    c. **Environmental Sustainability** when the Project makes public transportation and active transportation modes more attractive to auto users, which in turns reduces auto travel (auto trips & vehicle miles traveled), reducing carbon emissions and energy use, and combating climate change.
    d. **Safety Benefits** when the Project provides and/or improves bicycle and pedestrian facilities that reduce the risk and number of crashes and incidents involving active transportation users. If the Project makes public transportation more attractive to auto users, the reduced auto trips & vehicle miles traveled would have an additional positive impact by reducing the risk and amount of vehicle crashes and incidents.
    e. **Health Benefits** when the Project provides and/or improves bicycle and pedestrian facilities that increases walking and cycling. If the Project increases transit ridership, this could result in a higher level of physical activity among transit riders. Increased physical activity reduces obesity and the risks for developing chronic conditions such as diabetes and cardiovascular disease, reducing mortality risks from those who are induced to active transportation modes.
    f. **State of Good Repair of the Roadway Infrastructure** when the Project includes improvements to transit operations and services making public transportation more attractive to private auto users, which in turns increases the utilization of existing roadway capacity, reducing the cost of maintaining the roadway infrastructure in a state of good repair.
    g. **Quality (Amenity) Benefits** when the Project improves the quality of trips made by active transportation users, transit users, or both. Mobility hub amenities can include luggage storage, food service availability, wheelchair space, restrooms and showers, among others.

   h. **Property Value Increases** when the Project creates new spaces that are valued by the public (e.g., surplus project right-of-way that can be used to develop a park). Since increase in property values generally result from improved mobility and accessibility, to avoid double counting the Project benefits, any increase in property values should only capture otherwise unquantified benefits such as those already described above.

3. **Identify the data needed to quantify the expected public benefits to be generated by the proposed campus mobility hub**. This step identifies the data needed and corresponding data sources to quantify the potential public benefits from campus mobility hubs. Only benefits that can be quantified are analyzed in greater detail in Step 4.
4. **Measure the expected public benefits from the campus mobility hub over the operating period.** This step measures and monetizes the potential public benefits from campus mobility hubs. This involves comparing the Build Scenario against the No-Build Scenario over the expected useful life of the Project.

Figure 1 Methodological Framework to Assess the Public Benefits from Campus Mobility Hubs



Source: Cambridge Systematics.

Key Methodological Components

The BCA of a campus mobility hub (i.e., the Project) competing for Grant funding is conducted in accordance with the benefit-cost methodology recommended by the latest U.S. DOT Benefit-Cost Analysis Guidance for Discretionary Grant Programs. The methodology includes the following key components:

- Defining the existing and future conditions under the "No Build" (Baseline) scenario as well as under the "Build" scenario.
- Defining the analysis period.
- Estimating the annual and total Project benefits and costs during the analysis period. This involves the following:
- Using the U.S. DOT recommended values to monetize the public benefits (and disbenefits if any);
- Presenting dollar values in real 2020 dollars. In instances where cost estimates are obtained in historical dollar years other than 2020 dollars, the BCA uses the appropriate Consumer Price Index (CPI) to adjust the values; and
- Discounting future benefits and costs with a real discount rate of 7 percent (consistent with the latest U.S. DOT Benefit-Cost Analysis Guidance for Discretionary Grant Programs).

Potential Public Benefits Generated by Campus Mobility Hubs

Public benefits generated by campus mobility hubs include the following:

- **Safety Benefits –** The implementation of a dedicated bike lane will reduce the likelihood of fatalities, injuries and property damages that results from crashes involving cyclists under the existing condition (or No-Build scenario), improving the safety of all users of the dedicated bike lane under the Build Scenario.
- **Health Benefits –** People who use active transportation modes such as cycling and walking are, on average, more physically fit and have a reduced risk of cardiovascular disease compared to people who only use motorized transportation modes. Active transportation modes also provide a range of additional health benefits by improving people mood, concentration, and focus. Overall, daily physical activity can lead to

health benefits. The implementation of a dedicated bike lane will improve health outcomes by reducing the mortality risks of those users that are induced to active transportation modes from motorized transportation modes.

- **Facility Amenity Benefits –** This category captures improvements in the quality or comfort of trips made by cyclists arising from new or improved cycling facilities. The implementation of a dedicated bike lane can improve journey quality and comfort for cyclists.

Expected Public Benefits to be Generated by the Proposed Transit Mobility Hub

Proposed Campus Mobility Hub

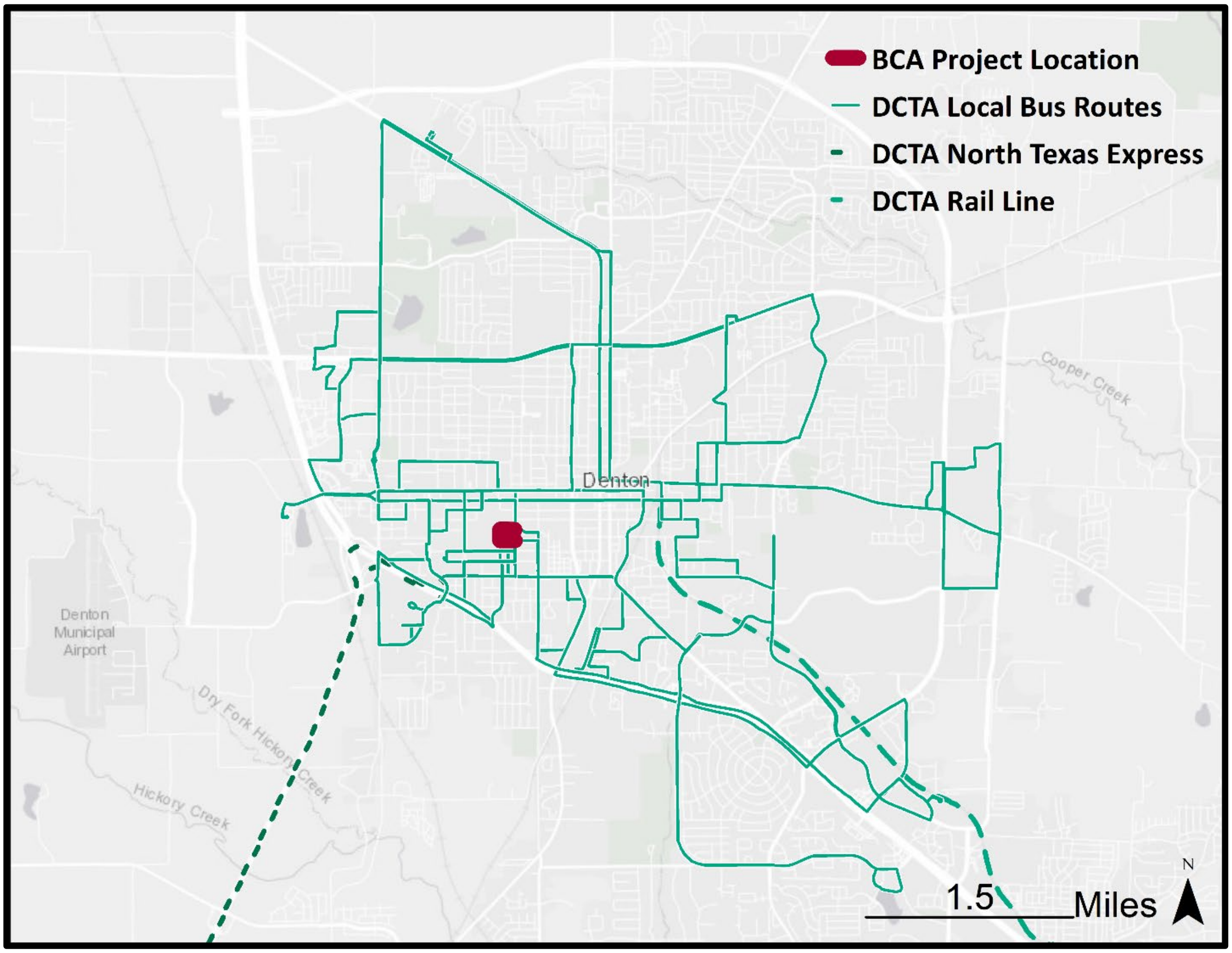
The main components of the hypothetical mobility hub located in the UNT campus in Denton, Texas (see Figure 2) are:

- A mobility hub building located at the Union Circle (see Figure 3) which will offer amenities (e.g., bicycle racks, restrooms, vending machines) to improve the quality and comfort of trips made by active transportation users.
- A dedicated 0.29-mile bike lane along the Union Circle Roadway (see Figure 4).
- Five e-cargo bikes which are part of an e-cargo bike program to circulate deliveries from the Student Union to their end delivery location.

It should be noted that the hypothetical campus mobility hub does not include improvements to transit serving the UNT campus and the proposed hub. As a result, it is assumed that the hypothetical mobility hub will not attract auto users to transit or generate benefits to existing or new transit riders.

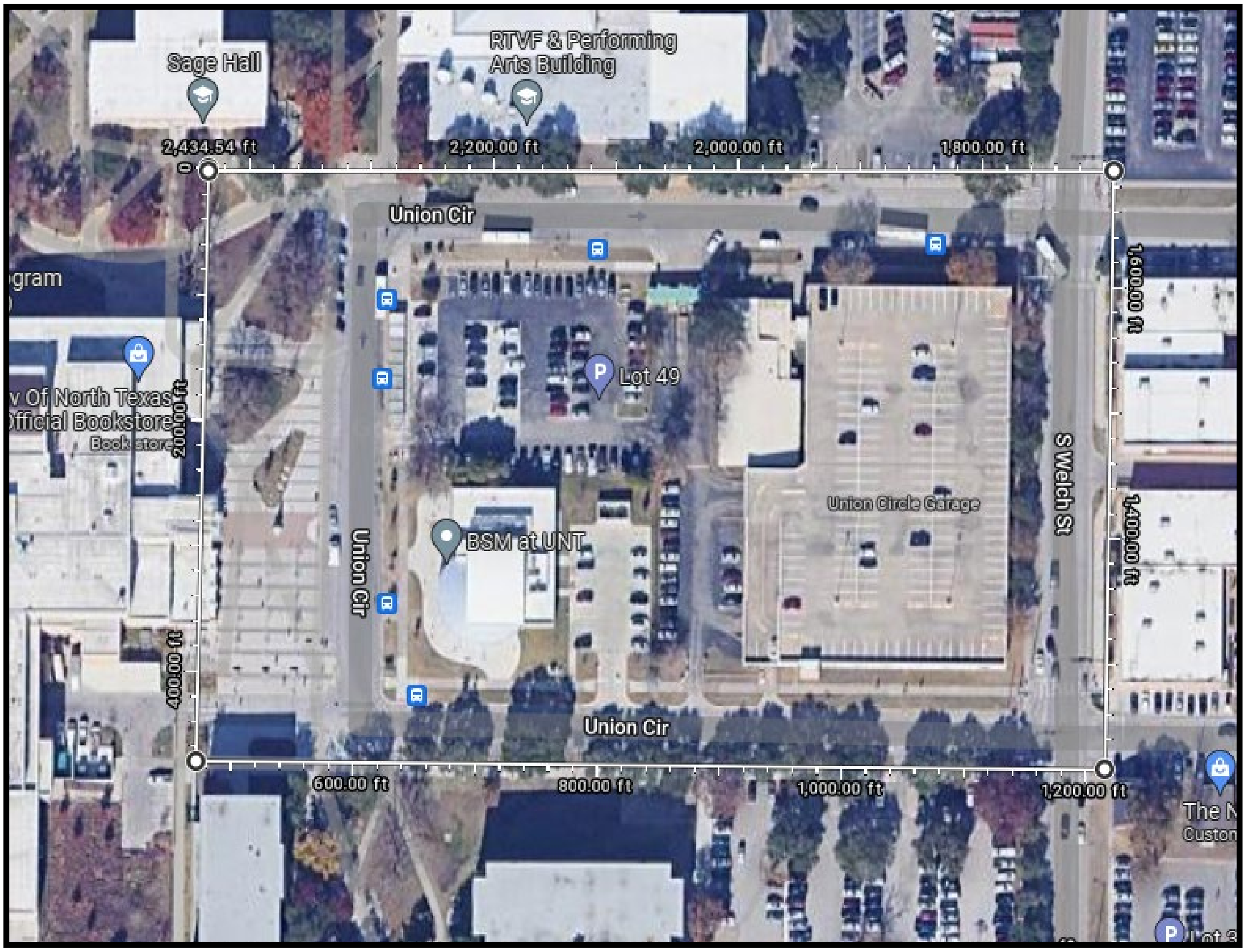
A full breakdown of benefits and costs incorporated into this analysis is included in **Appendix A**. In the future, the campus mobility hubs would include improvements to transit serving the UNT campus and the proposed hub. These improvements have the potential for switching auto users to transit. These additional benefits as well as the sketch steps to estimate them are discussed in **Appendix B**.

Figure 2 Location of the Hypothetical Campus Mobility Hub in the UNT Campus in the City of Denton, Texas



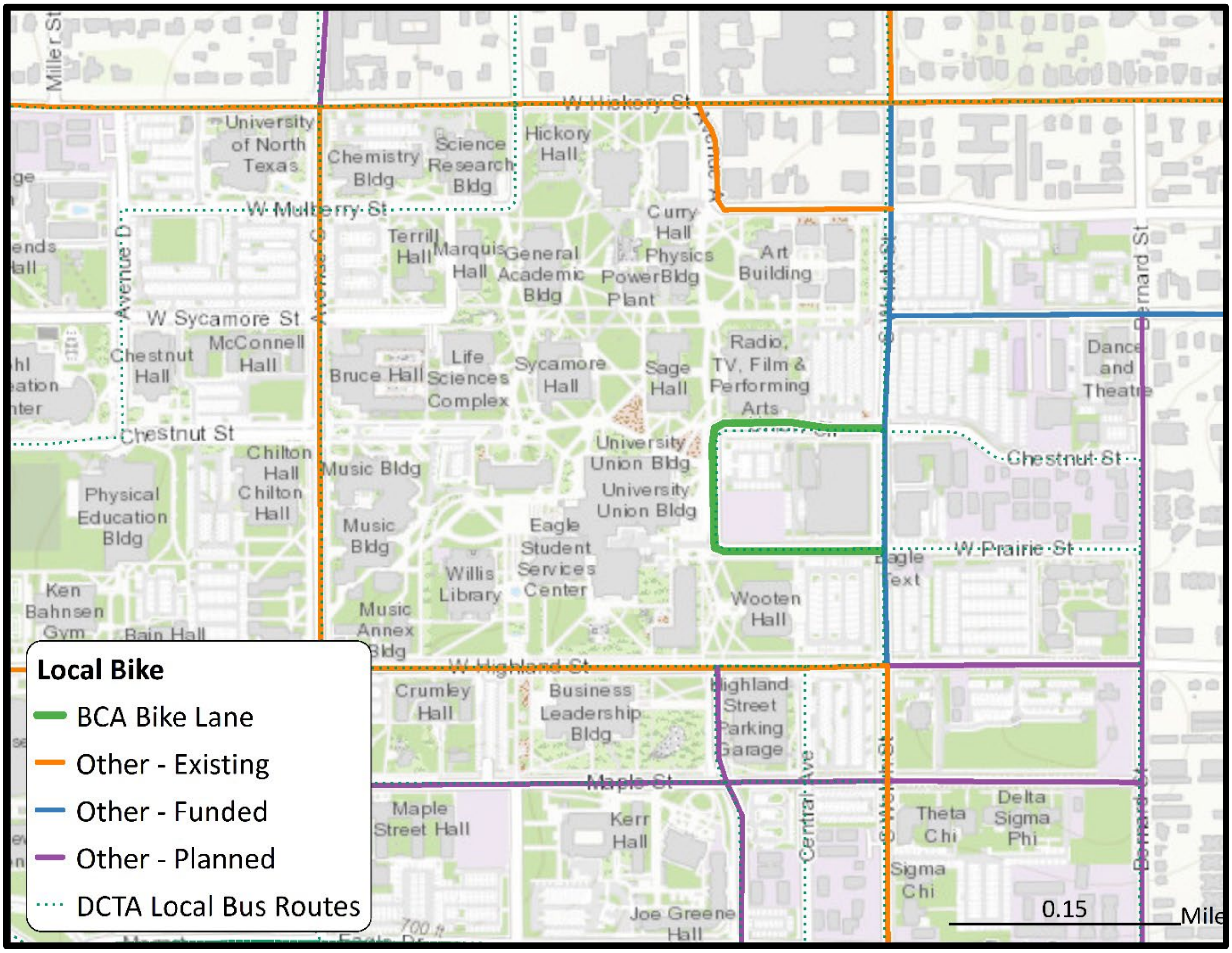
Source: Cambridge Systematics.

Figure 3 Location of the Hypothetical Mobility Hub at the Union Circle in the UNT Campus



Source: Nelson\Nygaard.

Figure 4 Location of the Hypothetical Dedicated Bike Lane along the Union Circle Roadway



Source: Nelson\Nygaard.

Expected Service Life of the Hypothetical Campus Mobility Hub

The expected life of the Campus Mobility Hub building is assumed to be 30 years. This number is based on peer agency [Hampton Roads Transit's 2021 strategic plan,] which has calculated useful life for several transit related facilities based on annual condition monitoring of their facilities, which they began doing in 2016. They estimate the useful life of a transit related building to be between 10-50 years, and the midpoint of this range is used for this analysis.

The expected life of the dedicated bike lane is assumed to be 30 years. This assumption is based on the expected service life of a well-constructed asphalt pavement which can last 25 years or more under low levels of traffic as per [Pavement life cycle]. This analysis assumes that the expected life of the dedicated bike lane can be extended to 30 years because proper maintenance of the lane will be performed on a regular, timely basis.

BCA Results

The BCA converts potential gains (benefits) and losses (costs) from the Project into monetary units and compares them. The following common benefit-cost evaluation measures are included in this BCA:

- Net Present Value (NPV) - The NPV compares the net benefits (benefits minus costs) after being discounted to present values using the real discount rate assumption. The NPV provides a perspective on the overall dollar magnitude of cash flows over time in today's dollar terms.

- Benefit Cost Ratio (BCR) – The present value of incremental benefits is divided by the present value of incremental costs to yield the BCR. The BCR expresses the relation of discounted benefits to discounted costs as a measure of the extent to which a project's benefits either exceed or fall short of the costs.

Table 1 presents the benefit-cost evaluation measures for the Project and Table 2 summarizes the results of the BCA by year over the analysis period. Results are presented in undiscounted and discounted at seven percent. All benefits and costs were estimated over an evaluation period extending 30 years beyond system completion in 2024 (starting in 2025). The total net benefits from the Project within the implementation period represent $22.5 million (including the O&M costs and residual value of e-cargo bikes) when discounted at seven percent. The total capital costs are calculated to be $4.4 million when discounted at seven percent. The difference of the discounted benefits and costs equal a NPV of $18.1 million, resulting in a BCR of 5.1. Every dollar of public investment in the campus mobility hub is anticipated to yield an additional $5.1 in public benefits in the NCTCOG region.

Figure 5 shows the cumulative 7 percent discounted costs and benefits of the Project, with breakeven in 2027.

Table 1 Project Net Present Value and Benefit-Cost Ratio

Item	Undiscounted 2020$	Discounted at 7%
Bicycle Safety Benefits	$17,727,931	$6,333,026
Cycling Journey Quality Benefits	$4,371,300	$1,504,939
Health Benefits	$49,188,642	$16,940,042
Operating & Maintenance Costs	-$6,343,424	-$2,239,796
Residual Value of E-cargo Bikes	$19,103	$2,048
Total Project Benefits = B	**$64,963,551**	**$22,540,259**
Total Project Costs = C	**$5,004,870**	**$4,434,897**
Net Present Value = NPV = B - C	**$59,958,681**	**$18,105,362**
Benefit Cost Ratio = BCR = B / C	**13.0**	**5.1**

Source: Cambridge Systematics.

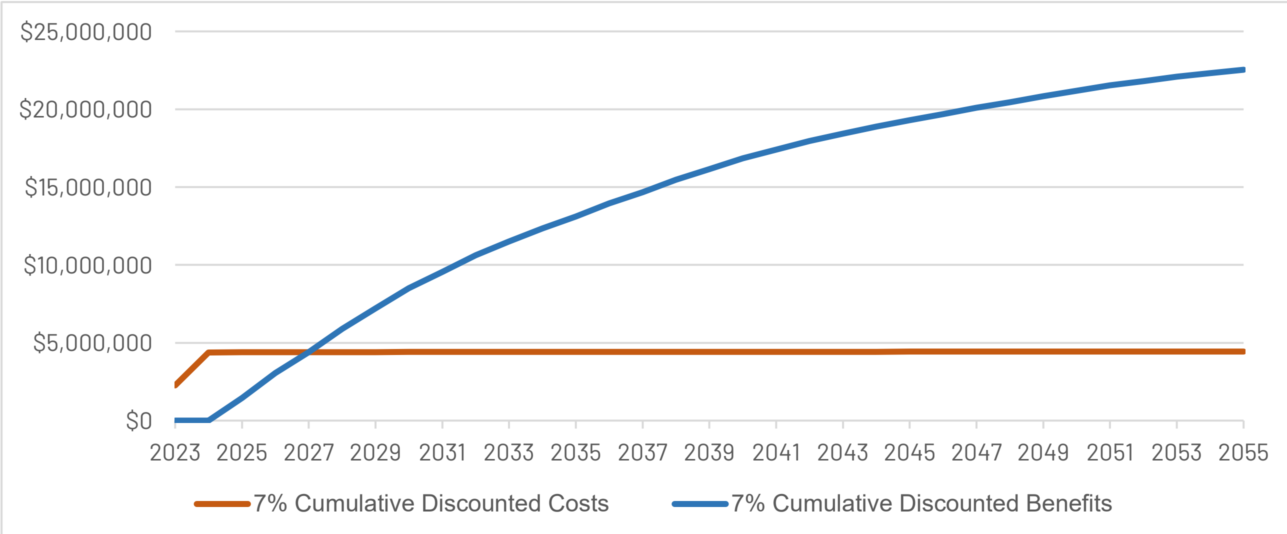
Table 2 Project Life Cycle Benefit-Cost Analysis

Year	Project Cost (Undiscounted 2020$)	Project Benefits (Undiscounted at 7%)	Project Cost (Discounted 2020$)	Project Benefits (Discounted at 7%)
2023	$2,418,861	$0	$2,260,618	$0
2024	$2,418,861	$0	$2,112,727	$0
2025	$23,878	$1,780,006	$19,492	$1,453,015
2026	$0	$2,095,851	$0	$1,598,915
2027	$0	$1,893,015	$0	$1,349,694
2028	$0	$2,253,287	$0	$1,501,460
2029	$0	$2,084,152	$0	$1,297,905
2030	$23,878	$2,238,360	$13,897	$1,302,746
2031	$0	$1,916,191	$0	$1,042,281
2032	$0	$2,112,313	$0	$1,073,793

Year	Project Cost (Undiscounted 2020$)	Project Benefits (Undiscounted at 7%)	Project Cost (Discounted 2020$)	Project Benefits (Discounted at 7%)
2033	$0	$1,844,695	$0	$876,401
2034	$0	$1,905,660	$0	$846,136
2035	$23,878	$1,865,381	$9,909	$774,067
2036	$0	$2,181,226	$0	$845,917
2037	$0	$1,978,390	$0	$717,060
2038	$0	$2,338,662	$0	$792,186
2039	$0	$2,169,527	$0	$686,817
2040	$23,878	$2,323,735	$7,065	$687,509
2041	$0	$2,001,566	$0	$553,450
2042	$0	$2,197,688	$0	$567,924
2043	$0	$1,930,070	$0	$466,137
2044	$0	$1,991,035	$0	$449,403
2045	$23,878	$1,950,756	$5,037	$411,506
2046	$0	$1,959,293	$0	$386,268
2047	$0	$2,275,138	$0	$419,192
2048	$0	$2,072,302	$0	$356,841
2049	$0	$2,432,574	$0	$391,475
2050	$23,878	$2,263,439	$3,591	$340,426
2051	$0	$2,417,648	$0	$339,831
2052	$0	$2,095,478	$0	$275,277
2053	$0	$2,291,601	$0	$281,347
2054	$0	$2,016,142	$0	$231,334
2055	$23,878	$2,088,368	$2,561	$223,946
TOTAL	**$5,004,870**	**$64,963,551**	**$4,434,897**	**$22,540,259**

Source: Cambridge Systematics Analysis

Figure 5 Project Cumulative Discounted Benefits and Costs at 7% Discount Rate



Source: Cambridge Systematics.

Sensitivity Analysis

A sensitivity analysis is conducted to help identify which variables have the greatest impact on the BCA results. Specifically, the sensitivity analysis estimates how changes to key variables from their preferred value affect the initial results and how sensitive the results are to these changes. This allows for the assessment of the strength of the BCA, including whether the results reached using the preferred set of input variables are significantly different by reasonable departures from those values. Table 3 summarizes the key variables which have been tested for sensitivity and the results of this analysis.

This sensitivity analysis shows that the Project BCR can fluctuate between 1.2 and 3.2 while the NPV can fluctuate from $1.1 million (discounted at 7 percent) to $14.8 million (discounted at 7 percent). In any case, the outcomes of the sensitivity analysis are an indication of the robustness of the BCA results; the public benefits outweigh the costs in all four tests. Every dollar of public investment in the campus mobility hub is anticipated to yield between $1.1 and $14.8 public benefits in the NCTCOG region.

Table 3 Results of the Sensitivity Analysis

Sensitivity Variable	Sensitivity Value	New BCR (Discounted at 7%)	New NPV (Discounted at 7%)
Test 1 - Number of Bike Trips & Linear Growth Rate of Bike Trips under the Build Scenario	Decrease the number of bike trips in 2025 and 2035 estimated by the NCTCOG's BNI/PNI tool by 50% Decreased the linear growth rate of bike trips under the Build Scenario by 50%.	2.9	$8,319,829
Test 2 - Project Capital Cost and Annual O&M Expenditures	Increase the project capital cost and O&M expenditures by 50%.	2.9	$14,765,967
Test 3 - Induced Trips under the Build Scenario	Decreased the induced trips under the Build Scenario by 25%.	3.2	$9,633,293
Test 4 - Combined Tests 1, 2 and 3	Decrease the number of bike trips in 2025 and 2035 estimated by the NCTCOG's BNI/PNI tool by 50%. Decreased the linear growth rate of bike trips under the Build Scenario by 50%.	1.2	$1,051,594

Sensitivity Variable	Sensitivity Value	New BCR (Discounted at 7%)	New NPV (Discounted at 7%)
	Increase the project capital cost and O&M expenditures by 50%. Decreased the induced trips under the Build Scenario by 25%.		

Source: Cambridge Systematics, Inc.

Conclusions

Based on the outcomes of the analysis performed in the previous sub-sections, the key takeaways for entities seeking grant funding for mobility hubs are:

- **The BCA is a systematic process that can be used to support funding decisions for infrastructure investments.** The process relies on data-driven decisions. The process provides an objective evaluation of investments that carefully considers and measures the benefits and costs that are expected to result from the investments, quantifies their value in dollar terms, and compared the total costs to the total benefits of undertaking a project or making an investment. The outcomes of the BCA indicate which investments to make and which to forgo and level-setting different alternative investments by calculating the benefit-cost ratio (BCR).
- **The BCA will also factor opportunity cost into the decision-making process.** Opportunity costs are alternative benefits that could have been realized when choosing one alternative investment over another. In other words, the opportunity cost is the forgone or missed opportunity as a result of a choice or decision. Factoring in opportunity costs allows decision makers to weigh the benefits from alternative investments and not merely the current choice being considered in the BCA. By considering all options and the potential missed opportunities, the BCA is more thorough and allows for better decision-making.
- **The USDOT Benefit Cost Analysis Guidance for Discretionary Grant Programs provides useful methods and monetization rates to evaluate and compare potential transportation investments for their contribution to the economic vitality of the U.S.** The guidance provides standardized methods and rates intended to ensure greater consistency in how various types of projects from across the country are evaluated. The guidance also recommends performing sensitivity analysis to understand how changes in input values and assumptions may impact outcomes. Although the guidance includes approaches for assessing some of the most common types of public benefits (e.g., safety benefits, travel time savings, vehicle operating cost savings, emission reduction benefits), the guidance is not intended to be an all-inclusive list of all the relevant benefits that may be expected to result from all types of transportation investments (e.g., a project that improves children's ability to walk and cycle to schools).
- **The BCA of the hypothetical mobility hub located in the UNT campus in Denton (i.e., the Project) was conducted in accordance with the benefit-cost methodology recommended by the USDOT.** Since the public benefits to be generated by the hub (i.e., safety, cycling journey quality and health benefits) outweigh the costs, this is a favorable project to undertake. Therefore, the outcomes of this sketch BCA support the original purpose of the analysis (i.e., the competitiveness of campus mobility hubs for grant funding).
- **One of the key changes in the latest version of the USDOT Benefit Cost Analysis Guidance for Discretionary Grant Programs is that it includes methodologies for estimating health benefits** of active transportation users and quality (amenity) benefits from improved pedestrian, cycling, and transit facilities. The approaches and monetization rates recommended by the USDOT were used in the estimation of the potential benefits to be generated by the hypothetical mobility hub located in the UNT campus in Denton.
- **The outcomes of the BCA of the hypothetical mobility hub can be used to communicate the expected public benefits that would come from continued investment in campus mobility hubs** that improve and expand active transportation services for students and commuters throughout the NCTCOG region. Beyond

the quantified public benefits, there are other benefits that frequently arise from the presence of campus mobility hubs that are difficult to reliably quantify but need to be considered as part of the decision-making surrounding this type of investments (e.g., a mobility hub that reduces accessibility barriers to education which is particularly important at campuses that are inaccessible to students without a car, a mobility hub that includes transit improvements and shared mobility options such as bike-sharing and shared scooters so that students could attend more campus events and be more engaged with the campus community).

- **This analysis also provides a compelling story** about the multiple ways in which a campus mobility hub generates public benefits in the NCTCOG region, as well as how this type of investment could be used to correct the underinvestment in active transportation modes and help achieve regional strategic goals such as social equity, public health, environmental protection, and economic growth.

04 Partnership Opportunities

The success of campus mobility hub planning, design, implementation, and management depends on a coordinated network of people, organizations, and agencies. More so, mobility hubs can open the door to new partnership opportunities between campus facilities, local municipalities, transit providers, campus transportation service providers, private mobility vendors, and beyond in the NCTCOG jurisdiction. Innovative and effective partnerships are critical to ensure they are well-integrated and provide the transportation services to meet the needs of campus residents and visitors alike.

Campus Transportation, Parking, and Transit Partnerships

Campus and public transportation providers are the nexus of campus mobility hubs. From early planning to daily management of a campus mobility hub, developing campus transportation and public transportation provider partnerships are critical to the hub's ability to provide seamless and convenient transportation options. Many federal funding opportunities require university campuses to partner with local governments or transit agencies – these partnerships can be crucial to achieving funding and implementation.

Innovation Districts

Campuses are a hot spot for innovative thinking and creativity. Campus mobility hubs are a natural fit to demonstrate and test innovative mobility solutions and approaches to the transit user experience. Establishing a campus mobility hub, or an entire campus, as a mobility innovation district can demonstrate new technology and business models while showcasing how mobility bolsters neighborhood and campus economies. Innovation districts can be co-created through public-private partnerships and can be achieved through a holistic mobility approach that includes experimentation in policy and with new mobility services, electrification infrastructure, and innovative services. Innovation districts offer an opportunity to test transportation options and adapt based upon need. Even signaling to public and private mobility providers the intent to partner, align on common problem statements, and pave the way for permitted operation will generate partner interest. Innovation districts are often backed by a combination of public funders, institutional interests, philanthropists, and industry. Recent examples of innovation districts can be found at the AllianceTexas Mobility Innovation Zone in Fort Worth and Washington, DC's recently launched Mobility innovation District in the Southwest Business District.

Research Programs

Mobility hubs can be exciting proving grounds to better understand emerging mobility technologies, travel behavior, mobility needs, civic engagement, public health, and beyond. The opportunities to gain new mobility insights and knowledge can be captured through academic partners including University Transportation Centers (UTCs), campus transportation offices, university professors and researchers, student organizations, and other academic partners. The Dallas-Fort Worth metroplex is home to a wide variety of research programs, including programs and efforts, including the UT Arlington Sustainable Mobility and Resilient Transportation (SMART) Research Lab, UT Dallas North Texas Center for Mobility Technology, and UT Dallas Center for Smart Mobility (COSMO). Additionally, non-profit research organizations interested in relevant topics such as Robert Wood Johnson Foundation and the Knight Foundation can be strategic partners to push forward campus mobility hub goals.

Pilots/Demonstrations

Pilot programs and demonstrations provide an opportunity to test out new ideas to see if they work before committing to fully scaled implementation – a kind of "try before you buy" option. In the campus mobility hub context, pilots can range from testing out mobility hub locations to amenities and technologies. Pilot programs should be paired with an engagement strategy to document how well the pilot is working towards its intention and goal. These pilots can provide an opportunity to build buy-in from potential partners and the community and expand access to funding. Mobility hubs with documented pilot success are also more attractive on grant applications. In additional piloting specific mobility options, like shared micromobility options, campuses can partner with vendors that offer coordinated, modular, and branded mobility hub solutions (see below from the City of Los Angeles' mobility hub program).

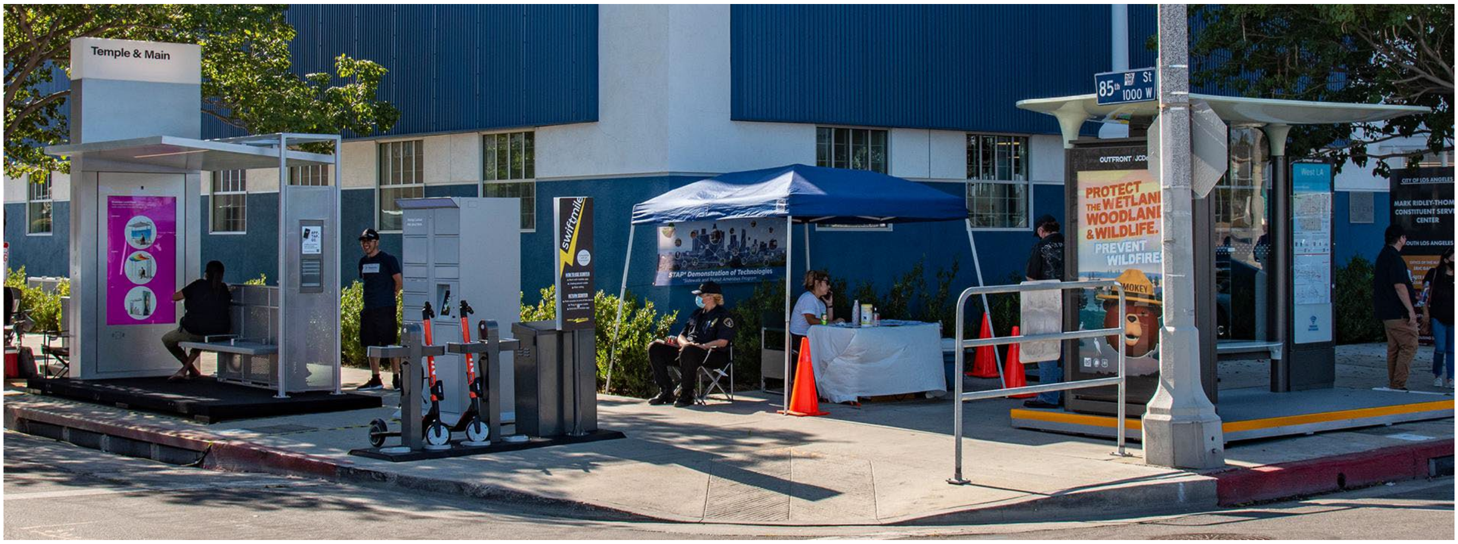


Image from City of Los Angeles

Mobility Consortia

A collection of public and private partners can work together to form a new entity aimed at providing mobility hub services and amenities, and in some cases (like the FTA EPD Pilot Program noted previously), are required for federal funding. For example, a mobility consortium can be developed to invite, encourage, and support private mobility providers to serve first- and last-mile connections to and from mobility hubs and major demand centers with the intention of reducing drive-alone trips. The Mobility Consortium can work to bring together micromobility services and charging stations, microtransit, car share, integrated booking and payments, and data platforms to support public transit reaching to and from campuses.

Transportation Management Association/Organization

A Transportation Management Association (TMA) can be formed as a non-profit organization responsible for coordinating and managing mobility programs and improvements on behalf of local government, private and public employers, and business districts. TMAs can work to centralize and execute the mobility hub's mission to ensure coordinated access and connections across the area's transit and shared mobility services. The TMA's function can be designed to support mobility hub vendor management, operations, maintenance, and ongoing performance measurement in collaboration with the mobility hub's partners. Many of the North Central Texas campuses (such as UNT, UT Arlington, UTD, UNT Dallas, TCU, and SMU, among others) are ideal candidates for a TMA given their robust local economy outside of the campus boundaries. Even smaller campuses have opportunities for TMA partnerships, such as Dallas College - Cedar Valley Campus which is within the Southern Dallas County Inland Port TMA.

05 Policy Opportunities

Opportunities to fund and implement mobility hubs can be made possible by ensuring that plans, policies, and new development at all levels across the DFW region incorporate mobility hub goals and provide the critical policy levers to make implementation possible.

Integrate into Transportation Plans

Mobility hub goals and planning should be incorporated into short-, mid-, and long-term transportation master plans, like NCTCOG's *Mobility 2045*. Each of these plans offer an opportunity to include a mobility hub typology, design guidance, and siting recommendations. Explicitly defining mobility hubs in the regional transportation plan can be the first domino to fall in addressing and supporting mobility hubs across the DFW area. Campus partners should also work to include mobility hub plans into their campus transportation planning documents.

Integrate into Walking and Biking Plans

Connected and comfortable walking and biking facilities are integral to providing access to and from mobility hubs. Similar to general transportation plans, mobility hub locations should be integrated into walking and biking network planning to ensure mobility hub access. Access to mobility hubs can even be used as a priority metric for funding facility improvements.

Consider Mobility Hub Zoning Overlays

Zoning is one of the more powerful tools to support public transportation and mobility hub implementation. A mobility hub zoning overlay is a tool to require through code curb, parking, and transportation demand management priorities within new development requirements. Working in collaboration with city partners, a mobility hub overlay can require specific mobility hub features for new or refitted developments in planned mobility hub locations.

Align with Transit Oriented Development

While not explicitly addressed within current DFW-area Transit Oriented Development plans (such as DART's TOD Policy and Guidelines), mobility hubs are an extension of transit oriented development (TOD) and should be incorporated as such. TOD plans offer the opportunity to plan and design mobility hub amenities tailored to specific neighborhood and station needs and better meet mobility needs.

Build into Transportation Demand Management

Mobility hubs should be considered a key Transportation Demand Management (TDM) tool for the DFW area, as they offer mobility solutions to offset single occupancy vehicle trips. A regional mobility hub program should be incorporated into the Travel Demand Management program offerings at NCTCOG, including integrating into NCTCOG's Try Parking It - Get Rewards for Greener Trips program. In collaboration with other city partners, mobility hub amenities (both physical and programmatic) can be incorporated into TDM requirements for new building and permits.

Appendix A: Benefit-Cost Analysis Benefit and Cost Details

Safety Benefits

Analytical Steps

Dedicated bike lanes separate bicyclists from automobile traffic enhancing the safety of cyclists and leading to a reduction in crashes involving cyclists in the Project area. Safety benefits result from the reduction in the number of predicted annual crashes from the "Build" scenario relative to the "No-Build" scenario. The estimation of these benefits involves the following steps:

- Estimate the number of injured people and fatalities from crashes involving cyclists under the No-Build scenario. This analysis obtained historical crash statistics by KABCO-scale injury within a 1-mile catchment area around the hypothetical new bike lane using TxDOT's CRIS Query tool. This historical data by KABCO-scale injury, summarized in Table A.1, allows for more granular monetization of avoided fatalities and injuries. To forecast the number of crashes under the No-Build over the operating period, it was assumed that the historical number of injured people and fatalities from crashes involving cyclists would remain the same every 10 future years over the 2025-2055 period.

Table A.4 Historical Crashes Involving Cyclist within the 1-Mile Catchment Area Around the New Dedicated Bike Lane, 2012-2021

Injury Severity Scale	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
K - Fatal	0	0	0	0	0	0	0	0	0	0
A - Suspected Serious Injury	1	2	0	3	1	2	1	1	1	0
B - Suspected Minor Injury	3	4	6	4	7	6	4	6	2	6
C - Possible Injury	1	3	3	1	3	3	2	5	0	4
O - Not Injured	0	2	2	1	1	3	3	2	2	2
U - Unknown	0	0	1	0	0	0	0	0	1	0
Total	**5**	**11**	**12**	**9**	**12**	**14**	**10**	**14**	**6**	**12**

Source: TxDOT CRIS Query

- Estimate the reduction in crashes under the Build Scenario. Relevant crash modification factors (CMFs) resulting from the implementation of new bike lanes were obtained from CMF Clearing House. These CMFs are reported from past studies for a variety of parameters. These parameters are reported as a range such as a minimum and maximum vehicle miles traveled, and these ranges help select the most appropriate CMFs for a particular project location. To calculate an appropriate CMF for this Project, this analysis estimated an average CMF based on the CMFs with an appropriate range of travel lanes, estimated VMT, and at least a 3-star quality rating. This yielded an average CMF of 0.646. The CMFs selected applied to all injuries regardless of the severity of the injury, though other, not selected CMFs may only apply to certain injury severities. The reduction in injured people under the Build Scenario over the expected service life (or operating period) was estimated using the formula below. As shown in Table A.2, this leads to 113 fewer injuries over the operating period.

$$\text{Injured People in Build Scenario, Year}_n = \text{Average CMF} \;\; \mathbf{x} \;\; \text{Injured People in No–Build Scenario, Year}_n$$

Table A.5 Build Scenario - Fewer People Injured, 2025-2050

Injury Severity Scale	People Injured under the No-Build Scenario	People Injured under the Build Scenario	Fewer People Injured under the Build Scenario
K - Fatal	0	0	0
A - Suspected Serious Injury	37	24	13
B - Suspected Minor Injury	147	95	52
C - Possible Injury	76	49	27
O - Not Injured	54	35	19
U - Unknown	6	4	2
Total	**320**	**207**	**113**

Source: Cambridge Systematics

- Monetize the safety benefits from fewer people injured under the Build Scenario. The USDOT's Benefit-Cost Analysis Guidance for Discretionary Grant Programs provides the standard rates to monetize the value of reduced fatalities and injuries. Since the historical crashes involving cyclists did not result in fatalities, the monetization rate for fatalities were excluded from the estimation of the safety benefits. These monetization rates shown in Table A.3 were multiplied by the fewer people injured under the Build Scenario over the expected service life (or operating period) of the Project. This step yielded the annual and total safety benefits over the 30-year service life of the Project shown in Table A.4. Overall, the implementation of the dedicated bike lane will save $17.7 million (in undiscounted 2020 dollars) or $6.3 million (in discounted at seven percent) over the operating period in avoided people injured in crashes involving cyclists.

Table A.6 Value of Reduced Fatalities and Injuries

KABCO/Unknown Severity Level	Monetized Value (in 2020$)	Unit
K - Killed	11,600,000	$/person
A - Incapacitating Injury	554,800	$/person
B - Non-Incapacitating Injury	151,100	$/person
C - Possible Injury	77,200	$/person
O - No Injury	3,900	$/person
U - Injured (Severity Unknown)	210,300	$/person

Source: U.S. DOT Benefit-Cost Analysis Guidance for Discretionary Grant Programs, March 2022 (Revised)

Table A.7 Safety Benefits Resulting from the New Dedicated Bike Lane, 2025-2055

Year	A - Suspected Serious Injury	B - Suspected Minor Injury	C - Possible Injury	O - Not Injured	99 - Unknown	Undiscounted Benefits (2020$)	Discounted Benefits at 7%
2025	$196,399	$160,468	$27,329	$0	$0	$384,196	$313,619
2026	$392,798	$213,958	$81,986	$2,761	$0	$691,504	$527,545
2027	$0	$320,936	$81,986	$2,761	$74,446	$480,130	$342,326
2028	$589,198	$213,958	$27,329	$1,381	$0	$831,865	$554,307
2029	$196,399	$374,426	$81,986	$1,381	$0	$654,192	$407,398
2030	$392,798	$320,936	$81,986	$4,142	$0	$799,863	$465,528

Year	A - Suspected Serious Injury	B - Suspected Minor Injury	C - Possible Injury	O - Not Injured	99 - Unknown	Undiscounted Benefits (2020$)	Discounted Benefits at 7%
2031	$196,399	$213,958	$54,658	$4,142	$0	$469,156	$255,190
2032	$196,399	$320,936	$136,644	$2,761	$0	$656,741	$333,854
2033	$196,399	$106,979	$0	$2,761	$74,446	$380,585	$180,813
2034	$0	$320,936	$109,315	$2,761	$0	$433,013	$192,263
2035	$196,399	$160,468	$27,329	$0	$0	$384,196	$159,428
2036	$392,798	$213,958	$81,986	$2,761	$0	$691,504	$268,177
2037	$0	$320,936	$81,986	$2,761	$74,446	$480,130	$174,021
2038	$589,198	$213,958	$27,329	$1,381	$0	$831,865	$281,781
2039	$196,399	$374,426	$81,986	$1,381	$0	$654,192	$207,100
2040	$392,798	$320,936	$81,986	$4,142	$0	$799,863	$236,651
2041	$196,399	$213,958	$54,658	$4,142	$0	$469,156	$129,726
2042	$196,399	$320,936	$136,644	$2,761	$0	$656,741	$169,714
2043	$196,399	$106,979	$0	$2,761	$74,446	$380,585	$91,916
2044	$0	$320,936	$109,315	$2,761	$0	$433,013	$97,737
2045	$196,399	$160,468	$27,329	$0	$0	$384,196	$81,045
2046	$196,399	$160,468	$27,329	$0	$0	$384,196	$75,743
2047	$392,798	$213,958	$81,986	$2,761	$0	$691,504	$127,409
2048	$0	$320,936	$81,986	$2,761	$74,446	$480,130	$82,676
2049	$589,198	$213,958	$27,329	$1,381	$0	$831,865	$133,872
2050	$196,399	$374,426	$81,986	$1,381	$0	$654,192	$98,392
2051	$392,798	$320,936	$81,986	$4,142	$0	$799,863	$112,431
2052	$196,399	$213,958	$54,658	$4,142	$0	$469,156	$61,632
2053	$196,399	$320,936	$136,644	$2,761	$0	$656,741	$80,630
2054	$196,399	$106,979	$0	$2,761	$74,446	$380,585	$43,669
2055	$0	$320,936	$109,315	$2,761	$0	$433,013	$46,434
Total	**$7,266,770**	**$7,862,942**	**$2,076,989**	**$74,552**	**$446,677**	**$17,727,931**	**$6,333,026**

Source: Cambridge Systematics

Data Sources

For the assessment of the safety benefits, the following data sources were used:

- Crash statistics obtained from the TxDOT's CRIS Query tool.
- Crash modification factors (CMFs) obtained from the CMF Clearing House.

Assumptions

To estimate the safety benefits, it was assumed that the historical number of injured people and fatalities from crashes involving cyclists over the 2012-2021 period would remain the same over the next three cycles of 10 years, that is, from 2025 to 2034, from 2035 to 2044, and from 2045 to 2055.

Cycling Journey Quality Benefits

Analytical Steps

Following federal BCA guidelines, the addition of a new cycling facility produces revealed preference benefits for existing and new users of the facility that measure the qualitative difference in ride quality and comfort. The estimation of these benefits involves the following steps:

- Estimate the annual (existing and new) riders for the Baseline (No-Build) and Build scenarios over the expected useful life of the Project. The results of the BNI tool estimations for the Build and No-Build scenarios are shown Table A.5. A tool developed by the North Central Texas Council of Governments (NCTCOG) was used to estimate a Bicycle Needs Index (BNI) at the Traffic Survey Zone (TSZ) level for the study scenarios. These indices are based on demographic forecasts of population, employment, and trip estimations of a certain length using a regional transportation demand model.

  - **Build Scenario** - A BNI was estimated for the Build Scenario assuming the dedicated bike lane was in place. The final BNI for the TSZ was multiplied by the population within a 2-mile catchment area of the dedicated bike lane. This yielded the number of daily bike trips in 2025 and 2035, which was multiplied by 365 to get annual uses of the bike lane. The number of annual bike trips for the years within the Project service life were estimated using a linear projection and assuming a linear growth rate of 7.3 average daily bikers/year.

  - **No-Build Scenario** - The BNI for the No-Build scenario was estimated by multiplying the Build-Scenario BNI by the percentage of zero car households within the 2-mile catchment area of 6.7 percent. This yielded the average daily bike users in 2025 and 2035, which were multiplied by 365 to get annual users of the bike lane. The linear growth rate for the No-Build scenario was 0.5 average daily bikers/year. The number of annual bike users for the years within the Project service life were estimated using a linear projection and assuming a linear growth rate of 0.5 average daily bikers/year.

Table A.8 Dedicated Bike Lane - Build and No-Build User Estimates

Year	No-Build Scenario		Build Scenario	
	Annual Average Daily Bike Users	Annual Bike Trips	Annual Average Daily Bike Users	Annual Bike Trips
2025	92	33,456	1,368	499,343
2026	92	33,634	1,375	502,007
2027	93	33,813	1,383	504,671
2028	93	33,991	1,390	507,334
2029	94	34,170	1,397	509,998
2030	94	34,348	1,405	512,662
2031	95	34,527	1,412	515,326
2032	95	34,705	1,419	517,989
2033	96	34,884	1,426	520,653
2034	96	35,062	1,434	523,317
2035	97	35,241	1,441	525,981

Year	No-Build Scenario		Build Scenario	
	Annual Average Daily Bike Users	Annual Bike Trips	Annual Average Daily Bike Users	Annual Bike Trips
2036	97	35,419	1,448	528,644
2037	98	35,598	1,456	531,308
2038	98	35,776	1,463	533,972
2039	99	35,955	1,470	536,635
2040	99	36,133	1,478	539,299
2041	99	36,312	1,485	541,963
2042	100	36,490	1,492	544,627
2043	100	36,668	1,499	547,290
2044	101	36,847	1,507	549,954
2045	101	37,025	1,514	552,618
2046	102	37,204	1,521	555,282
2047	102	37,382	1,529	557,945
2048	103	37,561	1,536	560,609
2049	103	37,739	1,543	563,273
2050	104	37,918	1,551	565,937
2051	104	38,096	1,558	568,600
2052	105	38,275	1,565	571,264
2053	105	38,453	1,572	573,928
2054	106	38,632	1,580	576,592
2055	106	38,810	1,587	579,255

Source: NCTCOG's BNI Tool for forecast years 2025, 2035

- Monetize the cycling journey quality benefits using the two formulas below. Note that new bike users only generate half the benefit of existing bike users. Existing bike users are estimated from the No-Build scenario, and new users are equal to the difference between the Build and No-Build scenario bike user projections from Table A.5. The revealed preference benefit per cycling mile for dedicated bike lanes is \$1.69 per mile, and the total length of the new dedicated bike lane is 0.29 miles. The benefits for each type of users are added to get the annual and total benefits over the 30-year service life of the Project. As shown in Table A.6, the cycling journey quality benefits of the Project total \$4.4 million (in undiscounted 2020 dollars) or \$1.5 million (in discounted at seven percent).

$$\text{Benefits to Existing Users} = \text{Number of Existing Cyclists} \ \mathbf{x} \ \text{Bike Lane Value per Cycling Mile} \ \mathbf{x} \ \text{Bike Lane Length}$$

$$\text{Benefits to New Users} = \frac{1}{2} \mathbf{x} \ \text{Number of New Cyclists} \ \mathbf{x} \ \text{Bike Lane Value per Cycling Mile} \ \mathbf{x} \ \text{Bike Lane Length}$$

Table A.9 Monetization of Cycle Journey Quality Benefits

Year	Benefits to Existing Users	Benefits to New Users	Undiscounted Benefits (2020\$)	Discounted Benefits at 7%
2025	\$16,397	\$114,166	\$130,562	\$106,578

Year	Benefits to Existing Users	Benefits to New Users	Undiscounted Benefits (2020$)	Discounted Benefits at 7%
2026	$16,484	$114,775	$131,259	$100,137
2027	$16,572	$115,384	$131,955	$94,082
2028	$16,659	$115,993	$132,652	$88,392
2029	$16,747	$116,602	$133,348	$83,043
2030	$16,834	$117,211	$134,045	$78,015
2031	$16,922	$117,820	$134,741	$73,290
2032	$17,009	$118,429	$135,438	$68,850
2033	$17,097	$119,038	$136,134	$64,676
2034	$17,184	$119,647	$136,831	$60,754
2035	$17,271	$120,256	$137,527	$57,069
2036	$17,359	$120,865	$138,224	$53,606
2037	$17,446	$121,474	$138,920	$50,351
2038	$17,534	$122,083	$139,617	$47,293
2039	$17,621	$122,692	$140,313	$44,420
2040	$17,709	$123,301	$141,010	$41,720
2041	$17,796	$123,910	$141,706	$39,183
2042	$17,884	$124,519	$142,403	$36,800
2043	$17,971	$125,128	$143,099	$34,560
2044	$18,059	$125,737	$143,796	$32,457
2045	$18,146	$126,346	$144,492	$30,480
2046	$18,234	$126,955	$145,189	$28,623
2047	$18,321	$127,564	$145,885	$26,879
2048	$18,409	$128,173	$146,582	$25,241
2049	$18,496	$128,782	$147,278	$23,702
2050	$18,583	$129,391	$147,975	$22,256
2051	$18,671	$130,000	$148,671	$20,898
2052	$18,758	$130,609	$149,367	$19,622
2053	$18,846	$131,218	$150,064	$18,424
2054	$18,933	$131,827	$150,760	$17,298
2055	$19,021	$132,436	$151,457	$16,241
Total	**$548,973**	**$3,822,327**	**$4,371,300**	**$1,504,939**

Source: Cambridge Systematics

Data Sources

For the assessment of the cycle journey quality benefits, the bicycling user estimates for the No-Build and Build scenarios were obtained from the NCTCOG's Bicycle and Pedestrian Need Index (BNI/PNI) tool.

Assumptions

To convert average daily users/trips to annual average daily users/trips, it was assumed that cyclists use the facility all 365 days of the year.

Health Benefits

Analytical Steps

Cycling as an active form of transportation imparts health benefits in the form of reduced mortality for new users on a per trip basis. The following steps were used to estimate the health benefits from the new cycling facility.

- Estimate the number of trips being taken by the new users of the dedicated bike lane who switched from non-active transportation modes. This step uses the same number of bike users for the Build and No-Build scenarios estimated using the NCTCOG's BNI/PNI tool shown in Table A.5. It should be noted that the number of bicycle users estimated by this tool represents number of trips.[3] Since this benefit only accrues to new bicycle users who were formerly taking non-active modes such as transit or driving private autos, this analysis assumes that the number of new users of the dedicated bike lane switching from non-active modes to cycling is 50 percent of all new users of the dedicated bike lane. Then, the number of induced active trips was estimated using the formula below. As shown in Table A.7, this estimation yields close to 7.8 million induced active transportation trips over the operating period.

$$\boxed{\text{Induced Cycling Trips} = 50\%\ \mathbf{x}\ (\text{Build Scenario Cyclists} - \text{No Build Cyclists})}$$

[3] Email from NCTCOG on November 23, 2022.

Table A.10 Induced Active Transportation Trips

Year	No Build Annual Trips	Build Annual Trips	Induced active transportation trips
2025	33,456	499,343	232,944
2026	33,634	502,007	234,186
2027	33,813	504,671	235,429
2028	33,991	507,334	236,671
2029	34,170	509,998	237,914
2030	34,348	512,662	239,157
2031	34,527	515,326	240,399
2032	34,705	517,989	241,642
2033	34,884	520,653	242,885
2034	35,062	523,317	244,127
2035	35,241	525,981	245,370
2036	35,419	528,644	246,613
2037	35,598	531,308	247,855
2038	35,776	533,972	249,098
2039	35,955	536,635	250,340
2040	36,133	539,299	251,583
2041	36,312	541,963	252,826
2042	36,490	544,627	254,068
2043	36,668	547,290	255,311
2044	36,847	549,954	256,554
2045	37,025	552,618	257,796
2046	37,204	555,282	259,039
2047	37,382	557,945	260,282
2048	37,561	560,609	261,524
2049	37,739	563,273	262,767
2050	37,918	565,937	264,009
2051	38,096	568,600	265,252
2052	38,275	571,264	266,495
2053	38,453	573,928	267,737
2054	38,453	573,928	267,737
2055	38,453	573,928	267,737
Total	**1,119,589**	**16,710,284**	**7,795,347**

Source: NCTCOG's BNI Tool for forecast years 2025, 2035 & Cambridge Systematics

- Monetize the health benefits from reduced mortality using the monetization rate of $6.31 per cycling induced trip recommended by the U.S.DOT and the formula below. This analysis assumes that all induced cycling trips are made by users within the 20 – 64 age range. This step yielded the annual and total health benefits over the 30-year service life of the Project shown in Table A.8. Overall, the implementation of the dedicated bike lane will generate $49.2 million (in undiscounted 2020 dollars) or $16.9 million (in discounted at seven percent) over the operating period in health benefits.

Health Benefits = # of Induced Cycling Trips **x** % of trips within age range **x** $ per Induced Trip

Table A.11 Monetization of Cycling Health Benefits

Year	Induced Cycling Trips (Trips from New Bicycle Users Switching from Non-Active Transportation Modes	Undiscounted Benefits (2020$)	Discounted Benefits at 7%
2025	232,944	$1,469,874	$1,199,855
2026	234,186	$1,477,715	$1,127,342
2027	235,429	$1,485,556	$1,059,181
2028	236,671	$1,493,397	$995,113
2029	237,914	$1,501,238	$934,896
2030	239,157	$1,509,079	$878,298
2031	240,399	$1,516,920	$825,104
2032	241,642	$1,524,761	$775,111
2033	242,885	$1,532,602	$728,128
2034	244,127	$1,540,443	$683,975
2035	245,370	$1,548,284	$642,483
2036	246,613	$1,556,125	$603,492
2037	247,855	$1,563,966	$566,853
2038	249,098	$1,571,807	$532,425
2039	250,340	$1,579,648	$500,076
2040	251,583	$1,587,489	$469,681
2041	252,826	$1,595,330	$441,122
2042	254,068	$1,603,171	$414,290
2043	255,311	$1,611,012	$389,081
2044	256,554	$1,618,853	$365,396
2045	257,796	$1,626,694	$343,146
2046	259,039	$1,634,535	$322,243
2047	260,282	$1,642,376	$302,606
2048	261,524	$1,650,217	$284,160
2049	262,767	$1,658,058	$266,832
2050	264,009	$1,665,899	$250,555
2051	265,252	$1,673,740	$235,266
2052	266,495	$1,681,581	$220,905
2053	267,737	$1,689,422	$207,415
2054	267,737	$1,689,422	$193,846
2055	267,737	$1,689,422	$181,165
Total	**7,795,347**	**$49,188,642**	**$16,940,042**

Source: Cambridge Systematics Analysis

Data Sources

For the assessment of the cycle journey quality benefits, the bicycling user estimates for the No-Build and Build scenarios were obtained from the NCTCOG's Bicycle and Pedestrian Need Index (BNI/PNI) tool.

Assumptions

To estimate the safety benefits, the following assumptions were made:

- The number of new users of the dedicated bike lane switching from non-active modes to cycling is 50 percent of all new users of the dedicated bike lane.
- All induced cycling trips are made by users within the 20 – 64 age range

Total Public Benefits

Table A.9 summarizes the public benefits to be generated by the Project over its expected useful life. The Project is expected to yield $71.3 million (in undiscounted 2020 dollars) or $24.8 million (in discounted at seven percent) in public benefits over its 30-year service life.

Table A.12 Project Long-Term Public Benefits, 2025-2055

Benefit Category	Undiscounted Benefits (2020$)	Discounted Benefits at 7%
Bicycle Safety Benefits	$17,727,931	$6,333,026
Cycling Journey Quality Benefits	$4,371,300	$1,504,939
Health Benefits	$49,188,642	$16,940,042
Total Benefits	**$71,287,873**	**$24,778,006**

Source: Cambridge Systematics

Transit Mobility Hub Costs

Estimated Capital Costs

Table A.10 summarizes the Project schedule and capital costs. The Project capital costs are primarily associated with the construction costs to build the mobility hub and the 0.29-mile dedicated bike lane, and the cost of five e-cargo bikes. The total Project capital cost is estimated at $5,090,000 (in 2021$). This cost was deflated from 2021 to 2020 using the Consumer Price Index (CPI) for all urban consumers (CPI-U) from the Bureau of Labor Statistics (BLS) in these two years.

Table A.13 Project Schedule and Capital Costs

Item	Value
Estimated Construction Start Year	2023
Estimated Construction End Year	2024
Construction Duration (in years)	2
Estimated Project Opening Year	2025
Mobility Hub Construction Cost (in 2021$) = (a)	$5,000,000
Dedicated Bike Lane Construction Cost (in 2021$) = (b)	$65,000
Total Cost of Five E-Cargo Bikes ($25,000 every five years) (in 2021$) = (c)	$175,000
Total Capital Cost (in 2021$) = (a) + (b) + (c) = (d)	**$5,240,000**

Item	Value
Total Capital Cost (in 2020$) = (d) x CPI-U$_{2020}$ / CPI-U$_{2021}$	**$5,004,870**

Source: Nelson\Nygaard and Cambridge Systematics

Estimated Operations and Maintenance Costs

Table A.11 shows the annual Project operations and maintenance (O&M) costs which includes the cost of labor and materials associated with the daily operations and normal repairs of the mobility hub, the dedicated bike lane and the e-bikes, and other activities needed to preserve the hub so that it continues to provide acceptable services and achieves its expected service life. The total annual Project O&M cost is estimated at $214,240 (in 2021 dollars). This cost was deflated from 2021 to 2020 using the Consumer Price Index (CPI) for all urban consumers (CPI-U) from the Bureau of Labor Statistics (BLS) in these two years.

Table A.14 Project Annual Operations and Maintenance Costs

Campus Mobility Hub - Labor	Value
Full-Time Employees (maintenance/clean up, ambassador duties, and site management)	1.5
Average Annual Salary (in 2021$)	$90,000
Annual Labor Cost (in 2021$) = (a)	**$135,000**
Campus Mobility Hub - Labor	**Value**
Replacement signs, maintenance/cleaning materials, materials for events/activation	$50,000
Programming, Marketing, and Communications	$25,000
Annual Material Cost (in 2021$) = (b)	**$75,000**
Dedicated Bike Lane Along the Union Circle Roadway	**Value**
Bike Lane-miles = (c)	0.29
Annual pavement marking maintenance cost per mile (in 2021$) = (d)	$6,000
Annual maintenance cost of five e-cargo bikes (in 2021$) = (e)	$2,500
Annual Maintenance Cost (in 2021$) = [(c) x (d)] + (e) = (f)	**$4,240**
Total Annual Operations and Maintenance (O&M) Costs	**Value**
Total Annual O&M Costs (in 2021$) = (a) + (b) + (f) = (g)	**$214,240**
Total Annual O&M Costs (in 2020$) = (g) x CPI-U$_{2020}$ / CPI-U$_{2021}$	**$204,627**

Source: Nelson\Nygaard and Cambridge Systematics Analysis

Project Life Cycle Costs Analysis

Table A.12 summarizes the life cycle costs associated with the Project, including capital and O&M costs. The Project capital costs are expected to total $4,862,000 (in undiscounted 2020 dollars) or $4,395,292 (in discounted at 7 percent) over the 2-year project implementation period. The total O&M expenditures are expected to total $6,386,000 (in undiscounted 2020 dollars) or $2,254,829 (in discounted at 7 percent) over the 30-year service life of the Project.

Table A.15 Project Life Cycle Costs

Year	Capital Cost (Undiscounted 2020$)	Capital Cost (Discounted at 7%)	O&M Cost (Undiscounted 2020$)	O&M Cost (Discounted at 7%)
2023	$2,418,861	$2,260,618	$0	$0

Year	Capital Cost (Undiscounted 2020$)	Capital Cost (Discounted at 7%)	O&M Cost (Undiscounted 2020$)	O&M Cost (Discounted at 7%)
2024	$2,418,861	$2,112,727	$0	$0
2025	$23,878	$19,492	$204,627	$167,036
2026	$0	$0	$204,627	$156,109
2027	$0	$0	$204,627	$145,896
2028	$0	$0	$204,627	$136,351
2029	$0	$0	$204,627	$127,431
2030	$23,878	$13,897	$204,627	$119,095
2031	$0	$0	$204,627	$111,303
2032	$0	$0	$204,627	$104,022
2033	$0	$0	$204,627	$97,217
2034	$0	$0	$204,627	$90,857
2035	$23,878	$9,909	$204,627	$84,913
2036	$0	$0	$204,627	$79,358
2037	$0	$0	$204,627	$74,166
2038	$0	$0	$204,627	$69,314
2039	$0	$0	$204,627	$64,780
2040	$23,878	$7,065	$204,627	$60,542
2041	$0	$0	$204,627	$56,581
2042	$0	$0	$204,627	$52,879
2043	$0	$0	$204,627	$49,420
2044	$0	$0	$204,627	$46,187
2045	$23,878	$5,037	$204,627	$43,165
2046	$0	$0	$204,627	$40,341
2047	$0	$0	$204,627	$37,702
2048	$0	$0	$204,627	$35,236
2049	$0	$0	$204,627	$32,931
2050	$23,878	$3,591	$204,627	$30,776
2051	$0	$0	$204,627	$28,763
2052	$0	$0	$204,627	$26,881
2053	$0	$0	$204,627	$25,123
2054	$0	$0	$204,627	$23,479
2055	$23,878	$2,561	$204,627	$21,943
TOTAL	**$5,004,870**	**$6,343,424**	**$6,343,424**	**$11,348,295**

Source: Cambridge Systematics

Appendix B: Additional Benefits from Auto Users Switching to Transit

Congestion Relief Benefits

Analytical Steps

In the future, the campus mobility hubs would include improvements to transit serving the UNT campus and the proposed hub. These improvements have the potential for switching auto users to transit. Riders who choose to use transit instead of other motorized modes will contribute to reduced congestion and improved mobility in the NCTCOG region. Reduced congestion on roadways would lead to reduced travel times and costs associated with delays for residents, visitors, and businesses and reduced vehicle operating costs. Congestion relief benefits result from the reduction in the number of auto vehicle-miles traveled and auto vehicle hours of delay in the "Build" scenario relative to the "No-Build" scenario. The estimation of these benefits involves the following steps:

- Obtain the annual auto vehicle-miles traveled and vehicle hours of delay for the "Build" and "No-Build" scenarios by trip purpose (commute, business, and personal trips) over the 2025-2055 analysis period. Auto commute trips refers to trips made for the purpose of going to or returning from work, business trips refers to work-related trips such as conference/meeting travel or any other business travel purpose excluding daily commutes, and personal trips refers to non-work and non-business trips such as leisure, medical visits, school, shopping and banking trips.
- Estimate the savings in travel delay as the product of the value of travel time by trip purpose (shown in Table B.1), the average auto occupancy for all travel (shown in Table B.2), and the corresponding changes in auto vehicle hours of delay between the "Build" scenario and the "No-Build" scenario over the 2025-2055 analysis period. This step can be refined by replacing the average auto occupancy rate for all travel recommended by the USDOT with the average auto occupancy by trip purpose in the NCTCOG region.
- Estimate the savings in vehicle operating costs as the product of the average vehicle operating cost per mile for autos (shown in Table B.3) and the corresponding changes in auto vehicle-miles traveled between the "Build" scenario and the "No-Build" scenario over the 2025-2055 analysis period. The average auto vehicle operating cost per mile recommended by the USDOT assumes an average of 15,000 miles driven per year and includes fuel, maintenance, tires, and depreciation costs. This marginal cost excludes the auto ownership costs that are fixed or transfers such as auto insurance, license, registration, taxes and financing fees.
- Estimate the total annual congestion relief benefits by adding up the annual savings in travel delays and vehicle operating costs over the 2025-2055 analysis period. This yields the benefits in 2020 dollars. To account for the time value of money, discount the benefits in 2020 dollars using a real discount rate of 7 percent as recommended in the USDOT guidance.

Table B.1 Value of Travel Time Savings

Trip Purpose	Monetized Value (in 2020$)	Unit
Commute Trips	$16.2	$/person-hour
Business Trips	$29.4	$/person-hour
Personal Trips	$16.2	$/person-hour

Source: U.S. DOT Benefit-Cost Analysis Guidance for Discretionary Grant Programs, March 2022 (Revised)

Table B.2 Average Vehicle Occupancy

Vehicle Type	Monetized Value (in 2020$)	Unit
Passenger Vehicles, All Travel	1.67	Passengers per vehicle

Source: U.S. DOT Benefit-Cost Analysis Guidance for Discretionary Grant Programs, March 2022 (Revised)

Table B.3 Average Vehicle Operating Costs

Vehicle Type	Monetized Value (in 2020$)	Unit
Passenger Vehicles	$0.45	$ per vehicle-miles traveled

Source: U.S. DOT Benefit-Cost Analysis Guidance for Discretionary Grant Programs, March 2022 (Revised)

Data Sources

For the assessment of the congestion relief benefits, which assumes auto users switching to transit and reducing auto trips & vehicle miles traveled, the following data sources are recommended:

- Outputs of the NCTCOG regional travel demand model to estimate the average annual auto vehicle hours of delay by trip purpose and the average annual auto vehicle-miles traveled over the 2025-2055 analysis period for the “Build” and “No-Build” scenarios.
- NCTCOG regional travel demand model to obtain average vehicle occupancy by trip purpose in the NCTCOG region.

Environmental Sustainability Benefits

Analytical Steps

Shifting riders from personal vehicles to transit would yield positive societal value through reduced air pollution, energy conservation and contributions to combatting climate change. Reducing low-occupancy automobile travel is an important way to reduce air pollutants generated by vehicular emissions, which are health hazards. Vehicular major pollutants include Carbon Dioxide (CO_2), Nitrogen Oxides (NOx), Sulfur Oxides (SOx), and Particular Matter ($PM_{2.5}$). In presence of oxygen, CO oxidizes to carbon dioxide (CO_2), the most prominent greenhouse gas (GHG). High quality transit travel emits less of these gases than automobile travel due to efficiencies of scale.

The estimation of reduced air pollution involves the following steps:

- Auto Travel - Estimate the average annual auto travel speeds for the “Build” scenario (and the “No-Build” scenario) over the 2025-2055 analysis period by dividing the average annual auto vehicle-miles traveled by the average auto vehicle-hours traveled in the “Build” scenario (and the “No-Build” scenario).
- Auto Travel - Collect the average annual running emission rates of major pollutants emitted by autos (i.e., CO_2, NOx, SOx and $PM_{2.5}$) as a function of average annual auto travel speeds. These running emission rates (in grams per auto vehicle miles traveled) are available in the California Life-Cycle Benefit/Cost (Cal-B/C) modules for federal discretionary grants in 2024 and 2044. For each major pollutant, use the running emission rates in 2024 and 2044 to calculate the average annual rate of change between these two years and apply this rate to estimate the annual emission rates for the intermittent years between 2024 and 2044. Since the Cal-B/C model does not provide emission rates for future years after 2044, it can be assumed that the emission rates in 2044 represent the emission rates over the 2045-2055 period. This is a conservative assumption since air pollutants emitted by autos are expected to continue to decline over time as the number of new electric vehicles sold continues to grow and the auto industry continues to look for new ways to reduce emissions from internal combustion engine vehicles by deploying lower-emission energy solutions such as advanced biofuels and eFuels.

- Auto Travel - Estimate the air pollutants (in grams) emitted by autos by multiplying the average annual running emission rates of major pollutants (in grams per auto vehicle miles traveled) by the average annual auto vehicle miles traveled in the "Build" scenario and the "No-Build" scenario over the 2025-2055 analysis period. Convert the air pollutants associated with each scenario from grams to metric tons (one metric ton equals to 1,000,000 grams). Estimate the savings in air pollutants (in metric tons) by subtracting the air pollutants in the "Build" scenario from the air pollutants in the "No-Build" scenario over the 2025-2055 analysis period.
- Auto Travel - Monetize the annual savings in air pollutants associated with reduced auto travel over the 2025-2055 analysis period by multiplying the results of the previous step by the unit damage costs of emissions for major pollutants shown in Table B.4. This yields the annual benefits in 2020 dollars. To account for the time value of money, discount the savings in 2020 dollars using a real discount rate of 7 percent for NOx, SOx and $PM_{2.5}$ and 3 percent for CO_2 as recommended in the USDOT guidance.
- Transit Travel - Collect the emission rates for major pollutants associated with the transit mode(s) providing the additional services at the UNT campus and the proposed hub. Estimate the average annual transit vehicles-miles traveled by the additional transit services in the "Build" scenario over the 2025-2055 analysis period. Estimate the average annual air pollutants (in grams) emitted by transit by multiplying the emission rates for major pollutants (in grams per transit vehicle miles traveled) by the average annual transit vehicles-miles traveled. Convert the average annual air pollutants from grams to metric tons. Monetize the air pollutants associated with the additional transit services under the "Build" scenario over the 2025-2055 analysis period by multiplying the average annual air pollutants (in metric tons) by the unit damage costs of emissions for major pollutants shown in Table B.4. This yields the annual emission costs in 2020 dollars. To account for the time value of money, discount the costs in 2020 dollars using a real discount rate of 7 percent for major pollutants other than CO_2 and 3 percent for CO_2 as recommended in the USDOT guidance.
- Estimate the net savings in air pollutants by subtracting the emission costs generated by the additional transit services from the savings in air pollutants associated with reduced auto travel.

Table B.4 Damage Costs of Emissions for Major Pollutants

Year	CO_2 Monetized Value (in 2020$)	NOx Monetized Value (in 2020$)	SOx Monetized Value (in 2020$)	$PM_{2.5}$ Monetized Value (in 2020$)
2025	$56	$16,500	$44,900	$801,700
2026	$57	$16,800	$45,700	$814,500
2027	$58	$17,100	$46,500	$827,400
2028	$60	$17,400	$47,300	$840,600
2029	$61	$17,700	$48,200	$854,000
2030	$62	$18,100	$49,100	$867,600
2031	$63	$18,100	$49,100	$867,600
2032	$64	$18,100	$49,100	$867,600
2033	$65	$18,100	$49,100	$867,600
2034	$66	$18,100	$49,100	$867,600
2035	$67	$18,100	$49,100	$867,600
2036	$69	$18,100	$49,100	$867,600
2037	$70	$18,100	$49,100	$867,600

Year	CO_2 Monetized Value (in 2020$)	NOx Monetized Value (in 2020$)	SOx Monetized Value (in 2020$)	$PM_{2.5}$ Monetized Value (in 2020$)
2038	$72	$18,100	$49,100	$867,600
2039	$72	$18,100	$49,100	$867,600
2040	$73	$18,100	$49,100	$867,600
2041	$74	$18,100	$49,100	$867,600
2042	$75	$18,100	$49,100	$867,600
2043	$77	$18,100	$49,100	$867,600
2044	$78	$18,100	$49,100	$867,600
2045	$79	$18,100	$49,100	$867,600
2046	$80	$18,100	$49,100	$867,600
2047	$81	$18,100	$49,100	$867,600
2048	$82	$18,100	$49,100	$867,600
2049	$83	$18,100	$49,100	$867,600
2050	$85	$18,100	$49,100	$867,600
2051	$85	$18,100	$49,100	$867,600
2052	$85	$18,100	$49,100	$867,600
2053	$85	$18,100	$49,100	$867,600
2054	$85	$18,100	$49,100	$867,600
2055	$85	$18,100	$49,100	$867,600

Source: U.S. DOT Benefit-Cost Analysis Guidance for Discretionary Grant Programs, March 2022 (Revised).

The estimation of reduced fuel consumption involves the following steps:

- Auto Travel - Estimate the average annual auto travel speeds for the "Build" scenario (and the "No-Build" scenario) over the 2025-2055 analysis period by dividing the average annual auto vehicle-miles traveled by the average auto vehicle-hours traveled in the "Build" scenario (and the "No-Build" scenario).
- Auto Travel - Collect the average annual fuel consumption rates for autos as a function of average annual auto travel speeds. These fuel consumption rates (in gallons per auto vehicle miles traveled) are available in the Cal-B/C modules for federal discretionary grants and represent the average rates in 2021, 2024 and 2044. It can be assumed that these rates represent the annual fuel consumption rates over the 2025-2055 analysis period. This is a conservative assumption since the deployment of lower-emission energy solutions being led by the public and private sectors will enable autos to use less fuel per miles traveled in future years.
- Auto Travel - Estimate the annual gallons of fuel consumed by autos by multiplying the auto vehicle-miles traveled by the average annual fuel consumption rate (in gallons per auto vehicle miles traveled) in the "Build" scenario and the No-Build" scenario over the 2025-2055 analysis period. Estimate the gallons of fuel saved annually by subtracting the annual gallons of fuel consumed in the "Build" scenario from the annual gallons of fuel consumed in the "No-Build" scenario.
- Auto Travel - Obtain the average annual retail gasoline price (in $/gallons) in Texas in 2020.
- Auto Travel - Monetize the annual gallons of fuel saved over the 2025-2055 analysis period by multiplying the average annual number of gallons of fuel saved by the average annual retail gasoline price (in $/gallons) in Texas. This yields the annual savings in 2020 dollars. To account for the time value of money, discount

the fuel savings in 2020 dollars using a real discount rate of 7 percent as recommended in the USDOT guidance.

- Transit Travel - Collect the average annual fuel consumption rates associated with the transit mode(s) providing the additional transit services at the UNT campus and the proposed hub. Estimate the average annual transit vehicles-miles traveled by the additional transit services in the "Build" scenario over the 2025-2055 analysis period. Estimate the average annual gallons of fuel consumed by transit by multiplying the fuel consumption rates (in gallons per transit vehicle miles traveled) by the average annual transit vehicles-miles traveled. Monetize the annual gallons of fuel used by the additional transit services over the 2025-2055 analysis period by multiplying the average annual gallons of fuel consumed by the average annual fuel price (in $/gallons) in Texas in 2020. This yields the annual fuel costs in 2020 dollars. To account for the time value of money, discount the fuel costs in 2020 dollars using a real discount rate of 7 percent as recommended in the USDOT guidance.
- Estimate the net savings in fuel consumption by subtracting the fuel cost associated with the additional transit services from the savings in fuel cost associated with reduced auto travel.

Data Sources

For the assessment of the environmental sustainability benefits, which assumes auto users switching to transit and reducing auto trips & vehicle miles traveled, the following data sources are recommended:

- Outputs of the NCTCOG regional travel demand model to estimate average annual auto vehicle-miles traveled, vehicle-hours traveled, and average annual auto travel speeds over the 2025-2055 analysis period for the "Build" and "No-Build" scenarios.
- The Cal-B/C modules for federal discretionary grants[4] to obtain the average annual running emission rates of major pollutants emitted by autos (i.e., CO_2, NOx, SOx and $PM_{2.5}$) as a function of average annual auto travel speeds in 2024 and 2044.
- The Cal-B/C modules for federal discretionary grants[5] to obtain the average fuel consumption rates for autos as a function of average annual auto travel speeds in 2021, 2024 and 2044.
- Average annual retail gasoline price (in $/gallons) in Texas in 2020 from the U.S. Energy Administration (EIA).[6]

Increased/Affordable Mobility Benefits

Analytical Steps

In the future, the campus mobility hubs would include improvements to transit serving the UNT campus and the proposed hub. These improvements have the potential for reducing accessibility barriers to education, particularly important for low-income and disadvantaged students who have to drive to campus and pay parking fees and spend money on vehicle ownership and operating costs. The estimation of these benefits involves the following steps:

- Auto Travel - Estimate the number of low-income and disadvantaged students that currently drive to the UNT campus and would switch to transit because of the improved transit services at the UNT campus and the proposed hub.

[4] Caltrans. The California Life-Cycle Benefit/Cost Analysis (Cal-B/C) modules for federal discretionary grants. Available at Transportation Economics | Caltrans.

[5] Caltrans. The California Life-Cycle Benefit/Cost Analysis (Cal-B/C) modules for federal discretionary grants. Available at Transportation Economics | Caltrans.

[6] U.S. Energy Administration (EIA). Available at Retail Prices for Gasoline, All Grades (eia.gov).

- Auto Travel - Estimate the average annual driving costs per low-income/disadvantaged student that currently drives to the UNT campus in 2020 dollars. Annual driving costs should include vehicle operating costs, ownership costs, parking fees, and any other related transportation expenses. Vehicle operating costs comprise fuel and regular maintenance costs (e.g., oil and fluid changes, tire rotations, tire replacements, and wiper replacement). Vehicle ownership costs include full-coverage insurance, fees (license, registration, and taxes), depreciation, and financing charges to owners of autos.
- Auto Travel - Multiply the number of low-income and disadvantaged students that currently drive to the UNT campus and would switch to transit because of the improved transit services at the UNT campus and the proposed hub by the average annual driving costs per student estimated in the previous step. This yields the total average annual driving costs incurred by these low-income/disadvantaged students.
- Auto Travel - Project the average annual driving costs of low-income/disadvantaged students today over the 2025-2055 analysis period by assuming these costs would increase by one percent annually. This rate of increase corresponds to the average annual increase in auto ownership and vehicle operating costs from 2011 to 2021 provided by AAA assuming an average of 15,000 miles driven per year. This step yields the annual driving costs in 2020 dollars. To account for the time value of money, discount the costs in 2020 dollars using a real discount rate of 7 percent as recommended in the USDOT guidance.
- Transit Travel - Collect the average transit fares per passenger associated with the improved transit services at the UNT campus and the proposed hub over the 2025-2055 analysis period.
- Transit Travel - Multiply the average transit fare per passenger by the annual number of low-income and disadvantaged students that would switch to transit because of the improved transit services at the UNT campus and the proposed hub. This yields the total average annual transportation costs of low-income/disadvantaged students riding transit over the 2025-2055 analysis period in 2020 dollars. To account for the time value of money, discount these costs in 2020 dollars using a real discount rate of 7 percent as recommended in the USDOT guidance.
- Estimate the net savings in transportation costs to be realized by low-income and disadvantaged students switching from auto to transit by subtracting the transit fares paid by these students from the driving costs they would incur by driving to the UTN campus.

Data Sources

For the assessment of the increased/affordable mobility benefits, which assumes low-income and disadvantaged students switching to transit because of the improved transit services at the UNT campus and the proposed hub, the following data sources are recommended:

- Socio-demographic and economic characteristics of UNT students to estimate the number of low-income and disadvantaged students that currently drive to the UNT campus.
- Annual vehicle operating costs and ownership costs (per vehicle-miles traveled or per year) provided by AAA.[7]
- Annual student parking fees at UNT campus.

State of Good Repair of the Roadway Infrastructure

Analytical Steps

In the future, the campus mobility hubs would include improvements to transit serving the UNT campus and the proposed hub. These improvements have the potential for switching auto users to transit. As more auto users

[7] AAA's Your Driving Costs. Available at AAA's Your Driving Costs – AAA Exchange

shifts to transit, reducing roadway travel, the annual cost of maintaining the highway system in a state of good repair is reduced. The quantification of these benefits typically focusses on pavement maintenance costs. Changes in VMT, whether increasing or decreasing, impact the condition of pavements over time. A decrease in VMT would lead to improved pavement conditions by reducing the wear and tear caused by automobiles. In contrast, an increase in VMT would lead to increased pavement maintenance costs.

. The estimation of these benefits involves the following steps:

- Collect the marginal unit cost unit cost (in $ per vehicle-miles traveled) associated with pavement maintenance due to auto travel and transit travel provided by the USDOT in 2000 dollars. Use the Consumer Price Index (CPI) to inflate the marginal pavement costs from 2000 to 2020.
- Auto Travel - Multiply the changes in auto vehicle-miles traveled between the “Build” scenario and the “No-Build” scenario over the 2025-2055 analysis period by the marginal unit cost associated with pavement maintenance due to auto travel. This yields the annual pavement maintenance costs in 2020 dollars. To account for the time value of money, discount the costs in 2020 dollars using a real discount rate of 7 percent as recommended in the USDOT guidance.
- Transit Travel - Multiply the transit vehicle-miles traveled associated with the additional transit services at the UNT campus and the proposed hub under the “Build” scenario over the 2025-2055 analysis period by the marginal unit cost associated with pavement maintenance due to transit travel in 2020 dollars. To account for the time value of money, discount the costs in 2020 dollars using a real discount rate of 7 percent as recommended in the USDOT guidance.
- Estimate the net pavement maintenance cost savings by subtracting the pavement maintenance costs associated with transit travel from the pavement maintenance cost associated with auto travel.

Data Sources

For the assessment of the state of good repair of the roadway infrastructure, which assumes auto users switching to transit and reducing auto trips & vehicle miles traveled, the following data sources are recommended:

- The marginal pavement costs by vehicle class (in 2000$ per vehicle-miles traveled) provided by the U.S. Department of Transportation (US DOT), 1997 Federal Highway Cost Allocation Study, Final Report, Table V-26, 2000 Marginal Pavement, Congestion, Crash and Noise Costs for Illustrative Vehicles Under Specific Conditions[8] that most closely correspond to the different vehicles (passenger cars and transit) and roadway types (urban roadways).
- Consumer Price Index (CPI) for all urban consumers (CPI-U) from the Bureau of Labor Statistics (BLS) in to inflate the marginal pavement costs from 2000 to 2020.

[8] Available at http://www.fhwa.dot.gov/policy/hcas/final/five.cfm,