U.S. Department of Transportation, Climate Change Center
Climate Strategies that Work

TRANSIT ORIENTED DEVELOPMENT (TOD)

Transit-oriented development connects neighborhoods and communities with equitable and accessible public transit and multimodal transportation options, reducing trip distances, vehicle miles traveled, and associated greenhouse gas emissions.

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OVERVIEW

Best Suited for:
Long Term & Short Term
Urban, Suburban

Supporting mixed-use development, including affordable housing, near transit can **reduce trip distances and make public transportation more convenient**. Transit oriented development (TOD) is usually defined as development within a half mile of transit. TOD can also make accessing common destinations and public services like grocery stores, schools, and libraries easier. In a suburban context, co-development of increased housing density and transit stations with active transportation infrastructure offers **a way for commuters to reach their destinations without needing to rely on personal vehicles**. In rural town centers, TOD could involve constructing housing adjacent to intercity rail or intercity bus terminals.

Transit oriented development **reduces dependence on cars, eliminates costs of car ownership, and encourages use of public transit, walking, and biking**. Transit oriented development may also **reduce traffic congestion** by supporting full mode choice and an increased sense of community.

Did you know?

At the project scale (no greater than a census tract), TOD has the potential to reduce GHG emissions by 31% (CAPCOA, 2021).

Creating new transit-oriented housing and development **involves long term planning** at the city or local government level, and is often supported by comprehensive urban development, land use, and transportation plans. Supply and diversity of land use and local zoning regulations are important elements of planning and implementation of TOD. Mixed-use development, for example, includes commercial spaces, which require **alignment with zoning policies, supportive market conditions, and private sector collaboration** in order to be financially viable. Housing demand, affordable housing requirements, neighborhood effects, and accessibility are additional considerations.

Homes in walkable and transit-accessible areas are extremely desirable, and insufficient supply generally leads to higher prices for these homes. Increasing the amount of development near transit **enables lower housing costs and makes more convenient transit service available for residents of all incomes**. Pairing TOD with a diverse mix of housing and infill development can also help **avoid displacement** of existing residents and allow them to access the same economic benefits.

Increased housing demand, increased cost of living, lack of housing production, and other market factors can lead to increases in property values with TOD. **Equitable transit-oriented development (ETOD)** is an approach to address these outcomes, **through the inclusion of affordable housing near transit to make public transportation more accessible and available for all users within a community.** ETOD also involves addressing additional discriminatory impacts, prioritizing community involvement, and ensuring inclusion of underserved groups in decision making processes. ETOD aims for transit to be relevant and beneficial to all people within a community, regardless of income or other factors.

> The U.S. Department of Transportation (USDOT) released a Policy Statement on TOD that encourages TOD projects to consider public benefit provisions such as anti-displacement strategies and increased supply of affordable housing. The policy statement provides project developers with guidance on strategies to ensure equitable housing practices for TOD, and compliance could be used in the future as a condition for certain discretionary funding programs.

GREENHOUSE GAS REDUCTION POTENTIAL

This section provides an overview of greenhouse gas (GHG) emission reductions associated with the strategy. It highlights key findings and relevant metrics from GHG modeling resources, peer-reviewed studies, and real-world applications.

GHG BENEFITS OF COMPACT DEVELOPMENT

Sites with high walkability, mixed uses, and high-frequency transit service have lower emissions compared with less accessible sites (CSG, 2020).

At the project scale (no greater than a census tract), analysis done by the California Air Pollution Control Officers Association found that TOD has up to a 31% GHG emissions reduction potential. The analysis assumed that TOD sites were within a 10-minute walk of a high-frequency transit station and a 4.9 ratio of transit mode share compared to existing transit mode share in the surrounding city (CAPCOA, 2021).

An RMI analysis using 2023 data shows that enacting state-level land use reform to encourage compact development can reduce annual CO_2-equivalent emissions by 70 million tons in 2033. About one half of this reduction would come from reduced travel, a third from reduced vehicle manufacturing and upstream fossil fuel production, and the remainder from preservation of natural carbon sinks that would otherwise be lost to urban sprawl and use of more efficient, lower-carbon building materials (Korn et al., 2024).

> TOD can be implemented on a variety of scales, from an office park to single neighborhood to an entire town or city center. In Alexandria, VA, the Braddock Metro Neighborhood Plan focused on better integrating the Braddock Road metro station into the neighborhood through improved pedestrian connectivity and mixed-use redevelopment. Analysis by the Coalition for Smarter Growth found that implementing the plan resulted in a 27.1% reduction in CO_2 emissions compared with a nearby non-TOD area (CSG, 2020; City of Alexandria, 2008).

The largest opportunity for GHG reduction is in states with the most severe housing shortages and largest anticipated population growth. For example, in Texas, Colorado, and North Dakota, land use reforms could reduce statewide vehicle miles

traveled (VMT) per capita by up to 9%, or between 400 and 800 kg of CO_2 per capita annually (Korn et al., 2024).

Smart growth strategies, including TOD, typically reduce energy consumption and emissions by 10% to 60%, particularly if integrated with complementary strategies like vehicle electrification (Litman, 2024d).

COMPACT, MIXED-USE DEVELOPMENT CAN REDUCE CAR RELIANCE

GHG emissions and vehicle miles traveled (VMT) are interconnected and one of the most effective ways to reduce VMT is by building transit-oriented communities. In the U.S., a recent survey found that transit-oriented communities averaged 17 to 25.5 VMT and 16-25 lbs. of daily CO_2 emissions per household, compared with 45 VMT and about 70 lbs. of daily CO_2 emissions for non-TOD communities (CSG, 2020).

A review of studies looking at the link between transit proximity and driving found VMT reductions ranging from 3.0 to 9.0 VMT per passenger mile (Ali et al., 2021). Doubling density has been shown to reduce vehicle travel from 5% up to about 20% (Litman, 2024d).

When determining parking volumes for a property, many developers reference the guidelines for vehicle trip generation and parking volumes provided by the Institute of Transportation Engineers (ITE) Trip Generation Manual and ITE Parking Generation Manual. However, these manuals were created using data from suburban areas with little access to transit, so they tend to overestimate the trip and parking generation at TODs, where residents have more mode choice (Ewing et al., 2017; Ewing et al., 2018). A study of trip generation rates across 17 TODs determined that, on average, the A.M. peak hour vehicle trip generation rate for TODs is only 51.3% of the rate estimated by ITE (Arrington & Cervero, 2008). Additional case studies of specific TODs revealed trip generation rates that are 34.7% to 69.8% of the ITE rate (Ewing et al., 2017; Ewing et al., 2018).

An analysis of FHWA data on urbanized areas (FHWA, 2018) demonstrates the inverse relationship between per capita VMT and population density. The largest decline in per capita VMT results from going from low density (less than 2,000 residents per square mile) to moderate density (more than 4,000 residents per square mile) (Litman, 2024d).

Residents of TODs typically own 20-60% fewer vehicles, driver 20-40% fewer miles, and use non-auto modes 2-to-10 fold compared with more auto-oriented areas. When TOD includes improvements in active transportation conditions, residents also walk 2-4 times more (Litman, 2024a).

> In Denver, development of new transit facilities has had immediate and significant impacts on land use and housing density. Between 2000 and 2006, housing density increased from 1,379 to 1,429 units per km^2 and use of non-car modes increased by 61% (Ali et al., 2021).

CO-BENEFITS

This section outlines the multiple co-benefits associated with the strategy, including safety benefits, local air quality improvements, and improved accessibility. Each co-benefit presents examples that demonstrate how the strategy enhances regional or community well-being while addressing emissions.

SAFETY

In the U.S., pedestrian and cyclist fatalities make up close to 20% of total annual traffic fatalities (Patnala et al., 2024). Communities designed with pedestrians, transit riders, bicyclists, and other micromobility users in mind can reduce the incidence of collisions, injuries, and fatalities on shared roadways. Safer streets and connecting trails can, in turn, encourage further shifts towards active transportation.

Investment in active transportation with TOD can promote the perception and reality of safety. Safe and comfortable walking and biking infrastructure can also reduce the likelihood of vehicle-pedestrian and vehicle-bicycle fatalities and serious injuries (Boutros et al., 2023).

Residents of TOD communities typically have 20-80% lower per capita traffic fatality rates as the same demographic groups living in non-TOD, vehicle-dependent areas (Litman, 2024d).

Introducing pedestrian zones across an area can reduce congestion on surrounding roadways and reduce both motorist and pedestrian injuries. The Broadway Boulevard Project in New York City introduced pedestrian zones across Times Square, Herald and Greely Squares, and Madison Square Park. These changes decreased congestion on most surrounding avenues and reduced traffic injuries by 63% and pedestrian injuries by 35% (C40, 2016).

RESILIENCE AND ADAPTATION

Adaptation strategies that support community density, like preservation of open green space, using greenways or other trails to mitigate flooding or heat impacts, or using multimodal hubs as evacuation points or heating/cooling centers for vulnerable populations help communities be more resilient to extreme events like floods (Davis et al., 2023).

RURAL COMMUNITIES

Although TOD is typically associated with high density, urban mixed-use (residential and commercial) development, and proximity to employment and daily destinations, it can also be applied to lower density settings and rural areas.

> An example is the historic town of Framingham, MA, which has plans to incorporate TOD in its downtown core due to changing market and resident demands. The historic town's growth in recent years has introduced a younger population to the downtown area, which has supported niche markets and a more urban lifestyle. In response, the town has submitted plans to the Massachusetts Department of Transportation and the Metropolitan Area Planning Council to create a more walkable and active, mixed-use development (City of Framingham, n.d.).

ECONOMIC GROWTH

There are significant economy-wide long-term cost savings associated with TOD and land use policies, resulting from increased property values for residents and businesses, easier travel, reduced pollution, and economic stabilization of neighborhoods (EPA, 2015).

By one estimate, a shift toward public and active transportation and denser urban development in the U.S. would save $13 trillion over the period 2023-2050, due to reduced costs for manufacturing, maintaining, fueling, and operating vehicles and building and maintaining infrastructure (Fulton and Reich, 2024).

TOD investments can generate large economic returns. The American Public Transit Association has found that investment in public transportation generates an estimated $5 in long-term annual economic returns, and every $1 billion invested in public transportation supports about 20,000 jobs (APTA, 2020).

TOD can support increased local foot traffic and public transit ridership, providing additional revenue to municipalities and transit agencies, as well as surrounding businesses (MAPC, 2017).

Transit infrastructure improvements can lead to higher local land values and spur more development. Land and property owners are often able to benefit from infrastructure investment in this way, and municipalities may be able to capture some of this value for residents through public-private partnerships, tax increment financing (TIF) districts, or other local measures (NASEM, 2020).

ACCESSIBILITY AND EQUITY

When TOD is implemented in previously segregated areas, it can improve transportation equity by connecting people to services and increasing access to opportunities previously not available due to transportation barriers (Holland, 2023).

"Transport poverty" occurs when people lack access to transportation options that are affordable and accessible. TOD increases access to job opportunities, education, and everyday destinations for those who cannot or do not drive, especially the elderly, disabled, youth, and people living in lower-income communities (IRPP, 2024).

Transportation costs can be reduced if affordable housing options are included in TOD. Residents of affordable housing can also have increased active transportation mobility if located near TOD (CAPCOA, 2021).

> During the planning phase of a new TOD, the planning board in Concord, MA negotiated for affordable housing units near the re-developed train station, allowing for residents of various incomes to live closer to transit (Holland, 2023).

TOD increases access to active and public transportation options, which are linked to decreased loneliness, increased access to family and friends, and greater levels of socialization Williams et al., 2021; Litman, 2024b).

Existing federal grant programs include opportunities to incentivize additional housing supply near transit to encourage more equitable development patterns. For example, Federal Transit Administration (FTA) includes land use and affordable housing as one of the criteria in the Capital Investment Grants program.

COST SAVINGS

Past suburban and exurban development resulted in families moving further and further from downtowns and urban centers to find affordable housing. In doing so, they often incur higher transportation costs associated with the location of that housing (Litman, 2024c).

Transportation is the second-largest household expense for low-income households, after housing (BTS, 2023).

In addition to the upfront costs of transportation, many of the costs associated with driving itself are not covered by user taxes. American households and the U.S. government combined currently pay $1,105 to $1,848 per household annually, which includes expenses such as road construction and maintenance, tax subsidies, and healthcare costs from car crashes and air pollution (Dutzik et al., 2015).

Shifting toward land use patterns that prioritize public transit and active transportation with TOD can reduce transportation costs by reducing the need for car ownership, maintenance, fuel, driving, and parking.

A study in California estimates, when controlling demographics, a household can save 18% of their annual transportation expenditures with TOD, which equates to around $1,232 per year. The study also shows TOD households in California own fewer vehicles (Dong, 2023).

AIR QUALITY AND HEALTH

TOD can reduce car reliance and associated vehicle emissions. Pollution from tailpipe and non-tailpipe emissions contribute to health inequities for communities, especially communities of color, which are disproportionately located near major roadways (Jbaily et al., 2022; EPA, 2014).

TOD residents who choose to integrate active transportation into daily routines can see improvements in physical well-being and stress reduction; for example, three hours of biking per week can reduce a person's risk of heart disease by 50% (Partlow, n.d.).

An additional health benefit from TOD relates to socialization. A 2023 advisory from the Surgeon General stated that the "mortality impact of being socially disconnected is similar to that caused by smoking up to 15 cigarettes a day" (HHS, 2023). A survey conducted by the City of Vancouver shows people are more likely to have a friendly social interaction when traveling by active transportation or transit than by private automobile (City of Vancouver, 2016).

COST CONSIDERATIONS

While there are upfront housing development costs when implementing TOD, it can provide long term financial and economic development benefits. TODs and the associated transit infrastructure can increase property values and encourage further development, which can benefit property owners, local businesses, and municipalities (NASEM, 2020).

TOD is usually a long-term undertaking established at the city or town level. Local jurisdictions control multiple funding streams that can be used to support affordable and mixed-income housing in transit zones. TOD investments can concentrate business activity and tax bases, which generate new revenue that can be reinvested in communities. Value capture strategies include: property and sales taxes, real estate lease and sales revenues, farebox revenues, fees on everything from parking to business licenses, joint development, special assessment districts and public-private partnerships (Reconnecting America, 2014).

Tax Increment Financing (TIF) is a public financing method that local governments and transportation agencies may consider which captures a portion of additional property and sales tax revenues as a result of increased revenues from transit investments (NASEM, 2021).

> To learn more about how communities have encouraged TOD and capitalized on increased revenues, see this Reconnecting America resource developed in conjunction with the EPA and other partners.

Federal funding opportunities are available to support a variety of TOD projects. See more information below.

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FUNDING OPPORTUNITIES

Federal Highway Administration (FHWA) Flexible Funds: In addition to FTA grant programs, certain funding programs administered by FHWA, including the Surface Transportation Block Grant (STBG) Program and the Congestion Mitigation and Air Quality Improvement (CMAQ) Program, may be used for public transportation purposes. These "flexible" funds are transferred from FHWA and administered as FTA funding, taking on the requirements and eligibility of the FTA program to which they are transferred. See 49 USC 5334(i) and FRA's Join Development Circular for more detail.

USDOT's **RAISE Discretionary Grant Program** includes funding for constructing surface transportation projects that will have a significant local or regional impact. The FY 2023 Notice of Funding Opportunity outlines the necessity of surface transportation components of transit-oriented development to advance goals of the program.

USDOT's **Transportation Infrastructure Finance and Innovation Act** and **Railroad Rehabilitation and Improvement Financing** programs, which provide low-interest financing for surface transportation projects, were expanded to include specific measures to better support TOD projects. Both programs may be used for economic development, including commercial and residential development, and RRIF may also fund public infrastructure and joint development.

FTA's **Pilot Program for TOD Planning** supports the expansion of more location-convenient and affordable housing near transit. Comprehensive planning funded through the program must examine ways to improve economic development and ridership, foster multimodal connectivity and accessibility, improve transit access for pedestrian and bicycle traffic, engage the private sector, identify infrastructure needs, and enable mixed-use development near transit stations.

U.S. Department of Housing and Urban Development (HUD)'s **Choice Neighborhoods Program** supports local investment and development through public and private funding. Communities can receive funding for planning to enable both public and private reinvestment in amenities that are important to residents, such as schools, businesses, and other community assets.

HUD's **Section 108 Loan Guarantee Program** provides Community Development Block Grant (CDBG) recipients with the ability to leverage their annual grant allocation to access low-cost, flexible financing for economic development, housing, public facility, and infrastructure projects. The program can fund TOD projects and related development efforts, either on its own or in combination with other economic development financing.

FTA's **Local Match Waver for Complete Streets** waives the non-federal match for the Metropolitan Planning Program and the State Planning and Research Program for Complete Streets planning activities. This waiver provides incentives for applicants to undertake complete streets infrastructure projects, which will increase convenience by diversifying the travel modes individuals can choose.

HUD's **Exploring Office to Residential Conversions** grant program provides funding for residential conversion activities, which can be relevant for TOD.

COMPLEMENTARY STRATEGIES

TOD can encourage active transportation by creating compact, mixed-use neighborhoods with pedestrian-friendly streetscapes and bike infrastructure. Active transportation infrastructure can enhance the accessibility and attractiveness of TOD by providing residents and visitors with safe and convenient options to access transit hubs and navigate the surrounding area. TOD and active transportation infrastructure work together to promote sustainable mobility and reduce GHG emissions.

Coordinated transportation planning, or planning across sectors (i.e., transportation and housing), jurisdictions (i.e., neighboring municipalities), and levels of government (i.e., municipal, county, and state), complements TOD by ensuring that these developments meet a range of community needs. For example, when coordinated transportation planning for TOD involves the housing sector, it can help ensure that there is a range of affordable housing options to meet diverse needs and income levels. Conversely, TOD can help achieve coordinated transportation goals, such as those related to affordable housing, access to jobs, and reducing GHG emissions.

Creating denser, mixed-use developments can increase demand for bus rapid transit and other public transit systems. Combining TOD with investments in BRT can reduce distances between common destinations and lower GHG emissions.

Free and reduced transit fare strategies further incentivize people to use public transportation, increasing ridership and supporting the viability of TOD. Free and reduced transit fare strategies can also help mitigate transportation costs, making it more attractive to live in TOD areas and reduce barriers to accessing employment, education, and essential services. TOD and free and reduced transit fare strategies work together to promote equitable access to transportation while reducing GHG emissions.

TOD can increase the demand for public transit services by creating dense, mixed-use neighborhoods where residents have easy access to transit options. Public transit expansion can support TOD by providing reliable and convenient transportation access to and from these developments, thereby increasing their attractiveness and viability. Overall, combining TOD with public transit expansion can lead to lower GHG emissions, and more vibrant, livable communities.

Integrated transit systems make it easier for residents of transit-oriented developments to travel within the community and beyond, enhancing attractiveness of these developments. Conversely, transit-oriented development can increase ridership of public transportation, making the case for further investment in transit integration to support growing demand.

TOD facilitates trip planning by providing easy access to transit options. Trip planning and modal integration can be attractive to TOD residents and visitors, allowing them to easily plan trips using digital, real-time trip planning tools and apps, while knowing that stations are conveniently located and well-connected to their destinations.

Zoning reform can facilitate the development of TOD projects by allowing for higher densities, reduced parking requirements, and streamlined approval processes.

View All Strategies

CASE STUDIES

BAY AREA RAPID TRANSIT TOD

In 2018, California passed the AB 2923 for the zoning of Bay Area Rapid Transit (BART) properties in Alameda, Contra Costa, and San Francisco Counties located within half a mile of transit stations. AB 2923 established baseline zoning standards and allowed BART to work with local jurisdictions to determine more stringent land use standards to enable TOD. The State Legislature developed this unique law as a way to address the high cost of housing and lack of affordable housing. BART's TOD program aims to encourage livable communities; increase ridership and housing affordability; and provide sustainable housing choices; among others.

VALLEY EXTENSION PROGRAM - SILICON VALLEY, CA

The Valley Transit Authority (VTA) has completed phase 1 of a transit corridor project to significantly expand public transit and regional rail service for 1.7 million county residents. The project will be implemented in two phases and is expected to be completed in 2040. The VTA aims to create multiple transit-oriented communities in Silicon Valley, offering multimodal transportation connectivity, affordable housing options, and parking requirements, in addition to roadway, utility, and environmental improvements.

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CONCORD COMMONS MIXED-USE DEVELOPMENT - CONCORD, MA

The Concord Commons is a mixed-use development in the small town of Concord, MA. The development is centered around a commuter rail station with a historic station building built in the 1800s. Sections of the parking lot area were converted to a landscaped garden and pedestrian walkway linking to the town center. The Concord Commons is an example of a small-town transit-oriented project providing walkable links between transit, housing, and daily destinations.

(Source: Littleton, MA)

ROSSLYN-BALLSTON CORRIDOR - ARLINGTON COUNTY, VA

Arlington County, VA implemented transit-oriented policies to increase development density along transit lines. Despite population growth at 1% per year, VMT has not increased, equating to 20%-30% VMT per person reduction from 1980 to 2005. Transit and active transportation modes of travel make up 47% of the commute, compared to a regional average of 29%. Compared to a regional average of 4%, 12% of households in Arlington County do not own a car.

IMPLEMENTING TOD: **WHAT TO READ NEXT**

Technical assistance, such as through FHWA's National Highway Institute's "Integrating Transportation and Land Use" course, can help transit agencies and local governments implement TOD projects. The course focuses on augmenting the resources available to communities and providing expertise in navigating grant programs to integrate transit and development.

The Institute for Transportation and Development Policy has a range of resources on TOD, including a TOD Standard Guide to understand, measure, and evaluate the key principles in urban spaces.

C40 Knowledge Hub provides a TOD implementation framework with a range of resources and case studies.

The Global Platform for Sustainable Cities provides a comprehensive toolkit with a step by step process for implementing different phases of TOD, as well as a focus on lower-middle income contexts.

HOW TO IMPLEMENT

Cities can set TOD targets to inform developers and residents of development visions and planning (C40, 2019).

New York City set a goal of 95% of new housing to be built within a half mile of transit stations. Los Angeles set TOD targets for new housing units within 1,500 feet of transit stations: 17,000 units by 2017 (met), 57% by 2025, and 65% by 2035. Portland, OR has set TOD goals encourage mode choice to active transportation modes and develop 20-minute-neighborhoods. In 2012, 45% of Portland residents lived in a "complete neighborhood" and the city aims to reach 80% by 2035 (C40, 2019).

TOD districts can benefit from Station Area Plans (SAP) that provide a development vision specific to the individual transit station. For more information about station area planning, see: TOD 202: Station Area Planning, developed by Reconnecting America and the Center for Transit-Oriented Development.

RESOURCES

GENERAL RESOURCES

EPA Smart Location Mapping tools: The Environmental Protection Agency (EPA) provides tools that can compare the accessibility of neighborhoods via public transit service across metropolitan regions in the United States. The tools can be used to evaluate current transit-oriented development projects or scope future projects and prioritize location-efficient investments. The tools are:

- Smart Location Database: This tool is a geographic data resource for measuring location efficiency across the U.S.
- Access to Jobs and Workers Via Transit Tool: This tool is a geospatial data resource and web mapping tool summarizing accessibility of jobs by workers, households, and population in neighborhoods via public transit.
- National Walkability Index: This tool is a nationwide geographic data resource ranking the walkability of census block groups.

FHWA National Highway Institute Integrating Transportation and Land Use course: The course can help transit agencies and local governments implement TOD projects. The course focuses on augmenting the resources available to communities and providing expertise in navigating grant programs to integrate transit and development.

Global Platform for Sustainable Cities Transit-Oriented Development Community of Practice : This resource includes a step by step process for implementing different phases of TOD, as well as a focus on lower-middle income contexts.

C40 Knowledge Hub How to Implement Transit-Oriented Development: This is a TOD implementation framework with a range of resources and case studies.

EPA TOD Infrastructure Finance Guide. In collaboration with four transit agencies, EPA developed a set of case studies that describe how the range of public and private financing models can be combined to support the essential infrastructure improvements that are often needed to accommodate TOD.

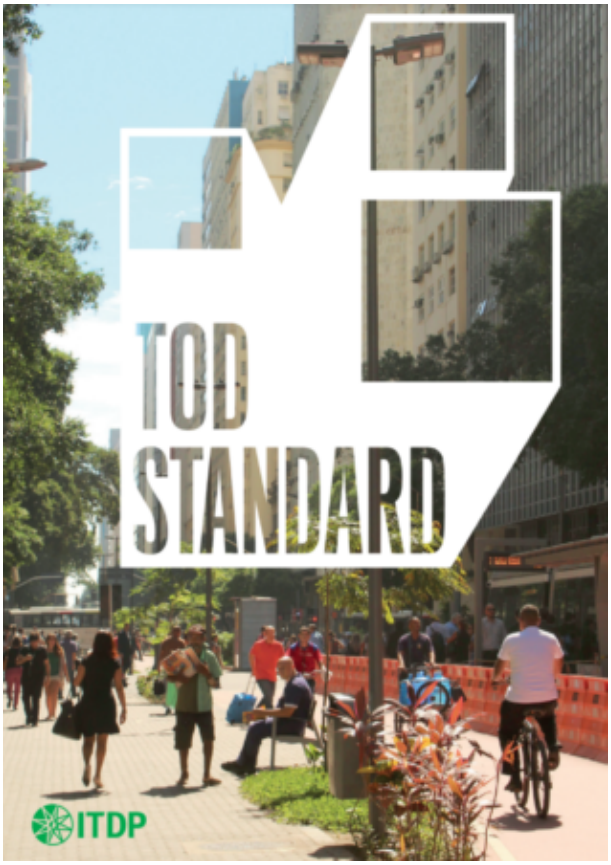
FTA Interim Asset Disposition Guidance. FTA has put forth interim guidance on asset disposition for federal assistance recipients, which authorizes transfer of assets to a local governmental authority, non-profit organization, or other third- party entity if, among other factors, it will be used for TOD and includes affordable housing.

FTA Joint Development Guidance: This FTA guidance supports flexibility for transit agencies to pursue joint development projects, with a goal of

creating more value for both transit systems and surrounding communities.

The White House Commercial to Residential Conversations: A Guidebook to Available Federal Resources: The guidebook presents an overview of the federal programs, loans, grants, guarantees, and tax incentives available for commercial to residential conversions. This list includes resources relevant for transit-oriented development.

Institute for Transportation and Development Policy TOD Standard Guide: The guide helps practitioners understand, measure, and evaluate the key TOD principles in urban spaces.



(Source: ITDP, 2017)

TOOLKITS AND MODELING APPROACHES

National Level

FHWA Performance-Based Approach to Addressing Greenhouse Gas Emissions through Transportation Planning (2013): This resource helps State DOTs and MPOs integrate GHG analysis into performance-based planning and programming. The resources also provides case studies.

FTA Transit Greenhouse Gas Emissions Estimator: The estimator is a spreadsheet-based tool that allows users to estimate the partial lifecycle GHG emissions generated from the construction, operation, and maintenance phases of a project across select transit modes. Users input general information about a project, and the Estimator calculates annual GHG emissions generated in each phase.

Infrastructure Carbon Estimator (ICE) – ICE is a spreadsheet tool that estimates the lifecycle energy and GHG emissions from the construction and maintenance of transportation facilities. ICE is intended to inform planning and other pre-engineering analysis such as those conducted during the NEPA process.

Travel demand model + EPA Motor Vehicle Emission Simulator (MOVES): The MOVES model provides tailpipe emission rates and mobile-source inventories.

Transportation Pooled Fund VisionEval Project and Associated Tools (i.e., Energy Emissions Reduction and Policy Analysis Tool; EERPAT): These tools are designed to evaluate many alternative futures and policies to help state and metropolitan area governments address pressing issues, despite uncertainty.

Mobility Energy Productivity Tool (MEP): This tool evaluates the ability of a transportation system to connect individuals to goods, services, employment opportunities, and others while accounting for time, cost, and energy. This tool also includes a separate metric to evaluate freight connectivity, called Freight MEP.

The Argonne Laboratory POLARIS Transportation System Simulation Tool: This is an open-source simulation tool that allows users to simultaneously model all aspects of travel decisions through a network-demand model. This tool can be used to understand impacts of transportation decisions across several key metrics, which includes congestion, accessibility, cost, emissions, energy, and environmental justice, that can be integrated into land use planning.

Department of Energy (DOE) Behavior, Energy, Autonomy, and Mobility Comprehensive Regional Evaluator (BEAM CORE): This is an open-source, integrative modeling tool that can capture and analyze a wide set of transportation system components. The tool produces various metrics such as aggregate vehicle and person miles traveled, congestion, energy consumption, and accessibility metrics, for insight on the interconnected impacts between transportation and land use decisions.

DOE and National Renewal Energy Laboratory (NREL) Mobility Energy Productivity (MEP): This metric is used to measure the existing and potential impact of changes in mobility options across transportation modes at the community or regional level. The MEP metric takes into account travel time, energy, and affordability. DOE's Lawrence Berkely National Laboratory (LBNL) developed the Individual Experienced Utility-Based Synthesis (INEXUS). INEXUS is a suite of accessibility metrics that measure agent-trip level accessibility. These metrics can be used to identify and measure individual travelers who benefit from improved mobility under different simulation scenarios. Tools such as these can be used to design improved operational efficiency in existing and future transportation systems.

State Level

California Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity: This handbook provides GHG calculation methods and variables to consider for project level TOD. The handbook also offers quantitative measures of co-benefits.

California Emissions Estimator Model (CalEEMod): CalEEMod is a statewide land use emissions computer model designed to provide a uniform platform for government agencies, land use planners, and environmental professionals to quantify potential criteria pollutant and greenhouse gas (GHG) emissions associated with both construction and operations from a variety of land use projects.

Fehr & Peers TDM+ (Beta): This is a VMT calculation tool designed for the State of California, which allows users to calculate the impacts of potential VMT reduction strategies, using various data inputs.

Local Level

Chicago and San Francisco: Center for Neighborhood Technology ETOD Impact Calculator: This calculator provides benefits of equitable TOD projects, including number of residents housed, residential buying power, on-site jobs, tax revenue, GHG, among others.

Washington State Tools for Estimating VMT Reductions from Built Environment Changes: This resource provides a list of tools to estimate GHG based on land use and transportation inputs. Applications can range from State, urban, and local community scales.

WORKING WITH COMMUNITIES

Institute for Transportation and Development Policy: This website provides information on TOD, a standard policy brief with standardize principles of TOD, and a scorecard to evaluate if TOD developments meet the outlined principles.

Center for Neighborhood Technology (CNT): CNT offers resources on advocating for TOD at the community level.

Planetizen: This website provides a course in equitable transit-oriented development, prioritizing inclusive community development. The course is open to the public.

RURAL SPECIFIC

FTA National Rural Transit Assistance Program (RTAP): This FTA program provides technical resources, toolkits, training, webinars, a resource library, news updates, and information on Tribal transit and State RTAP programs.

AARP Livable Communities Transportation and Mobility: This website includes resources such as policy briefs and a rural transportation toolkit for rural communities on the topics of livability, funding opportunities, health care, and transportation options available in rural areas.

Community Transportation Association for America Transit Planning 4 All: This program, in partnership with several organizations, supports older adults and people with disabilities in getting involved in coordinated transportation system development. The members are involved in surveys, research activities, grants, and creating a knowledge sharing network.

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For more information visit the DOT Climate Change Center, https://www.transportation.gov/priorities/climate-and-sustainability/dot-climate-change-center