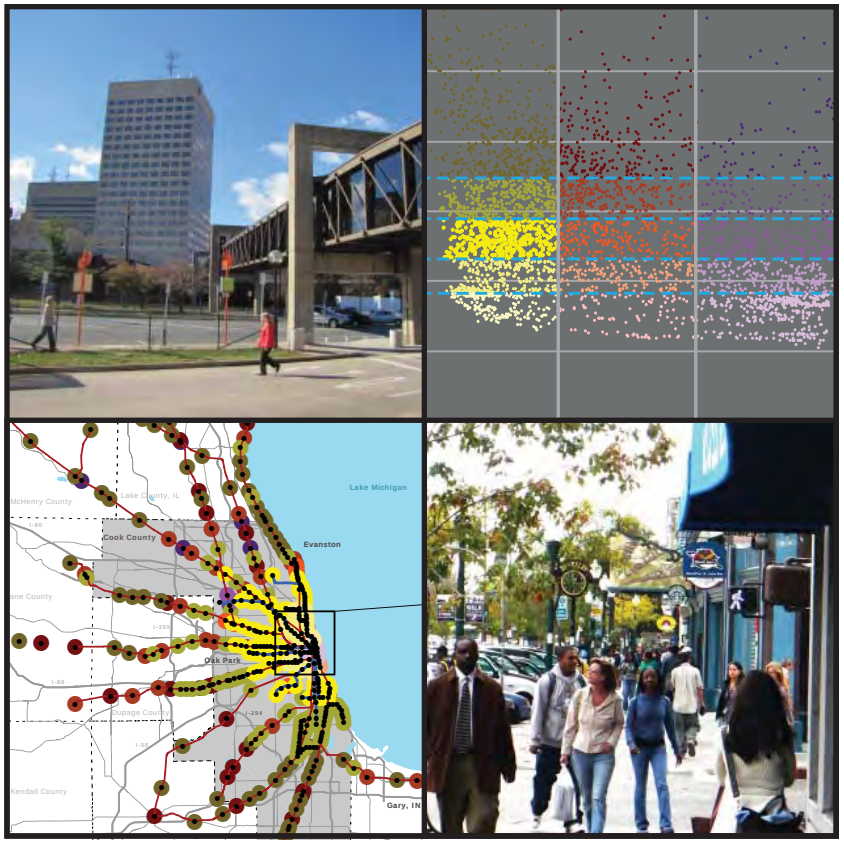
Performance-Based Transit-Oriented Development Typology Guidebook



CTOD CENTER FOR TRANSIT-ORIENTED DEVELOPMENT

December 2010

The Center for Transit-Oriented Development (CTOD) is the only national nonprofit effort dedicated to providing best practices, research and tools to support market-based transit-oriented development. CTOD partners with both the public and private market sectors to strategize about ways to encourage the development of high performing communities around transit stations and to build transit systems that maximize development potential. CTOD works to integrate local and regional planning, generate new tools for economic development, real estate and investment issues, improve affordability and livability for all members of the community, and respond to imperatives for climate change and sustainability. The Center for TOD is a partnership of Reconnecting America, the Center for Neighborhood Technology, and Strategic Economics. For more information go to CTOD's website at www.ctod.org.

Reconnecting America works to create better communities – places where transportation choices make it easy to get from place to place, where businesses flourish, and where people from all walks of life can afford to live, work and visit. Reconnecting America not only develops research and advocates for public policy, but we also build on-the-ground partnerships and convene the players necessary to accelerate decision-making.

The Center for Neighborhood Technology is a creative think-and-do tank that combines rigorous research with effective solutions. CNT works across disciplines and issues, including transportation and community development, energy, natural resources, and climate change. The goal is urban sustainability – the more effective use of resources and assets to improve the health of natural systems and the wealth of people.

Strategic Economics is a consulting and research firm specializing in urban and regional economics and planning. The firm helps local governments, community groups, developers and nonprofit organizations understand the economic and development context in which they operate in order to take strategic steps towards creating high-quality places for people to live and work.

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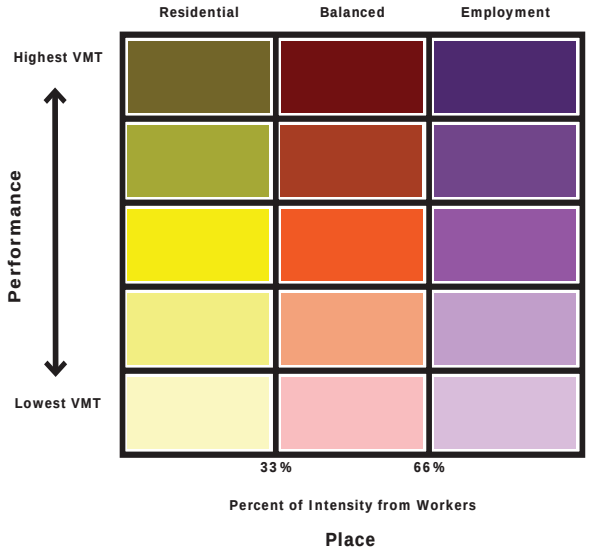
Executive Summary: Performance Based TOD Guidebook

Development of a Performance-Based TOD Typology Tool

Transit-Oriented Development is a community development model that when successfully implemented can produce significant economic, environmental and social benefits for people and the neighborhoods, cities and regions in which they live, work and play. These benefits can best be realized through the utilization of analytical tools that can provide all TOD stakeholders with the ability to make fully informed decisions.

To that end, the practitioners of TOD and the decision makers that help make TOD happen, can benefit from using a performance-based typology that helps identify the different conditions that exist in places, and that should ultimately determine the form that TOD takes. Some of the questions a performance-based TOD typology might answer include: What economic, environmental and social outcomes can we expect from investments in transit and TOD? What differentiates transit-oriented development from transit-adjacent development? What standards should be utilized in evaluating zoning for TOD or other policy interventions?

As evidenced in the following report, the compositions of our communities and the quality of transit has a great influence on greenhouse gas emissions and the ability of cities, regions and states to meet climate change goals outlined in public policy. Yet it has remained a challenge to better link land use and transportation decisions to meeting climate change policy goals. Mismatched decision-making structures, uncertain outcomes, and a lack of a common framework for measuring performance has often been a stumbling block in the attempts to use TOD to address climate change and community development goals simultaneously.



Performance Based TOD Typology

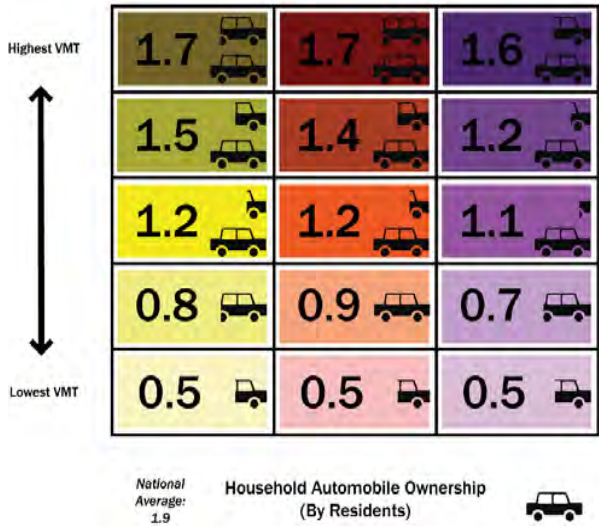
To help address this issue, the Center for Transit-Oriented Development has designed the Performance-Based TOD Typology as a user-friendly tool that gives interested people around the country the ability to evaluate the performance of the transit zones in their neighborhoods and towns. The typology creates distinct place types by identifying the number of miles the typical household within each transit zone will travel in a year and whether the area is primarily residential, employment, or a balance of the two. Understanding where an individual transit zone sits in this spectrum, or how all of the transit zones in a region compare to one another can make it easier for stakeholders to identify strategies to reduce VMT or to take advantage of existing low VMT places.

CTOD affirms that the performance of TOD should be measured at the neighborhood scale, or larger. Therefore, the Performance-Based TOD Typology defines the half-mile radius around each transit station as a unique transit zone. The characteristics of all households within this radius are averaged together, and those averages are used to define the place types and other characteristics of each transit zone throughout this guidebook. This analysis includes the approximately 3,760 existing transit station areas in 39 regions across the country, as reported in the CTOD's National TOD Database.

Key Findings

Overall, most transit stations perform better than or at the national average, outperforming the typical non-transit-oriented place on key metrics such as auto ownership, commuting behavior, and density/intensity. Within each metric or set of metrics there are some interesting variations on this general theme.

Auto Ownership & Transportation Costs:
Transit zones in low VMT places types tend to have low transportation costs and low rates of automobile ownership. Auto ownership in the lowest VMT places average 0.5 cars per household.



Low VMT transit zones have lower car ownership rates

Commute Travel Behavior:
Low VMT place types exhibit more transit ridership and higher rates of walking and biking to work than high VMT transit zones. This finding is equally true of commutes by residents living in transit zones and commutes by workers who work in transit zones. Transit commute mode share in the lowest VMT place types is from 5 to 11 times greater than the national average.

Employment Proximity:
Low VMT transit zones are located much closer to employment than high VMT transit zones. A typical low VMT place is proximate to ten times more jobs than the highest VMT places.

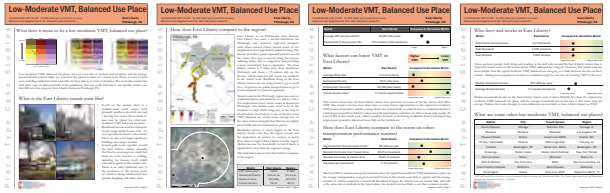
Urban Form:
Low VMT transit zones tend to have more intensity (residents + workers) and higher residential densities than high VMT transit zones. Residential densities in low VMT transit zones are over 15 times as high compared to high VMT transit zones. Additionally, transit zones have smaller block sizes.

Case Studies

This report includes nine case studies of transit zones to help illustrate the concepts of the Performance-Based TOD Typology. The case studies were chosen in order to show a variety of types of transit zones that differ not only in their place type as defined by the Performance-Based TOD Typology, but also differ in where they are located in the US, the size of the overall region, the size and age of the transit network, the type of transit in place in the transit zone, and the median income in the transit zone. The case studies include:

Vermont/Santa Monica Station, Los Angeles CA
Oak Park, IL
West Irving, TX
East Liberty Station, Pittsburgh PA
Downtown Berkeley, CA
Gresham Transit Center, OR
Essex Street Station, Jersey City NJ
Buckhead Station, Atlanta GA
Rockville, MD

Detailed four-page spreads on each case study are included in the report.



Each case study has four detailed pages

Scenario Studies

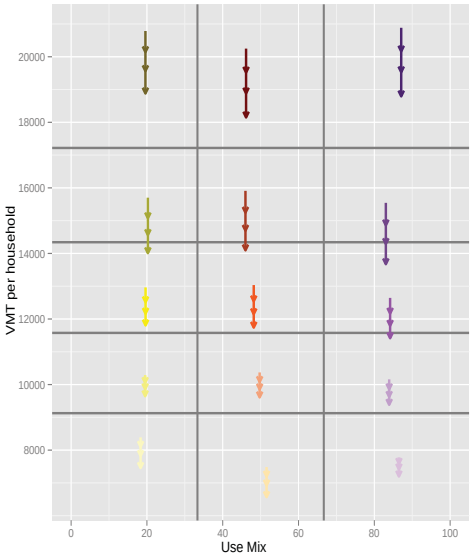
This report includes a series of scenario studies, conducted to understand how additional increments of growth and development in existing transit zones would affect overall performance. Scenarios of 15%, 30%, and 50% increments of growth in both residential households and employment access were included, as well as an assessment of an increase in 2,000 households per station area.

Key lessons from the scenarios include:

1. Encouraging new development in transit zones, independent of the place type, can help reduce regional VMT, especially in regions where the average household VMT is higher than the average household VMT for even high VMT places.

2. High VMT transit zones (residential, balanced and employment) can see significant reductions in average household VMT from relatively moderate amounts of new development.

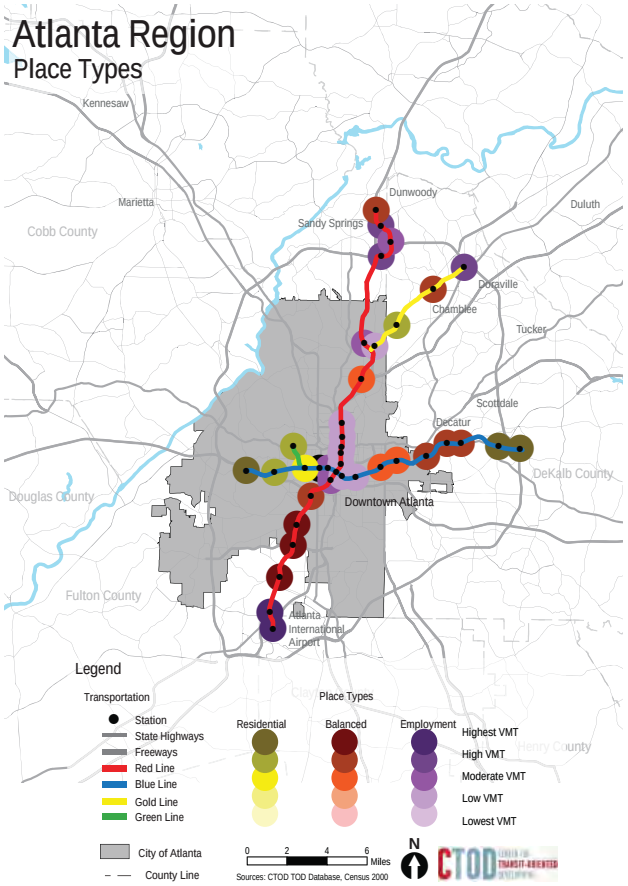
3. Prioritizing low VMT transit zones for new development can produce the largest reductions in total regional VMT.



Adding Jobs and Housing Increases Performance

Policy Implications

Creating a robust Performance-Based TOD Typology has implications for policy at all levels including local zoning codes, regional incentive programs, State housing allocations, and Federal funding decisions, and many more in between. While this effort has been primarily focused on developing a useful tool that can be used by many TOD stakeholders, this report includes a series of potential policy implications and outcomes that can be the basis for future applications of the typology.



Atlanta's Place Types

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I. Introduction

Why Create a Transit-Oriented Development Typology?

Transit-oriented development (TOD) is an approach to community development that leverages the unique opportunities provided by access to high-quality public transportation. TOD contributes to creating healthy, walkable communities that provide residents with housing and transportation choices, which support an affordable lifestyle. At the neighborhood scale, TOD is typically defined as compact community development within easy walking or biking distance of a transit station.

There is no "one-size-fits-all" approach to TOD. Over the last five years the Center for Transit-Oriented Development (CTOD) has developed and applied many TOD Station Area Typologies, in different regions, such as Denver, Portland, Chicago, and Baltimore, to help plan for station area revitalization and development.

A TOD typology is a way to group together different transit zones that have a common set of characteristics. A typology has several place types, and all of the station areas within one place type have some elements in common. The characteristics that define a typology can differ depending on what outcomes the typology is meant to accomplish, and not every station area in one place type will be exactly the same. Typologies are useful tools because they increase understanding of characteristics that contribute to place, establish measurable performance benchmarks, and provide a framework to set goals for better performance.

The widely varying characteristics that help define places require different strategies and approaches to be employed to foster the growth of vibrant transit-oriented neighborhoods that enhance existing assets and conditions and serve people of all incomes. These differences can often be highlighted through the use of a typology tool that identifies key themes and strategic decisions that apply across a range of places when implementing TOD.

Why Use Performance-Based Measures in a TOD Typology?

Performance measures use data on existing conditions to compare station areas to aspirational outcomes. Performance measures can be studied over time, gauging whether station areas are moving towards aspirational conditions or away from them. Using performance measures in a typology means that users can identify "higher-performing" place types as aspirational places, making goal-setting a more straightforward process. Using place types also helps stakeholders compare one transit zone to another and understand the characteristics that make them different.

TOD in particular can benefit from using a performance-based typology to define and differentiate different types of TOD. Some of the questions a performance-based TOD typology might answer include: What outcomes can we expect from investments in transit and TOD? What differentiates transit-oriented development from transit-adjacent development? What standards should be utilized in evaluating zoning for TOD or other policy interventions?

Why VMT as the Performance Measure?

Vehicle miles traveled (VMT) works well as a performance measure for a TOD typology because places with lower VMT tend to be places where more people walk, bike and take transit, one of the goals of TOD. VMT accounts for not only the number of trips households take but also the distance traveled on each trip, both of which affect greenhouse gas emissions. The total

number of trips in a transit zone or region is not necessarily correlated with VMT—a household that takes only a few very long trips a day may have higher annual VMT than a household taking many very short trips.

At the core of transit-oriented development is the idea that people with a wide range of incomes can live and work in places with more transportation options, giving them the choice to take care of some of their daily trips by using transit, walking and biking, rather than driving. Most transit supportive places also tend to be compact neighborhoods of varying densities. Density is the key variable that allows communities in rural, suburban and urban environments to support a mix of uses and activities including work places, child care, stores, restaurants, and different housing types.

Because these neighborhoods are both small enough to be walkable and have many uses and activities, it is easy for residents and workers to walk or bike to take care of some of their daily needs. Thus, people are able to reduce the amount of money spent on travel, their household VMT, and perhaps the number of cars they own – creating positive benefits for households and for greenhouse gas reduction goals. While other characteristics (reduced household expenditures on housing and transit, increased transit ridership, etc.) might also have served as a performance-based measure, VMT correlates strongly with those metrics and using it as the performance-based measure accomplishes other purposes.

VMT also serves as a good performance measure for TOD because of the growing interest in sustainable communities, neighborhoods that have more housing and transportation choices, are closer to jobs, shops or schools, are more energy independent and help protect clean air and water. While there is a growing understanding and appreciation for TOD in America, urban, suburban and rural policy makers are increasingly concerned with sustainability at the state, regional, municipal, and neighborhood level.

Figure 1: Performance-Based Typology

The pursuit of sustainability includes a wide range of policy goals that address environmental, equity, and economic conditions. The transportation sector is frequently seen as a place ripe for helping regions meet their sustainability goals because of its relationship to global warming, pollution, employment access, and household costs. To address global warming and pollution especially, policy makers use a three-pronged approach, with the first two prongs focusing on improving fuel efficiency and vehicle efficiency to address transportation's role in increased emissions and travel. The third prong, the built environment, has been linked by numerous studies to vehicle miles traveled and greenhouse gas emissions (GHGs).[1][2][3]

In this Guidebook, VMT serves as an estimate of the number of miles driven by a household in one year. TOD is at the nexus of the land use

1 Cambridge Systematics. Moving Cooler: Transportation Strategies to Reduce Greenhouse Gas Emissions. 2009 <http://www.movingcooler.info/home>

2 CTOD. Transit Oriented Development and the Potential for VMT Related GHG Emissions Reduction. 2010 <http://www.reconnectingamerica.org/public/stories/1530>

3 United States Department of Transportation. Transportation's Role in Reducing U.S. Greenhouse Gas Emissions. 2010 <http://ntl.bts.gov/lib/32000/32700/32779/DOT_Climate_Change_Report_-_April_2010_-_Volume_1_and_2.pdf>

changes and increased transportation options that can reduce carbon production, improve air quality, and reduce the burdens on households related to the cost of automobile ownership and operation. Average household VMT is an important driver of all of these outcomes, and is thus an important variable in assessing the sustainability of a place.

Using VMT as a performance measure for TOD also helps simplify and focus the discussion around how to reduce VMT. Many policy makers and stakeholders want to reduce VMT in their communities, but there is little consensus on the best way to achieve this goal. Nor is there agreement on what amount of VMT reduction is achievable or what strategies should be employed to meet these goals in different places. The inputs that can affect VMT, especially land use and transportation policies, tend to happen at different scales. Bringing VMT to the local level helps tie regional VMT reduction strategies to local TOD improvements.

Currently many of the attempts to reduce VMT or address climate change use language that is often hard to understand. It is difficult to create rallying cries such as "returning to 350 parts per million" or "a 30% reduction in emissions," but building 1,000 more housing units or providing more transit service are much easier for most people to understand. Because stakeholders often have more pressing needs, climate change goals are often left behind when addressing short-term challenges such as economic or equity goals — even though these are not mutually exclusive options. Moreover, since transportation relates to other strategies, making the connection to VMT can have a tremendous impact. Using VMT as a performance-based measure for TOD can help engage a broader set of people in identifying solutions that may reduce VMT.

CTOD's previous TOD typologies sorted station areas with similar critical characteristics to provide a framework for how to organize planning strategies, preservation approaches and community development goals. The Performance-Based TOD Typology builds upon this work by developing Normative Metrics from nationally comparable data on a number of different factors across regions and provides baseline guidance for long-term strategies that address the goals of reducing VMT and transportation-based greenhouse gas emissions.

A User Friendly Tool

The Performance-Based TOD Typology is a user friendly tool that gives communities around the country the ability to evaluate the performance of their transit zones (see Figure 2). The typology creates distinct place types by identifying the number of miles the typical household within each transit zone will travel in a year and whether the area is primarily residential, employment, or a balance between the two. Understanding where an individual transit zone sits in this spectrum, or how all of the transit zones in a region compare to one another can make it easier for stakeholders to identify strategies to reduce VMT or to take advantage of existing low VMT places.

The Normative Metrics in Section 3 expand upon the typology's existing conditions analysis by looking at several categories of place characteristics, including urban form, transportation, and household characteristics.

Figure 2: Normative Metrics Example

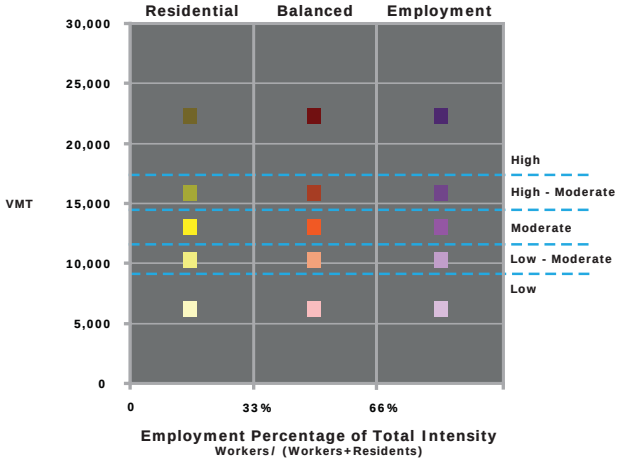
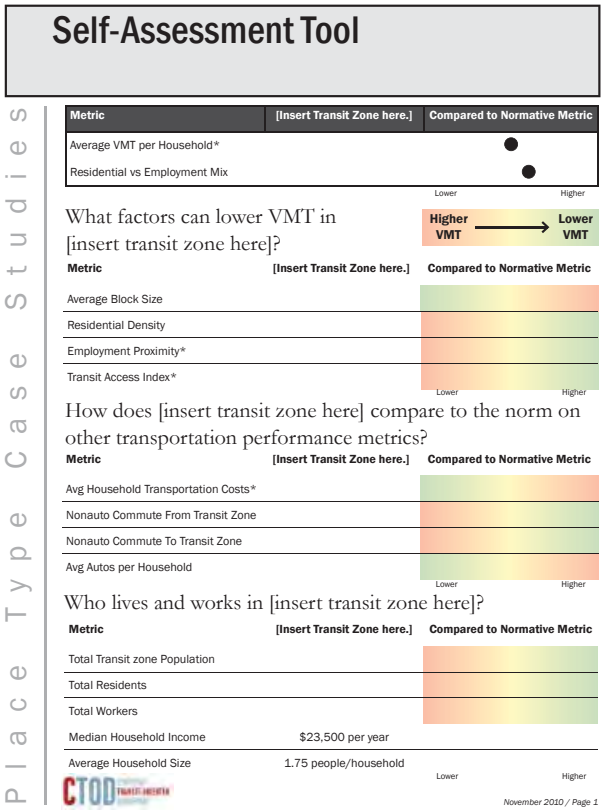


Figure 3: Self-Assessment Template



With the Normative Metrics, users can compare the metrics from each station to others within their place type. Transit zones that have lower transportation costs, higher transit ridership, and smaller block sizes than the norm for their place type will set different goals than places that do not perform as well as other stations areas in the same place type.

The Case Studies in Section 4 provide examples of transit zones in different place types and show how they compare to the Normative Metrics and where they can improve. Stakeholders, from elected officials to local advocates, can use these up-to-date, quantitative measures on population, travel behavior, and urban form to communicate clearly and with hard facts.

This Guidebook also shows how users can perform self-assessments on the transit zones in their communities. These self-assessments build the groundwork on which to enact specific policy, programmatic, and fiscal interventions in order to improve specific outcomes like reduced VMT.

Bringing Together the Actors

Stakeholders often have different views on how to decrease reliance on autos, create more walkable communities, or advance climate change, transit and TOD goals, making policy decisions a sometimes daunting task. By creating a starting point for discussion, the Performance-Based TOD Typology can bring together a wide array of actors working at the full range of geographic scales to improve regional and local sustainability.

VMT and greenhouse gas reduction is usually analyzed at the city or regional scale, while land use and transportation policy making generally happens at more local levels. Combining regional goals of VMT reduction with locally created land use polices has been a major challenge in the past. This tool helps bring together those geographies by using simple, specific, and tangible numbers to measure transit zone performance while creating a communication device for speaking about these complex issues in local public forums with a range of actors. This tool also helps identify how small changes in individual transit zones can result in significant benefits regionally.

The tools in this Guidebook can be used to augment policy decision-making on many important issues, including transportation planning, economic and community development, and urban design. For example, economic development strategies can fold in sustainability objectives, showing that the benefits of connecting jobs to transit can not only reduce congestion but also greenhouse gases.

Affordable housing advocates can come together with regional planners to understand that the benefits of locating more housing and employment near transit goes beyond convenience but will provide lower costs for families and fewer cars on crowded freeways. Bike and pedestrian planners and public health workers may use the tool as evidence

that walkable blocks and compact growth are important elements to improving sustainability.

Audience/Users

The Performance-Based TOD Typology will be of use to policy makers, planners, employers, and residents who have interest in matters related to transit ridership, climate change, economic development, affordable housing, urban design, or any one of the countless other issues linked to transportation, employment, and place.

Whether working locally, regionally, or at another geographic scale, the Guidebook will provide critical and easy to understand information to help guide action aimed at creating high-quality TOD and reducing VMT in communities around the country.

While this tool could be useful in guiding future planning decisions by a variety of stakeholders, there are three specific groups at different levels of government that could most readily use it to affect decision-making:

- At the federal and state level, agencies can use the tool to inform funding and investment policies and in regional planning and decision-making;
- At the regional level, regional agencies, including Metropolitan Planning Organizations (MPOs), transit agencies, and other stakeholders can use this tool to guide corridor planning and regional investments in housing and transportation; and
- At the local and neighborhood level, cities, community-based organizations and other stakeholders can use this tool to inform local planning decisions from long range plans to affordable housing location.

II. TOD Typology Methodology

Defining Place Types

The performance of TOD should be measured at the neighborhood scale, or larger. Therefore, the Performance-Based TOD Typology defines the half-mile radius around each transit station as a unique transit zone. The characteristics of all households within this radius are averaged together, and those averages are used to define the place types and other characteristics of each transit zone throughout this Guidebook. This analysis includes the approximately 3,760 existing transit station areas in 39 regions across the country, as reported in the CTOD's National TOD Database.[4]

There are many benefits associated with TOD, including reduced household expenditures on housing and transit, increased transit ridership and reduced vehicle miles traveled. While any of these could have been adopted as performance measures, these outcomes tend to be highly correlated with each other. For example, households that own fewer cars tend to have lower household VMT and lower household transportation costs. However, because it is useful to have one overall measure of how much people are driving, rather than several related and overlapping values, CTOD chose to use the average annual VMT per household as the primary performance measure of transit zones.

By defining each transit zone by the average VMT per household, the typology ties the place types to a measurable outcome that results from locational attributes, such as walkability and residential density.

Estimating Average VMT

The Center for Neighborhood Technology developed a model of household travel behavior as a part of its Housing and Transportation (H+T®) Affordability Index.[5] The model is based on a multidimensional regression analysis, in which a formula describes the relationship between three dependent variables (auto ownership, auto use, and transit use) and nine main independent household and local environment variables. Neighborhood level (Census block group) data were utilized as the independent, or predictor variables, includes:

- household income (both average and median),
- household size,
- commuters per household,
- journey to work time (for all commuters, transit commuters, and non-transit commuters),
- household density (both residential and gross),
- block size,
- transit access,
- and job access.

The end result is a measure of *household* VMT.

To define different TOD place types, the model estimates the average VMT per household using the underlying household and local environment data from the CTOD database. In order to fully understand the influence of neighborhood characteristics on VMT, household size, income, and commuters per household were fixed to represent the typical regional household of the metropolitan area of each given transit zone.

Fixed-guideway[6] transit stations in the US operate in a wide variety of locations, and the average VMT within these transit zones varies accordingly, ranging from 5,200 miles driven per year up to 31,400 miles. To define different VMT types, CTOD divided the transit zones into five groups, as shown in Table 1.

4 The National TOD Database is available at http://toddata.cnt.org/

5 The H+T® Affordability Index is available at http://htaindex.cnt.org/

6 Fixed-guideway transit includes underground subway and elevated heavy rail, light rail, commuter rail, and bus rapid transit that incorporates dedicated right-of-ways.

Table 1. VMT Types

Household VMT Type	VMT Range
1 – Low	< 9,100
2 – Low-Moderate	9,100 to 11,600
3 – Moderate	11,600 to 14,300
4 – High-Moderate	14,300 to 17,200
5 - High	> 17,200

Estimating Use Mix

While VMT measures how each transit zone performs relative to others in terms of household travel behavior, it gives little sense of what that area looks like "on the ground." Land use mix, or the balance between residential and non-residential uses is a critical determinant of the qualities and characteristics of a place.

Table 2. Use Mix Types

Use Mix Type	Percentage of workers relative to workers and residents
1 primarily residential	33.3% or less
2 balanced	33.3% to 66.7%
3 primarily employment	66.7% or more

Predominantly residential places require different approaches to planning and investment than employment-dominated places. Places with a mix of uses also have their own planning opportunities.

Detailed land use data for all of the transit zones is not available, but counts of residents and workers in the area can be used as proxies for the mix of residences and employment. For counts of residents, the Performance-Based TOD Typology uses 2000 Census data, and for counts of workers, it uses employee counts from the 2000 Census Transportation and Planning Package (CTTP). When the Census Bureau releases the 2010 data, these numbers (and the other metrics used in the Guidebook) will be updated.

Figure 4: Performance-Based Place Types

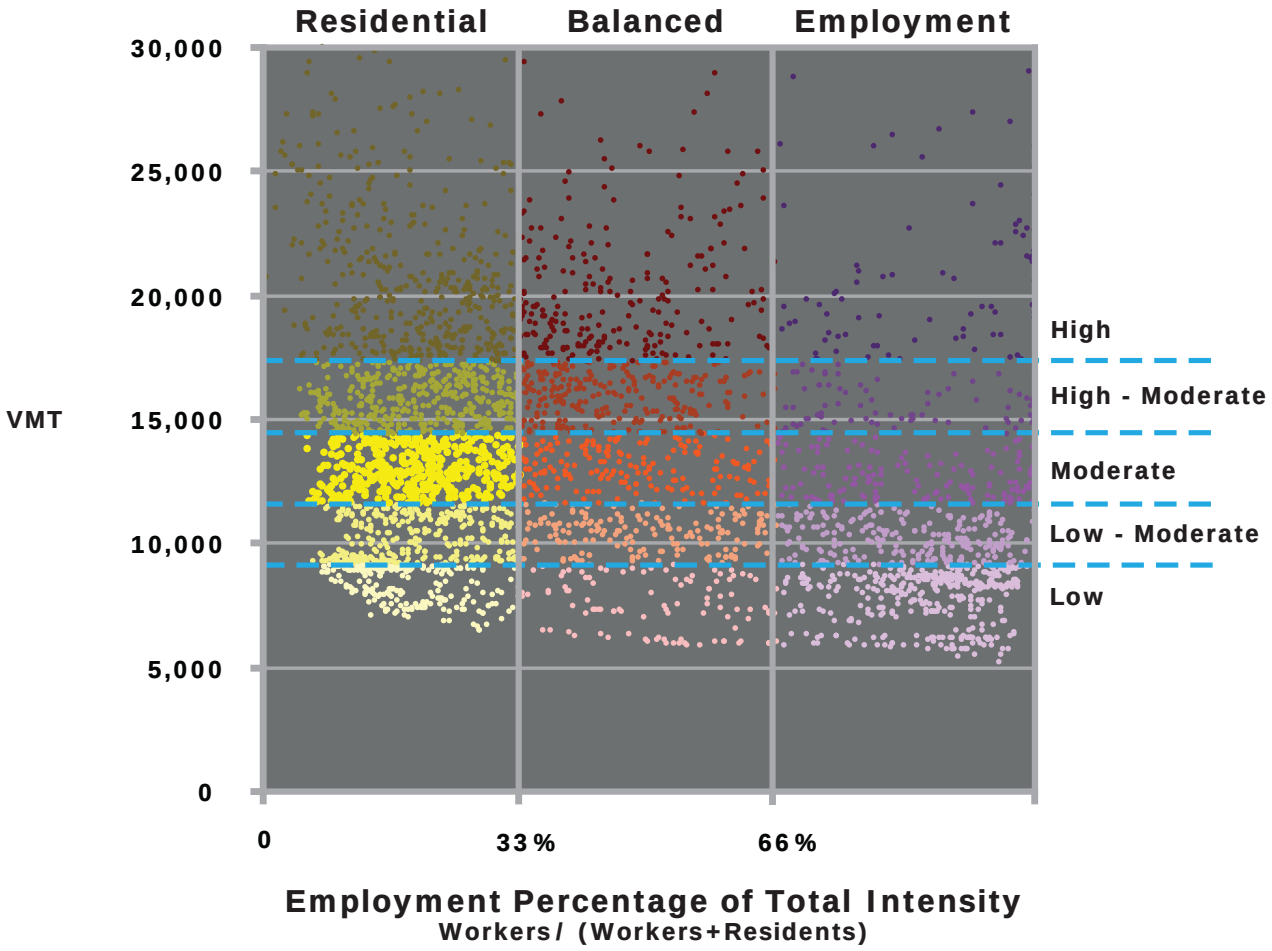
CTOD defines "use mix" as the percentage of workers in a station area, relative to the overall count of residents and workers (workers/(workers + residents)). Station areas are then divided into three types according to this use mix measure, as shown in Table 2. This is a simplified measure in the absence of detailed land use data—but nonetheless conveys the general characteristics of the station area.

Creating Performance-Based TOD Place Types

Performance-Based TOD Place Types utilize two factors: (1) performance—as defined by household VMT and (2) place—as defined by use mix. The typology includes 15 station area place types that are defined by the combination of the three types of use mix with the five VMT types. Figure 4 shows a graphic representation of these place types, with the "highest performing" place types near the bottom with the lowest VMT.

Each place type may include a wide range of transit zones, from more suburban commuter

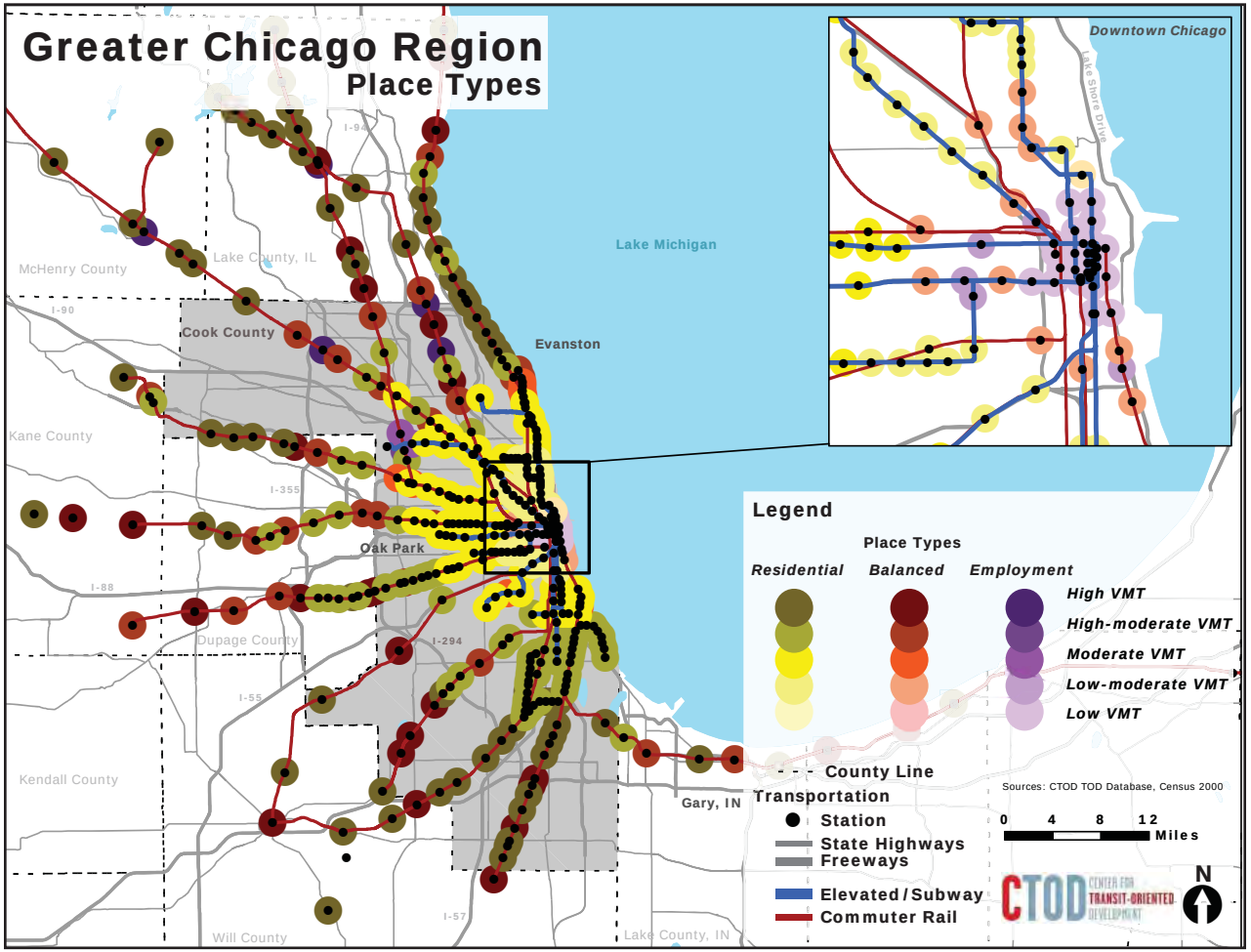
Figure 5: All Stations Sorted into Performance-Based TOD Typology



stations to major downtown transit hubs. Figure 5 shows a graph of all of the existing transit zones, with VMT along the vertical axis and use mix along the horizontal. This graph shows that transit zones exist along a continuous spectrum, though the typology divides that spectrum into distinct parts.

There are several benefits to organizing transit zones in this way. Though each transit zone is a unique place, there are similarities between the transit zones in each place type. These similarities allow policy makers and stakeholders to create common sets of strategies to improve performance. Using place types also helps stakeholders compare one transit zone to another and understand the different characteristics that make one transit zone a lower VMT type than another.

Figure 6. Chicago Region Place Types



Comparing Place Types within a Region

Once each transit zone has an assigned place type, it can be compared to the other transit zones along a corridor, within a neighborhood, or in a region. Figure 6 shows the place types for all of the existing transit zones in the Chicago region. Putting transit zones into their regional contexts makes it easier to identify high performing TOD in the region. Regional context (employment access, the transit network, historical land use and development patterns) is a major contributing factor to the average household VMT in a transit zone. Understanding how this context affects transit zone performance can help inform decisions about transit and TOD. This approach elucidates the similarities and differences among transit and land use patterns across regions as well.

In Chicago, the lowest VMT stations are in the region's core, with low VMT-employment places within the central business district (CBD) and low VMT-residential transit zones surrounding the CBD. These transit zones are more likely to have the elements that support more walking, biking, and transit use. Along suburban commuter rail corridors, the transit zones are more often higher VMT places with both primarily residential and

Figure 7. Bay Area Region Place Types

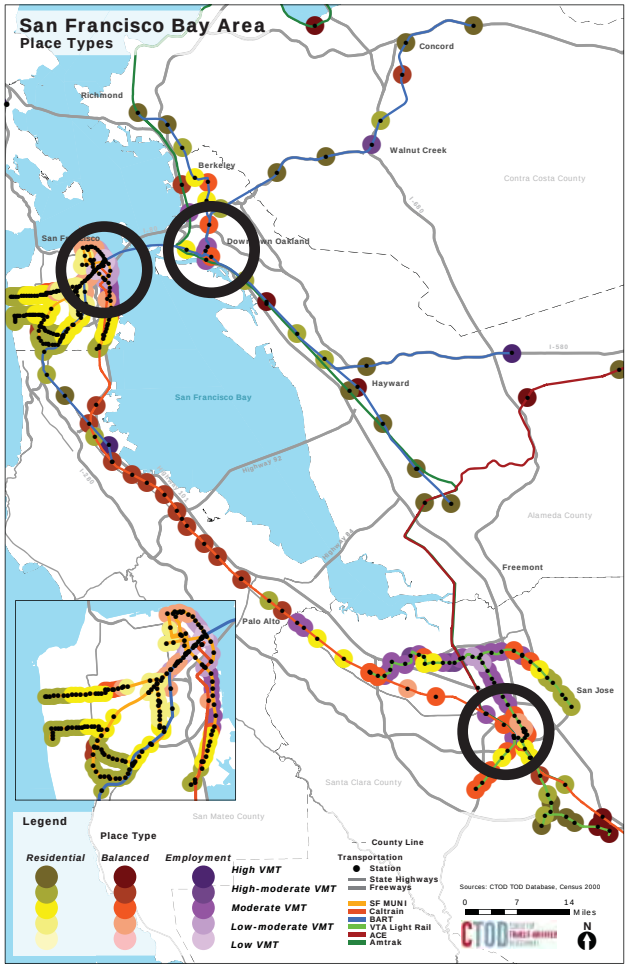


Figure 8. Bay Area Place Types

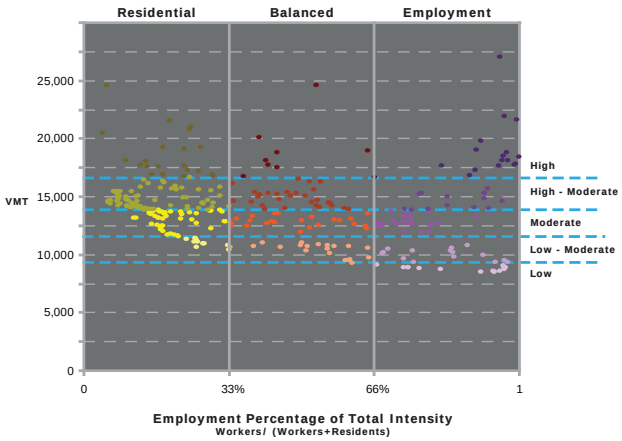
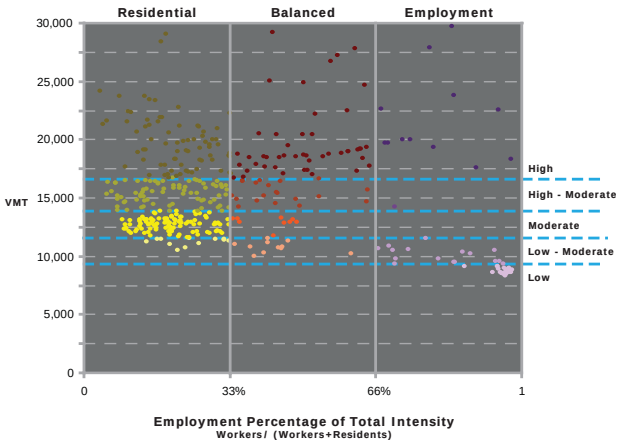


Figure 9. Chicago Region Place Types



balanced use mixes. Households living along these suburban corridors may take transit to work, but they drive more miles than the average residents who live closer to the CBD.

Chicago represents a prevailing pattern seen in both large and small regions, and regions with a variety of economic characteristics. Figure 7 of the San Francisco Bay Area highlights some of these similarities: lower VMT, employment transit zones near downtowns, and higher VMT residential and balanced transit zones farther out from the center. The Bay Area represents a multi-nucleated region, with major centers in San Francisco, San Jose and Oakland. Of these centers, San Francisco has some of the lowest VMT transit zones. Outside of San Francisco, transit zones tend to be higher VMT places, with many more employment-based transit zones.

Figures 8 and 9 above show how transit zones in the Chicago and Bay Area regions are distributed among the fifteen place types. Comparing these distributions, you can see that Chicago has a larger concentration of transit zones in the lower VMT residential place types. San Francisco has more balanced and employment transit zones, and the overall distribution of transit zones ends to be in the moderate VMT categories. In both regions, there are only a few transit zones in the high VMT categories. This is partly indicative of higher residential densities found in urban areas as well as established transit systems.

III. Normative Metrics

What Are the Normative Metrics?

Performance (VMT) and place (use mix) are combined to create place types that help organize transit zones. However, each place type also has additional characteristics (or metrics) that can be used to evaluate performance. For the purpose of this Guidebook a Normative Metric is defined as a measure that allows for the comparison of similar transit zones within each place type. These metrics are normative, in the sense that they represent the average value, of the universe of values, within each place type. They can be used to compare any given transit zone to the average or norm of the universe of similar transit zones.

The Normative Metrics in this Guidebook can be used as performance measures. Paired with the Performance-Based TOD Typology, they gauge the performance of transit zones. The data for each station area comes from a variety of sources and are compiled from CTOD's National TOD database. Table 3 shows the different metrics analyzed and the national average for each metric (if applicable.)

Comparing the national average of these metrics to the Normative Metric for each place type can show if transit zones of different place types

Table 3: Normative Metrics

Metric	National Average
Total Intensity (residents + workers)	N.A.
Residents	N.A.
Workers	N.A.
Workers/Residents	N.A.
Households	N.A.
Household Size	2.59
Gross Density (units/acre)	N.A.
Residential Density (units/acre)	N.A.
Average Block Size (acres)	N.A.
Monthly T Cost	N.A.
Yearly T Cost	N.A.
Average Median Income (1999)	$40,696
Travel Time to Work (minutes)	24.3
Employment Gravity (jobs nearby)	N.A.
Transit Access Index	N.A.
Autos/Household	1.9
Home Journey to Work Transit	5.7%
Home Journey to Work Walk/ Bike/Transit	8.2%
Workplace Journey to Work Transit	5.7%
Workplace Journey to Work Walk/Bike/Transit	8.2%

Figure 10: Normative Metric Relationships

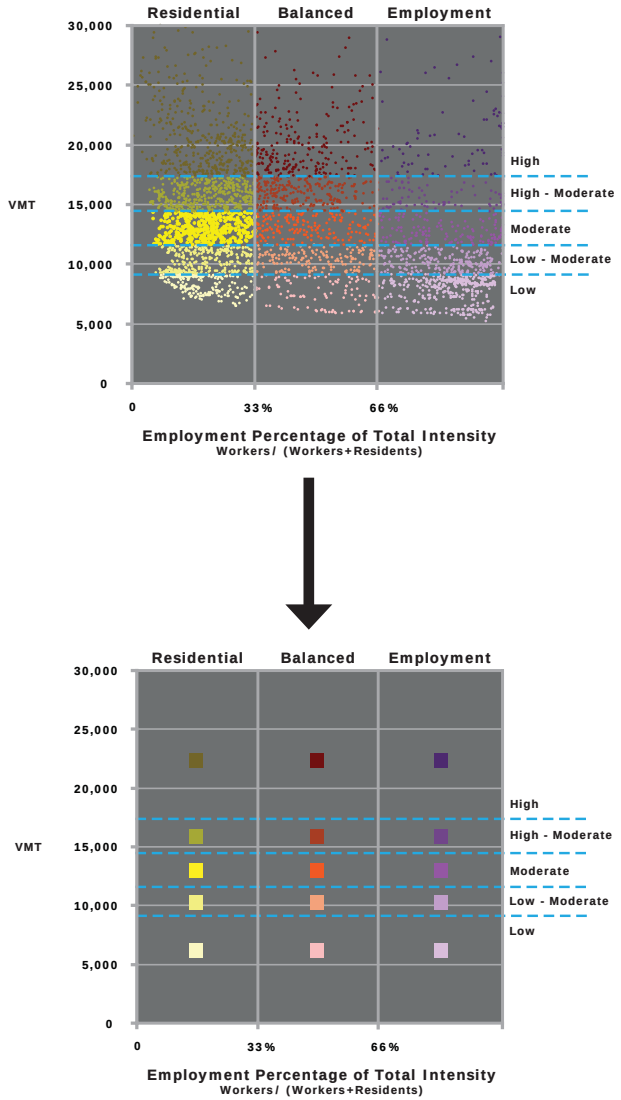


Table 4. Normative Metrics

Place Types	Residential Places					Balanced Places					Employment Places				
	Low VMT	Low-Mod VMT	Mod VMT	High-Mod VMT	High VMT	Low VMT	Low-Mod VMT	Mod VMT	High-Mod VMT	High VMT	Low VMT	Low-Mod VMT	Mod VMT	High-Mod VMT	High VMT
Total Intensity (residents + workers)	54,216	24,718	12,580	7,708	3,429	64,155	21,763	11,600	6,867	3,242	109,306	34,914	13,009	5,969	2,325
Residents	44,293	20,106	10,229	6,292	2,716	29,875	10,732	5,884	3,695	1,764	12,581	5,103	2,065	1,154	321
Workers	9,923	4,612	2,351	1,416	713	34,280	11,031	5,716	3,172	1,478	96,725	29,811	10,944	4,815	2,004
Workers/Residents	18.3%	19.5%	19.6%	20.3%	19.6%	51.6%	49.7%	48.2%	46.0%	46.2%	86.5%	83.9%	84.2%	83.0%	87.1%
Households	16,214	7,684	3,906	2,253	974	15,466	4,646	2,429	1,467	670	6,828	2,524	861	467	120
Household Size	2.71	2.61	2.62	2.71	2.68	1.95	2.21	2.41	2.43	2.60	1.58	1.67	2.22	2.28	2.64
Gross Density (units/acre)	50.0	21.6	10.3	5.7	2.2	48.7	16.4	7.6	4.0	1.9	28.5	10.3	4.6	2.2	0.9
Residential Density (units/acre)	53.2	23.6	12.1	6.7	3.4	55.6	20.9	10.5	5.8	3.5	51.4	20.6	10.8	6.0	2.9
Block Size (acres)	4.2	4.1	5.7	7.7	18.8	3.7	5.8	8.5	9.9	23.7	3.7	6.4	14.2	69.9	86.7
Monthly T Cost	$422	$563	$688	$781	$906	$394	$597	$721	$794	$900	$463	$613	$713	$793	$920
Yearly T Cost	$5,064	$6,756	$8,256	$9,372	$10,872	$4,728	$7,164	$8,652	$9,528	$10,800	$5,556	$7,356	$8,556	$9,516	$11,040
Average Median Income (1999)	$31,713	$35,643	$41,344	$53,492	$62,06t9	$43,997	$37,364	$43,395	$51,138	$65,544	$41,875	$34,183	$43,935	$40,985	$57,562
Travel Time to Work (minutes)	35.6	31.4	27.4	25.5	24.7	23.5	22.1	21.4	21.6	22.9	18.0	17.1	18.7	19.0	21.5
Employment Proximity	233,890	127,448	65,640	42,260	20,788	451,725	152,310	73,393	41,335	27,131	396,277	159,118	99,648	58,747	32,167
Transit Access Index	31	19	13	10	3	56	28	11	9	4	85	45	19	10	4
Autos/Household	0.45	0.82	1.18	1.47	1.71	0.52	0.87	1.22	1.41	1.68	0.48	0.74	1.11	1.18	1.61
Home Journey to Work Transit	58%	39%	23%	15%	8%	43%	25%	14%	10%	8%	25%	16%	13%	9%	5%
Home Journey to Work Walk/Bike/ Transit	68%	47%	27%	18%	10%	64%	40%	23%	15%	11%	58%	37%	24%	18%	9%
Workplace Journey to Work Transit	33%	20%	11%	7%	2%	38%	17%	8%	5%	3%	38%	16%	9%	5%	3%
Workplace Journey to Work Walk/Bike/ Transit	47%	30%	18%	12%	6%	48%	23%	12%	8%	5%	43%	19%	11%	7%	5%

are performing better or worse than the national average. (The national average is the average of all people or households in the US, not just those living in transit zones.)

Table 4 on page 15 shows the Normative Metrics for each place type in the typology. These metrics are meant to give an overall sense of the characteristics of each place type. The metrics were calculated by averaging all of the transit zones within each place type. For example, the normative intensity for a low VMT, residential transit zone is derived by averaging all of the transit zones in that place type, and computes to 54,215 persons (workers and residents.) The TOD Database provides these metrics for every operational transit zone in the US.

In Figure 10, each point in the graphic at the top is a transit zone in the TOD database. The boxes in the graphic to the bottom show figuratively how the Normative Metrics represent the average of all the stations within one place type. (A more detailed explanation of how CTOD calculated each metric is in the appendix.)

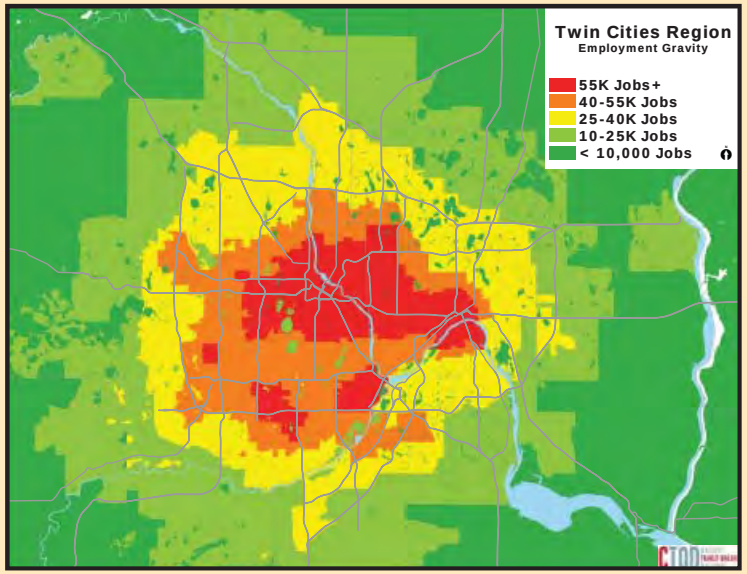
Overall, the Normative Metrics of lower VMT places show higher performing TOD than higher VMT places (higher transit ridership, lower auto ownership, etc.) A discussion of key findings from the Normative Metrics follows.

Focus on Employment Proximity

Employment proximity, or employment gravity, measures the access that residents within a transit zone have to jobs across the region by using a gravity based model.[7]

Previous research by CNT and CTOD has found that households that are near many jobs, or have higher employment proximity, have lower VMT than those with lower access to employment.[8] There are at least two factors that may reduce the need for driving in the presence of greater employment: 1) Because there are a more jobs near the transit zone, residents are more likely to have shorter commutes than people who live in places with low employment access. 2) Places with high employment access may also have many local services and shopping opportunities that residents can access without driving long distances. The map shows employment gravity in the Twin Cities, with the areas in red with the highest employment gravity, or proximity.

Figure 11. Employment Gravity in the Twin Cities



7 The total employment access is defined as the sum of all of the jobs in a region, weighted by the inverse square of their distance from a given station area. For example, a block group with 100 jobs that is 2 miles from a station area would contribute $100/2^2 = 100/4 = 25$ jobs to the employment access for that station area, whereas a block group with 100 jobs that is 10 miles away would only contribute $100/10^2 = 100/100 = 1$ job.

8 Center for Transit Oriented Development and Center for Neighborhood Technology. "Transit Oriented Development and the Potential for VMT-Related Greenhouse Gas Emissions Reduction," March 2010.

Key Findings from Normative Metrics

Overall, most transit stations perform better than or at the national average, outperforming the typical non-transit-oriented place. Within each metrics or set of metrics there are some interesting variations on this general theme.

Auto Ownership & Transportation Costs

Transit zones in low VMT places types tend to have low transportation costs and low rates of automobile ownership. This finding could influence local land use policies, such as parking requirements for new development, providing a rationale for allowing lower parking ratios in lower VMT places. Higher VMT transit zones that want to improve their performance on this metric might consider what elements would make it easier for households to get rid of one or more cars, including grocery stores within walking distance of households or sidewalks and other pedestrian amenities.

Figure 12 shows how the Performance-Based TOD Place Types differ on vehicle ownership. The difference between the highest and lowest VMT places is significant, but scaling down from one level to another happens incrementally. This graphic also shows that auto ownership does not vary significantly with changes in use mix, though it does with VMT.

While the Normative Metrics compare the performance of transit zones around the country to one another, it is also important to consider how these areas are performing when compared to the national average. On this particular metric, the national average for vehicle ownership (1.9 cars per household) is slightly higher than the average for the highest VMT place type. However, households in low VMT transit zones own one fourth as many cars on average.

Figure 13 shows that the average household living in a low VMT transit zone spends half as much on transportation costs than households living in high VMT places ($4,000-5,000 compared to $10,000-11,000). Transportation costs quantify the yearly expenditures the average household will make on auto ownership (car payments, maintenance, etc.), auto use (gas purchases), and transit use. The average household in the US spends about 19 percent of their income on transportation costs, and 47 percent of their income on the costs of housing and

Figure 12: Normative Metrics for Household Automobile Ownership

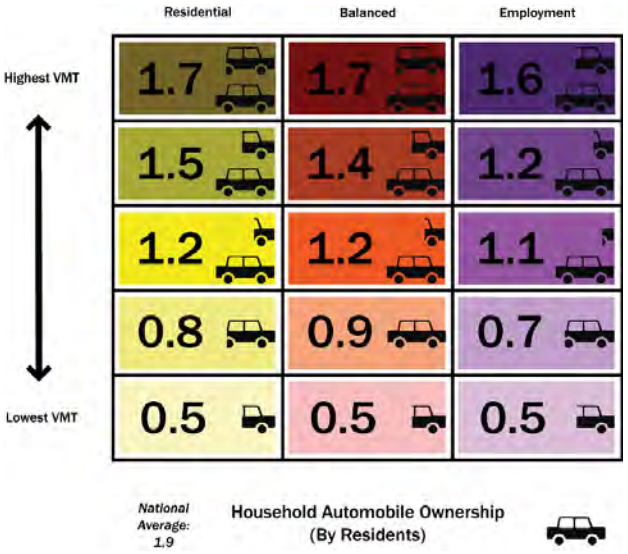
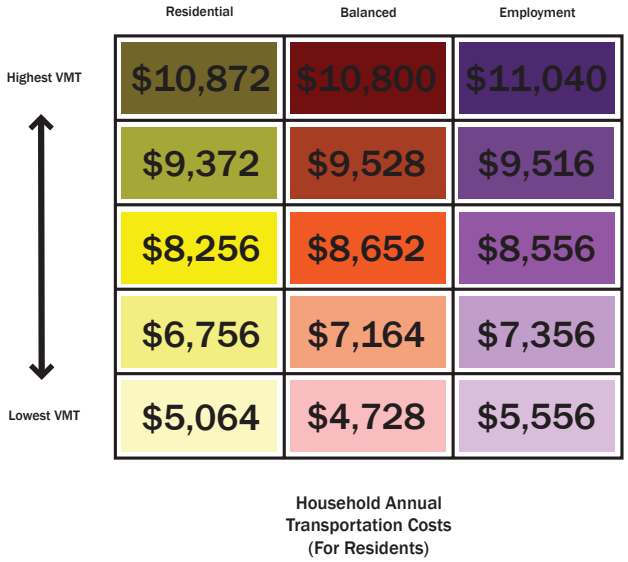


Figure 13: Normative Metrics for Transportation Costs



transportation combined.[9] More and more, policy makers and stakeholders are looking at both housing and transportation costs as a measure of the neighborhood affordability.

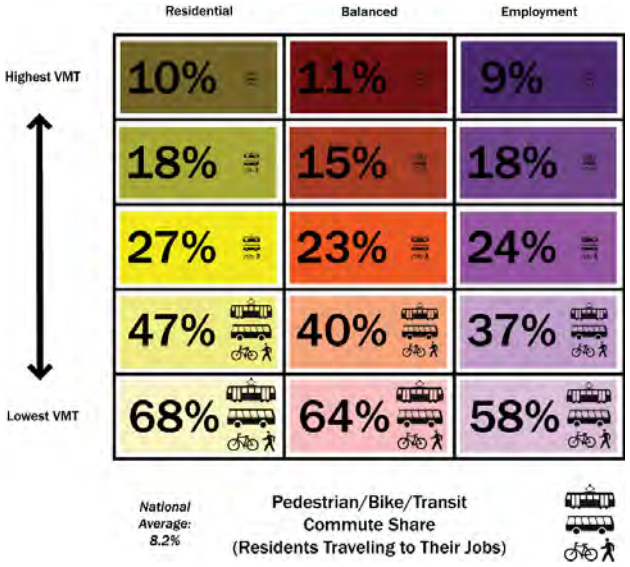
Because of the potential savings on transportation costs that are available in low VMT place types, these transit zones are important places to ensure that a range of housing options exist to serve residents with a wide range of incomes.

Commute Travel Behavior

Low VMT place types exhibit more transit ridership and higher rates of walking and biking to work than high VMT transit zones. This finding is equally true of commutes by residents living in transit zones and commutes by workers who work in transit zones.

Figure 14 shows that 58 percent of commuters in low VMT, residential places use transit to get to work, more than 10 times the national average. However, transit ridership rates in high VMT transit zones are much lower (closer to the national average.) In general, workers living in more residential transit zones use transit to commute more than residents in balanced or

Figure 14: Normative Metrics for Non-Auto Journey to Work



employment place types, independent of VMT. However, these differences are less pronounced when comparing the percent of people who use transit, walk, and bike to work. Residents of transit zones that have a lot of employment activity may find it easier to walk or bike to jobs within the transit zone.

The Normative Metrics also underscore a similar pattern for people who work in transit zones. In low VMT transit zones, workers take transit at 8 times the rate as the national average. In contrast, workers traveling to high VMT transit zones take transit even less than the national average. This finding suggests that concentrating employment in low VMT transit zones will have a strong positive impact on transit use in general.

Urban Form

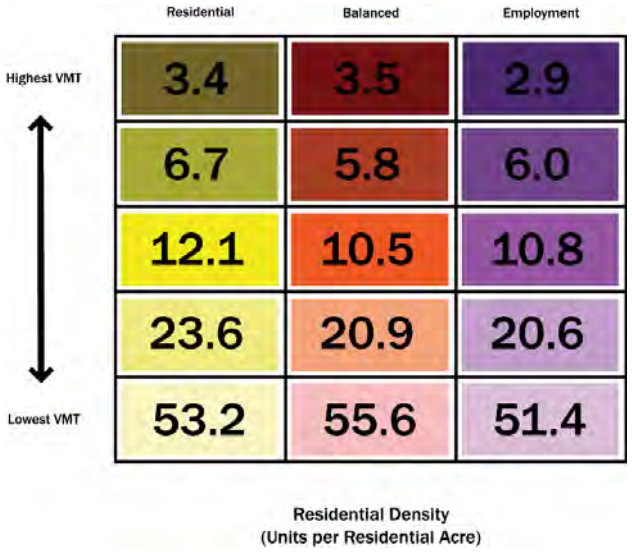
Low VMT transit zones tend to have more intensity (residents + workers) and higher residential densities than high VMT transit zones. Residential densities in low VMT transit zones are over 15 times as high compared to high VMT transit zones (shown in Figure 15.) Blocks in low VMT transit zones average between 3.7 acres (for employment and balanced use places) and 4.2 acres (for residential places). In high VMT places, the range is between 18.8 acres (for residential places) and 86.7 acres (for employment places).

This finding suggests that low VMT transit zones are also characterized by urban form that is generally more pedestrian-friendly than high VMT transit zones. Block sizes and pedestrian connectivity are difficult to change, a challenge for high VMT transit zones that want to transition into lower VMT places.

However, there are examples of places where older, suburban-style malls or manufacturing districts have recreated grid street networks to support more walking. In Oak Park, a pedestrian mall was reintroduced to the street

9 Center for Transit-Oriented Development and CNT. "The Affordability Index: A New Tool for Measuring the True Affordability of a Housing Choice," January 2006.

Figure 15: Normative Metrics for Residential Density



network and loaded with pedestrian amenities. It provided some parking for local businesses and opened up traffic flow to reduce congestion. In Gresham, OR, the city reintroduced the grid when redeveloping a large tract of land into a commercial center. Research has shown that urban form characteristics known as "the four Ds" (density, design, distance, destinations) are critical for lowering overall VMT. While this study has focused on household VMT data as a performance standard, future research should look to investigate the 4D research with this performance-based approach.

Other Uses for Normative Metrics

The case studies show how the Normative Metrics can also be used to analyze the performance of a particular transit zone. The Normative Metrics offer individual transit zones a starting point to analyze how they compare to stations that are similar to them in terms of VMT and use mix. The individual transit zone may differ considerably from a normative metric for its place type. Places in transition may use the Normative Metrics to see where they might end up on the spectrum.

Policy makers and stakeholders that want to outline strategies to improve the performance of their station area can use the Normative Metrics to set quantitative goals. To lower VMT, they may look to the Normative Metrics to see what the norm for that place type is in terms of vehicle ownership, transit use, density and more to determine the types of changes to be made.

Many policy changes will happen locally, but federal and state actors could also use the Normative Metrics to set up funding mechanisms and initiatives that will help local jurisdictions achieve their goals. Allocations of federal grants for affordable housing or redevelopment funds could be targeted to areas that plan for more changes. Additionally, with an existing baseline for each station area, it is possible to track progress over time, making adjustments to funding easier and giving each jurisdiction a fair playing field no matter what type of place they are.

The Normative Metrics may also be useful in scenario planning at the regional scale, discussed more in Section IV below. Residential density, employment proximity, transit access, and block size are all important inputs to the average VMT in a transit zone. Some metrics may be more important than others for a particular transit zone, and the potential for a transit zone to change some of those metrics will differ depending on the specific place. A full complement of illustrations of the metrics can be found in the Appendix.

IV. Case Studies

The case studies take a look at nine different transit zones within the Performance-Based TOD Typology: Vermont/Santa Monica, CA; Oak Park, IL; West Irving, TX; East Liberty, PA; Downtown Berkeley, CA; Gresham Transit Center, OR; Essex Street, NJ; Buckhead, GA; and Rockville, MD. They serve as examples of the nine different place types and act as a template for stakeholders to created their own existing conditions analysis. This section gives an overview of the purpose and how to use the case studies. The full four-page case studies are in Section VII of this Guidebook..

Criteria for Choices

The case studies were chosen in order to show a variety of types of transit zones that differ not only in their place type as defined by the Performance-Based TOD Typology, but also differ in where they are located in the US, the size of the overall region, the size and age of the transit network, the type of transit in place in the transit zone, and the median income in the transit zone. Table 5 shows how the case studies are distributed.

Each of the stations chosen was on a transit line that began operating before the 2000 Census. While all places have experienced some change since 2000, this report focuses on transit zones where the basic demographic conditions used to categorize and measure performance already reflected the existence of transit.

This report includes case studies for nine of the fifteen total place types. To show a diverse range of place types, the case study stations were chosen to ensure that at least one low or low-moderate, one moderate, and one high or high-moderate place type in each use mix category was represented. Figure 16 shows which place types are presented by the case studies, with dashed lines separating the low and low-moderate and high and high-moderate place types.

Using Case Studies

There are four parts to the case studies:

- Part 1: Place Type Overview
- Part 2: Regional Context
- Part 3: Comparing to Normative Metrics
- Part 4: Other Examples Across the Country

The case studies perform several functions. They show an example of a typical station and transit zone within each major place type and discuss how that station performs compared to the Normative Metrics for that place type. They also demonstrate how to perform an existing conditions analysis for any transit zone in the US using the National TOD Database and the H+T® Affordability Index.[10]

Part 1: Place Type Overview

This section discusses what it means to be in a particular place type, and pulls some examples from the case study to show what housing looks like in terms of density, whether there are small blocks on a grid or sprawling suburban cul-de-sacs, and what kinds of retail or employment uses are in the area.

10 The Database is available online at http://toddata.cnt.org/ and the H+T® Affordability Index is available at http://htaindex.cnt.org/

Figure 16: Case Studies

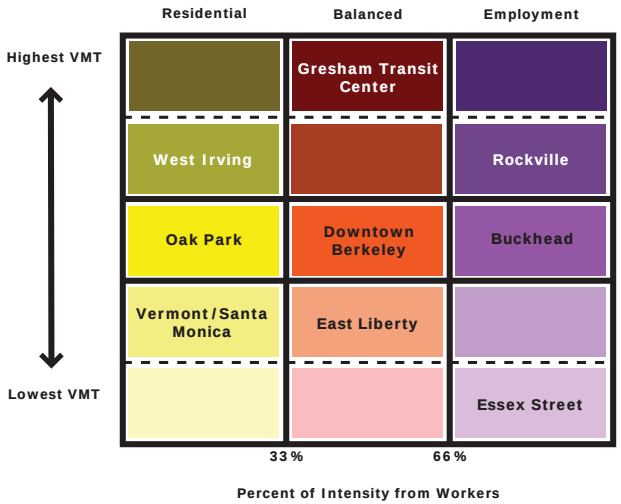


Table 5. VMT Place Type Case Studies

Place Type		Station Name	Transit Region	Rail Type	Median Income	Size of Transit Network	Geographic Region
VMT	Use Mix						
Low-moderate VMT	Residential	Vermont / Santa Monica	Los Angeles	Heavy Rail	Low	Large	West
Moderate VMT	Residential	Oak Park	Chicago	Heavy Rail	High	Expansive	Midwest
High-moderate VMT	Residential	West Irving	Dallas	Commuter Rail	Moderate	Medium	South
Low-moderate VMT	Balanced Use	East Liberty	Pittsburgh	Bus Rapid Transit	Low	Medium	East
Moderate VMt	Balanced Use	Downtown Berkeley	San Francisco	Heavy Rail	Low	Expansive	West
High VMT	Balanced Use	Gresham Transit Center	Portland	Light Rail	Moderate	Large	West
Low VMT	Employment	Essex, NJ	New York Tristate	Light Rail	High	Expansive	East
Moderate VMT	Employment	Buckhead	Atlanta	Heavy Rail	High	Medium	South
High-moderate VMT	Employment	Rockville	Washington, DC	Heavy Rail	Moderate	Large	East

For example, the moderate VMT, employment use transit zone (Buckhead in Atlanta, GA) has the following characteristics:

- Tall office buildings surround the Buckhead station, which is located along a major arterial (Highway 400). This kind of land use may be typical of other employment place types.
- Buckhead is also close to a large shopping mall, and has many other auto-oriented retail centers in the area. As a moderate VMT place, people will drive to many of these destinations.
- There is a small residential area within the transit zone, where residential density is very low, only 3.4 households per acre.
- The streets are curvilinear without a clear grid; there are few intersections, and there are no direct paths from residential areas to the transit station or mall, making walking from the residential area to the mall extremely challenging.

Some of these may also be characteristics of other moderate VMT, employment use places, but are not necessarily true for all transit zones in this place type. This description is meant to give the unfamiliar user a sense for what a moderate VMT, employment use place might be like.

In contrast, the low-moderate VMT, residential use case study (Vermont/Santa Monica in Los Angeles, CA) has the following characteristics:

- Vermont/Santa Monica is primarily a residential area, bordered by older retail corridors. Many central urban stations in older cities with extensive transit networks have many stations in this place type.
- In the Vermont/Santa Monica transit zone, residential density is about 19 units per acre, which takes the form of moderately dense 3-4 story apartment buildings.
- Streets around the Vermont/Santa Monica station are in a well-connected grid, though there are a few large blocks directly around the station.
- Both Vermont Ave. and Santa Monica Blvd. are retail corridors, but instead of walkable, small scale retail, most of the stores are auto-oriented, and there are a few larger big box shops near the station itself.

From this simple description, these two places have some obvious differences:

- Residential density is much higher in the low-moderate VMT, residential use place
- The street patterns are very different: curvilinear in the moderate VMT, employment use place and gridded in the low-moderate VMT residential place.
- Both places have some retail uses. Buckhead's is mostly in the mall and surrounding areas, while Vermont / Santa Monica's retail is along commercial corridors.

Part 2: Regional Context

This section compares the case study transit zone to the region. Knowing how far away the station is from major employment centers in the region helps broaden the understanding of employment proximity and access (discussed in the Normative Metrics section above.) Comparing one particular station and transit zone to others in the same region can be helpful for local and regional actors as well—regional conditions play an important role in determining how transit zones perform on the metrics discussed in the Guidebook, and understanding how a station fits into the region is important to identifying policies to help lower VMT in transit zones.

The maps in Figure 17 show the place types of transit zones in two regions: Dallas-Forth Worth, TX and Pittsburgh, PA. There are some similarities between these two regions:

- Transit zones in the downtown areas in both regions tend to be in the low VMT, employment use place type.
- The majority of transit zones are moderate VMT or higher.
- Transit zones are more likely to be higher VMT the farther away they are from the central city.

However, these two regions also differ in fairly significant ways:

- Dallas has far more employment-centric and balanced stations than residential ones. Most of Pittsburgh's transit zones are primarily residential places.
- Pittsburgh connects to several low VMT residential and balanced use places outside of the CBD. Dallas has almost no low VMT transit zones outside of its CBD.
- Pittsburgh's transit system is a mix of pre and post WWII lines, while Dallas-Fort Worth's was all built after 1996.

Regions with different transit systems will also

Figure 17. Dallas-Fort Worth vs Pittsburgh, PA

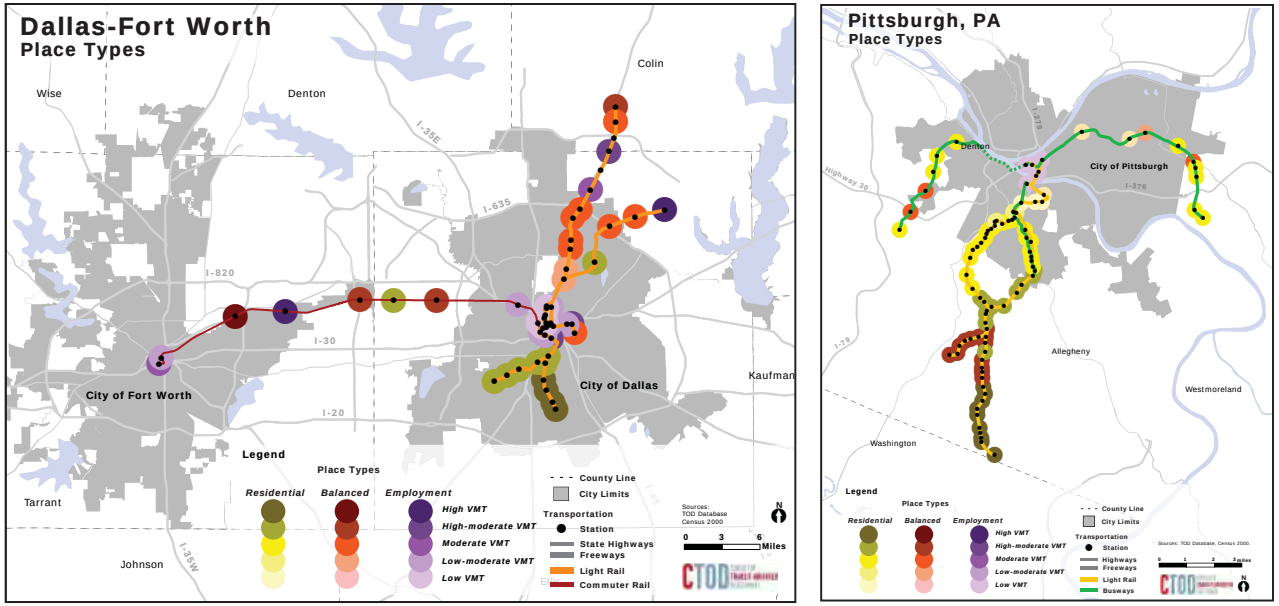
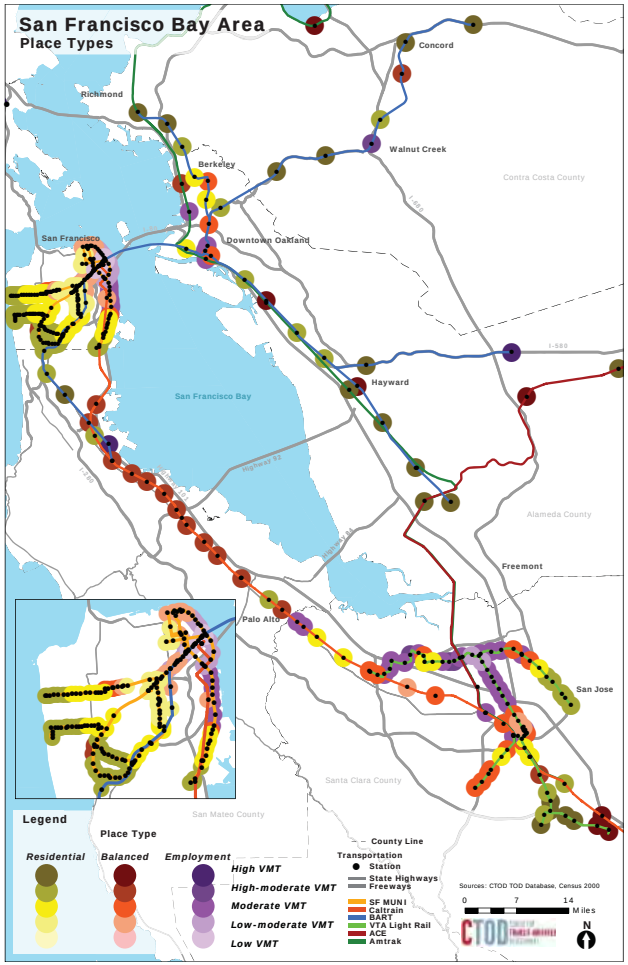


Figure 18. Transit Zones in the Bay Area



have a different pattern of place types. The map in Figure 18 shows the San Francisco Bay Area.

The Bay Area has an extensive system, older than Dallas's new light rail, but younger than other extensive systems like Chicago and New York City. While the region has many stations in many different kinds of places, the map shows that even within the City of San Francisco, transit zones have a range of VMT and use mix types. Similar to Dallas and Pittsburgh, stations outside of city centers in the Bay Area tend to be higher VMT places, but these include both more residential places in the East Bay and balanced use places along the Caltrain line along the Peninsula.

Regional planners trying to reduce VMT, increase transit ridership, and offer more walkable mixed use neighborhoods can benefit from understanding the overall picture of how transit zones are performing compared to the national Normative Metrics laid out in this Guidebook. Looking at the regional picture can help identify places that are already high performers within the region and help guide policy decisions to support similar "high-performing" places in other parts of the region. These places may be models for other transit zones in the region.

At the station area scale, understanding how a particular transit zone relates to the region (through its proximity to employment, its connections to the broader transit and transportation network, and how it compares to the region on the performance metrics discussed in the Section II) can help to define station area planning priorities and goals. Below are two examples of regional analysis in the case studies.

Downtown Berkeley

Located in the East Bay of the San Francisco Bay Area, downtown Berkeley is on the Bay Area Rapid Transit (BART) heavy rail system. Downtown Berkeley is one of the more urban stations in the BART network, with a mix of office buildings, moderate to higher density residential, and a plethora of restaurants, bars, and shops. This station is also in close proximity to the University of California at Berkeley campus, a major employer and activity generator.

Downtown Berkeley is well-connected to regional job centers. The transit zone is within a 20 minute transit ride to downtown San Francisco and a 10 minute ride to downtown Oakland. The transit zone itself is also an important job center for the region, with nearly 18,000 workers in the half mile around the station alone. Downtown Berkeley has the highest percentage of workers who commute by walking, nearly 14%, in part due to the many housing opportunities in proximity to these jobs. Increasing employment proximity may be the best way to reduce household VMT in this transit zone.

The Bay Area has a diverse mix of transit zones, and Downtown Berkeley falls in the middle in terms of VMT. Many stations in the city of San Francisco fall into the low-moderate and low VMT types, while the Peninsula and the South Bay (where San Jose and Silicon Valley are located) have more transit zones in the higher VMT places.

Oak Park

The Oak Park transit zone is located in the Village of Oak Park, on the western border of the City of Chicago. The station is the second to last on the CTA's Green Line, an elevated heavy rail line whose stations are close together, about a half-mile apart. A commuter rail station (run by Metra) is about a half-mile from the Oak Park station and has a direct connection to the Green Line's terminal station, Harlem and Lake. The corridor around the Green Line is primarily mixed-use, with retail and office uses mixed with apartment and condo buildings. A single-family residential neighborhood extends beyond the mixed-use zone. Oak Park is well-known for its many Frank Lloyd Wright homes, but the neighborhood has a diverse mix of housing.

Oak Park has many transit connections to downtown Chicago, the major employment hub in the region, including the Green Line, Metra's Union Pacific West Line, and the CTA Blue Line located in the southern half of Oak Park. The Metra Line continues west from Oak Park and together with PACE bus service provides a limited number of connections to several suburban employment centers such as Oak Brook and Wheaton. Oak Park has also worked to improve the mobility options within the city; Oak Park boasts a rickshaw taxi service, two car sharing program, and a bicycle and electric car rental service.

Oak Park is fairly dense (15.2 households/acre), compared to the Chicago region (4.8 households/acre) and to the average residential density of other transit zones in the region (8.5 households/acre.) Median household income is slightly higher in Oak Park than the region ($51,680) and the area includes a diverse range of income groups. While housing in the Chicago region is predominantly owner-occupied, Oak Park has an even mix of renters and owners.

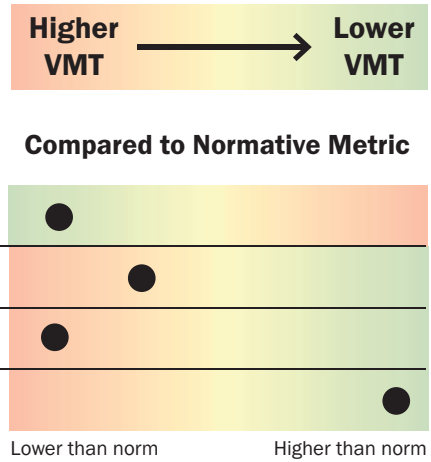
Part 3: Comparing to Normative Metrics

This part of the case study compares the metrics for each case study station to the Normative Metrics for that place type. There are three sections within this part of the case studies.

One section focuses specifically on the metrics that directly impact the VMT model used in this Guidebook: block size, residential density, employment proximity, and transit options. Though there are other inputs to the model, these four are pieces of the built environment

Figure 19. Part 3 of Case Studies

What factors can lower VMT in East Liberty?



Metric	East Liberty
Average Block Size	3.2 acres/block
Residential Density	15.5 units/acre
Employment Proximity*	64,760 jobs nearby
Transit Access Index*	71 transit opportunities

and transportation alternatives that planners and decision makers can impact.

Figure 19 shows how the metrics for an individual station are compared to the Normative Metrics. This section shows how the East Liberty transit zone performs on some of the key factors that affect VMT. The transit zone has more than twice as many transit opportunities as the typical low-moderate VMT, balanced use place, and the average block size is about half as small. However, residential density is a little lower in East Liberty station than the typical place, and there are half as many jobs nearby. To lower VMT in this transit zone, efforts could be focused on increasing residential density and improving employment proximity.

The second section in Part 3 includes other transportation performance metrics to broaden the overall picture of car ownership, transportation costs, and travel patterns within the transit zone; the third section is an assessment of the total residential and worker population and of other factors like household size and median income that can help form a picture of what a transit zone is like, but that may not be relevant to lowering VMT.

Part 4: Other Examples Across the Country

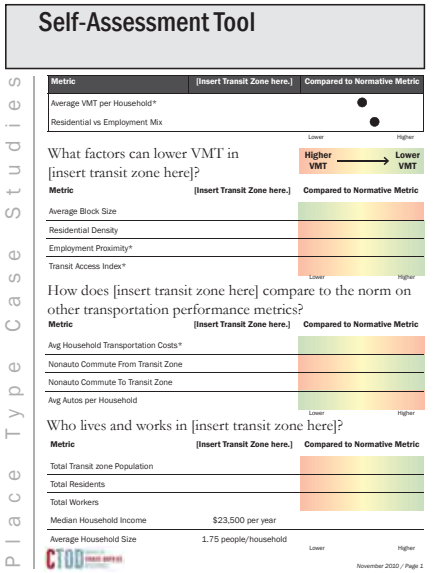
The last section shows ten examples of other stations around the country that are the same place type. Readers who are unfamiliar with the case study region or station may recognize another station on the list, making it easier to contextualize the different place types.

Build Your Own

Figure 20 is a template that stakeholders interested in lowering VMT in their station area can use. The template shows all of Part 3 from the case studies, the section that analyzes how the individual station compares to the Normative Metrics for that place type.

Stakeholders interested in how their station area is performing compared to the average station area in the same place type can fill out the form in the Appendix. Using this template can also help stakeholders identify where there are opportunities to lower VMT. The next section of the Guidebook discusses scenario planning, and shows that stations in the highest VMT types have some of the greatest opportunity to lower VMT by making fairly incremental changes. Increasing residential density and improving employment proximity can create the most opportunity for lowering VMT in a transit zone. Identifying how a particular transit zone already performs on these indicators will improve the overall understanding of what strategies can be implemented.

Figure 20. Template Place Type



To fill out the template, stakeholders should use the TOD Database (http://toddata.cnt.org/), which provides data for over 4,000 existing and potential transit zones in the US. VMT is given in the H+T® Affordability Index, also available online (http://htaindex.cnt.org/.) The Normative Metrics for each place type are given in this Guidebook. Stakeholders should first identify their station's place type and then compare each metric in their station to the Normative Metrics for that place type.

V. Changing Transit Zone Performance

The typology uses existing conditions to group together similar transit zones from all parts of the country. It is primarily oriented around the average household VMT in transit zones and can be used as a tool to determine how to lower the average VMT in an individual transit zone, effectively moving the transit zone from one place type to another.

Table 6 provides context for evaluating household VMT reductions, showing the ranges of VMT in each category. Reducing average VMT in a transit zone by approximately 2,500 would enable a transit zone to change its place type. However, even reductions of less than 2,500 can have a meaningful impact and reduce VMT and CO_2 emissions in the transit zone and the region, even if the place type does not change.

Table 6. VMT Category Widths

VMT Category	VMT Range	Width
Low	< 9,100	
Low-Moderate	9,100-11,600	2,500
Moderate	11,600-14,300	2,700
High-Moderate	14,300-17,200	2,900
High	>17,200	

Key questions for users are 1) what needs to change to lower VMT, and 2) how much change is needed to significantly lower VMT. Previous work by CNT and CTOD has shown that residential household density and employment access are strong drivers behind the travel behavior of households.[11]

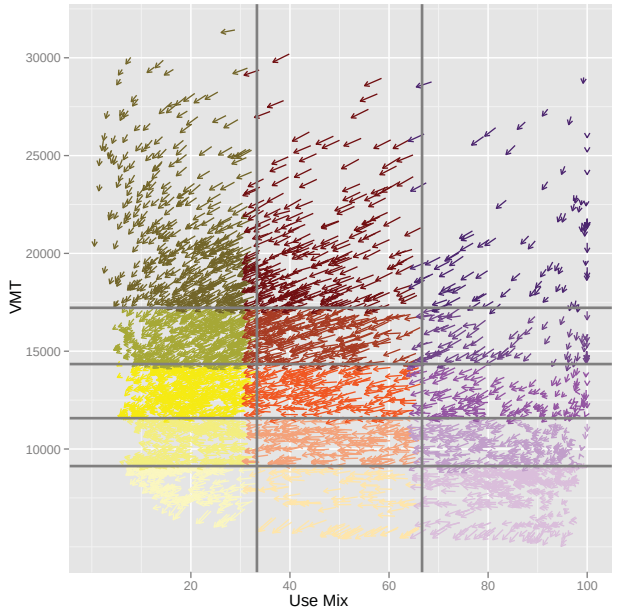
While these scenarios show broad pictures of the VMT reductions possible with increases in housing and employment, planning for such increases in the real world should ensure that increasing housing means increasing the diversity of housing types affordable to a range of household incomes. Likewise, employment growth should be aimed at a wide range of job opportunities, with varying skills and salaries. Increasing employment access means strengthening existing job centers, not creating new ones or adding employment to every transit zone. New transit investments should also connect to existing job centers to enhance regional access.

As both housing and employment are inputs to the model that CNT developed to predict household travel behavior, they can be used to show how changes might affect transit zone VMT.

Development Scenarios

New development can change both employment access and residential density. Regions plan for a finite number of new residents and jobs, and

Figure 21: Scenario A - Increased Employment Access & Households by 15 Percent



11 CTOD and Center for Neighborhood Technology. "Transit Oriented Development and the Potential for VMT-Related Greenhouse Gas Emissions Reduction," March 2010.

the Performance-Based TOD Typology can help prioritize areas for growth by showing where these changes can be most impactful. To illustrate the potential impacts of development on transit zone performance, it is useful to consider some hypothetical scenarios. In the following three scenarios, both the number of households and the employment access increase at the same time by 15 percent, 30 percent and 50 percent more than the existing conditions. These are designated scenarios A, B and C respectively. All transit zones will not be able to grow by these amounts, but these scenarios paint a picture of the VMT reductions that are possible overall.

To estimate the effects of these changes on VMT, household density and employment access for each transit zone included in the typology were increased in the VMT model to predict how household travel behavior could change. Adding more hosueholds or jobs to a transit zone may increase the travel in the area but will reduce the VMT of the average household. The use mix was also updated to account for the new residents and jobs that would be added to the transit zones in each scenario. Increasing employment access means increasing the total number of jobs in the region; some of these jobs were allocated to individual transit zones, in proportion to the existing ratio of jobs in the transit zone to total jobs in the region.

Figure 22: Scenarios A, B, C - Increased Employment Access & Households by 15, 30, and 50 Percent

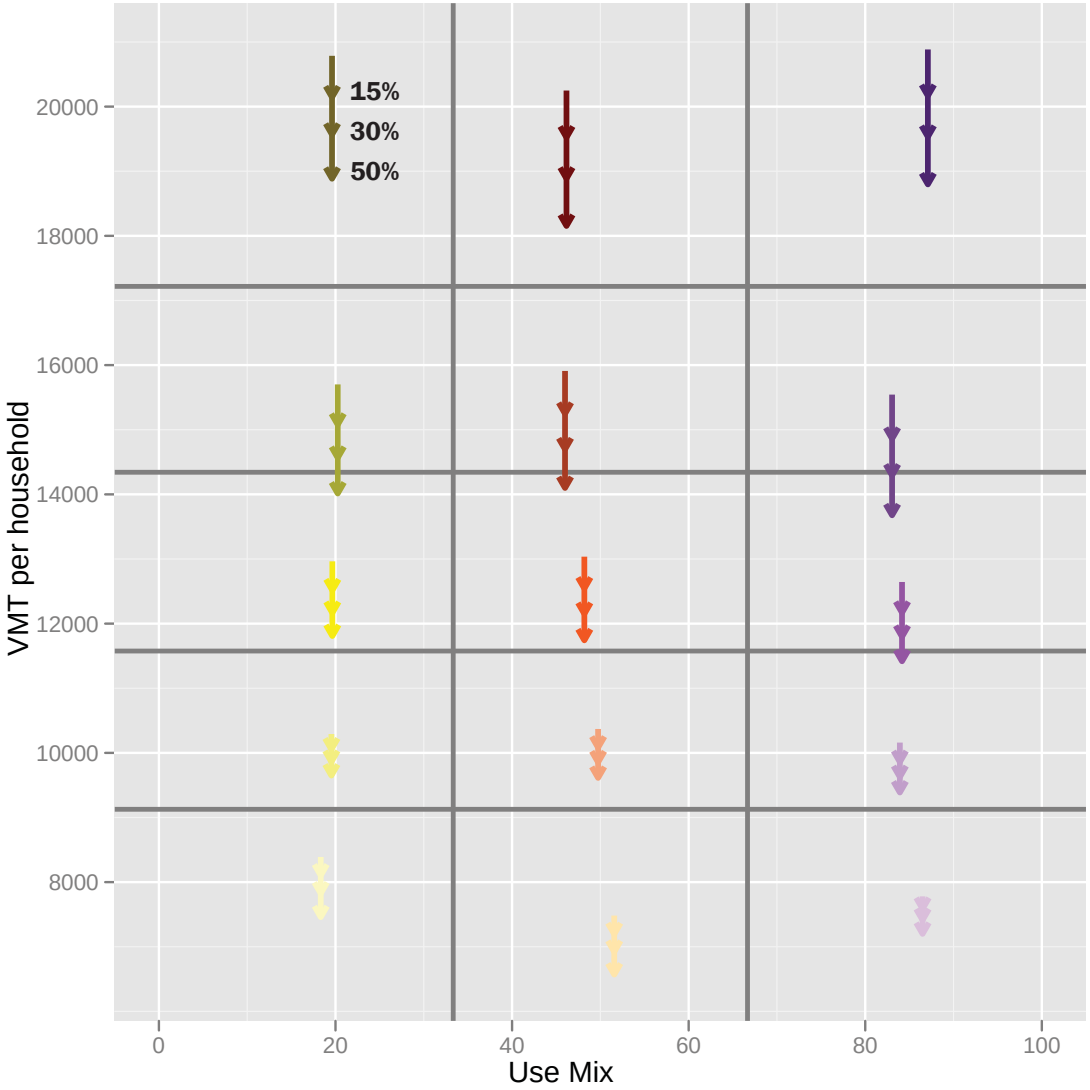


Figure 21 illustrates the effect of increasing both the number of households and employment access by 15% on all transit zones in the typology. While the impacts on individual transit zones differs a bit depending on the place type, there are some overall trends. Transit zones in higher VMT categories can reduce average household VMT by greater amounts than already low VMT places. Also, the potential to reduce VMT is not dependent on the use mix of the transit zone—residential, balanced, and employment places can all reduce average VMT by about the same degree.

Figure 22 shows a simplified version of all three scenarios, illustrating the average changes in household VMT and use mix. The arrows depict the average reduction in VMT possible in transit zones of each place type; each arrowhead marks a different scenario: 15 percent, 30 percent and 50 percent. The longest arrow corresponds to the largest change in density and employment.

Tables 7, 8, and 9 show the average VMT reductions under each scenario for each place type. The impact of each scenario on average household VMT are shown both as the reduction in miles driven and as a percentage. The Tables also include the potential reduction in annual CO_2 emissions per household. Table 7 shows the most modest scenario, a 15 percent increase

Table 7: Scenario A: Increase households & employment access by 15%

VMT Type	Use Mix Type	Increase in Households	Increase in employment access	Increase in Jobs in Station Area	Change in Household VMT	% Change in Household VMT	Change in Household CO2 emissions (tons annually)
Low	Residential	2,430	35,100	1,490	-288	-3%	-0.13
Low-moderate	Residential	1,150	19,100	692	-240	-2%	-0.11
Moderate	Residential	586	9,850	353	-449	-3%	-0.20
High-moderate	Residential	338	6,340	212	-624	-4%	-0.28
High	Residential	146	3,120	107	-643	-3%	-0.29
Low	Balanced	2,320	67,800	5,140	-289	-4%	-0.13
Low-moderate	Balanced	697	22,800	1,650	-289	-3%	-0.13
Moderate	Balanced	364	11,000	857	-494	-4%	-0.22
High-moderate	Balanced	220	6,200	476	-663	-4%	-0.30
High	Balanced	100	4,070	222	-727	-4%	-0.33
Low	Employment	1,020	59,400	14,500	-194	-2%	-0.09
Low-moderate	Employment	379	23,900	4,470	-301	-3%	-0.14
Moderate	Employment	129	14,900	1,640	-476	-4%	-0.22
High-moderate	Employment	70	8,810	722	-685	-4%	-0.31
High	Employment	18	4,830	301	-720	-3%	-0.33

Table 8: Scenario B: Increase households & employment access by 30%

VMT Category	Use Mix Category	Increase in Households	Increase in employment access	Increase in Jobs in Station Area	Change in Household VMT	% Change in Household VMT	Change in Household CO2 emissions (tons annually)
Low	Residential	4,860	70,200	2,980	-567	-7%	-0.26
Low-moderate	Residential	2,310	38,200	1,380	-432	-4%	-0.20
Moderate	Residential	1,170	19,700	705	-799	-6%	-0.36
High-moderate	Residential	676	12,700	425	-1,140	-7%	-0.52
High	Residential	292	6,240	214	-1,220	-6%	-0.55
Low	Balanced	4,640	136,000	10,300	-562	-8%	-0.26
Low-moderate	Balanced	1,390	45,700	3,310	-517	-5%	-0.23
Moderate	Balanced	729	22,000	1,710	-886	-7%	-0.40
High-moderate	Balanced	440	12,400	952	-1,210	-8%	-0.55
High	Balanced	201	8,140	443	-1,360	-7%	-0.62
Low	Employment	2,050	119,000	29,000	-367	-5%	-0.17
Low-moderate	Employment	757	47,700	8,940	-534	-5%	-0.24
Moderate	Employment	258	29,900	3,280	-848	-7%	-0.38
High-moderate	Employment	140	17,600	1,440	-1,250	-8%	-0.57
High	Employment	36	9,650	601	-1,350	-6%	-0.61

in households and employment access (or proximity.) While the percent change in VMT per household ranges from 2-4 percent for all place types, in raw numbers small changes can make significant reductions to average household VMT.

For example, increasing the number of households in a high VMT, residential transit zone by about 150 households, the average household VMT for those households can be reduced by nearly 650 miles a year.

Table 8 shows a similar pattern. Again, relatively small changes to higher VMT places can result in significant VMT reduction.

Thinking about VMT at the regional scale is also important. While reducing average household VMT in lower VMT places requires significant infill development and a long term outlook, because there are so many more people living in those places, the VMT savings are multiplied.

Table 9: Scenario C: Increase households & employment access by 50%

VMT Category	Use Mix Category	Increase in Households	Increase in employment access	Increase in Jobs in Station Area	Change in Household VMT	% Change in Household VMT	Change in Household CO2 emissions (tons annually)
Low	Residential	8,110	117,000	4,960	-932	-11%	-0.42
Low-moderate	Residential	3,840	63,700	2,310	-643	-6%	-0.29
Moderate	Residential	1,950	32,800	1,180	-1,160	-9%	-0.52
High-moderate	Residential	1,130	21,100	708	-1,690	-11%	-0.77
High	Residential	487	10,400	357	-1,900	-9%	-0.86
Low	Balanced	7,730	226,000	17,100	-914	-12%	-0.41
Low-moderate	Balanced	2,320	76,200	5,520	-757	-7%	-0.34
Moderate	Balanced	1,210	36,700	2,860	-1,290	-10%	-0.59
High-moderate	Balanced	734	20,700	1,590	-1,810	-11%	-0.82
High	Balanced	335	13,600	739	-2,100	-10%	-0.95
Low	Employment	3,410	198,000	48,400	-580	-7%	-0.26
Low-moderate	Employment	1,260	79,600	14,900	-773	-8%	-0.35
Moderate	Employment	431	49,800	5,470	-1,230	-10%	-0.56
High-moderate	Employment	233	29,400	2,410	-1,870	-12%	-0.85
High	Employment	60	16,100	1,000	-2,090	-10%	-0.95

Figure 23: Case Studies Under Scenario C

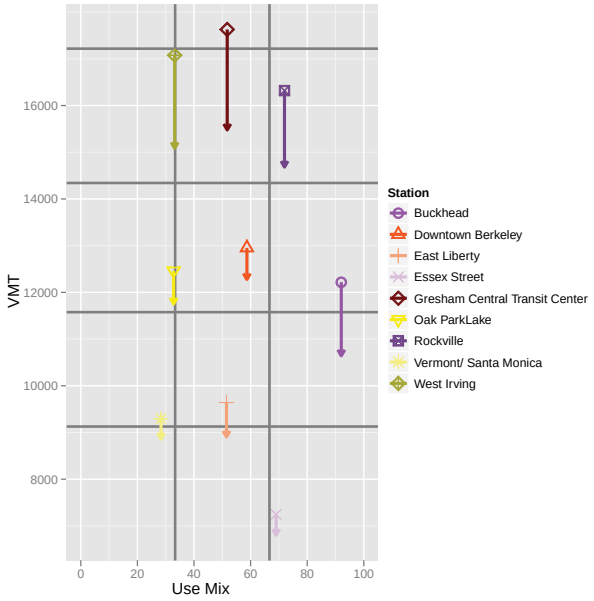
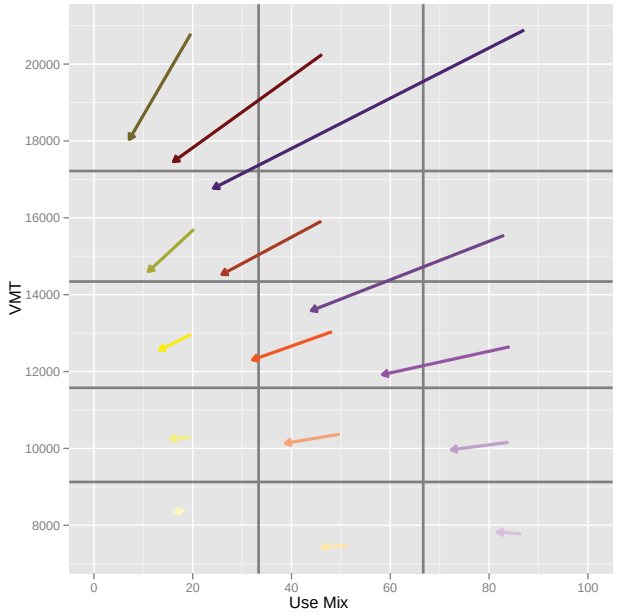


Table 9 shows the most aggressive scenario for reducing VMT by increasing residential density and employment access. However, these increases are not impossibly large. They could be folded into long range plans for cities and regions, especially since they can result in VMT reductions of about 10 percent across the board. Figure 23 shows how Scenario C would affect the case study transit zones. Four station areas would move to a lower VMT place type.

Table 10: Scenario D: Increase households by 2,000

VMT Category	Use Mix Category	Increase in Households	Increase in employment access	Increase in Jobs in Station Area	Change in Household VMT	% Change in Household VMT	Change in Household CO2 emissions (tons annually)
Low	Residential	2000	0	0	-48.1	-1%	-0.02
Low-moderate	Residential	2000	0	0	-39.9	0%	-0.02
Moderate	Residential	2000	0	0	-409	-3%	-0.19
High-moderate	Residential	2000	0	0	-1100	-7%	-0.50
High	Residential	2000	0	0	-2740	-13%	-1.24
Low	Balanced	2000	0	0	-66	-1%	-0.03
Low-moderate	Balanced	2000	0	0	-235	-2%	-0.11
Moderate	Balanced	2000	0	0	-733	-6%	-0.33
High-moderate	Balanced	2000	0	0	-1380	-9%	-0.63
High	Balanced	2000	0	0	-2780	-14%	-1.26
Low	Employment	2000	0	0	44.2	1%	0.02
Low-moderate	Employment	2000	0	0	-194	-2%	-0.09
Moderate	Employment	2000	0	0	-724	-6%	-0.33
High-moderate	Employment	2000	0	0	-1960	-13%	-0.89
High	Employment	2000	0	0	-4120	-20%	-1.86

Figure 24: Increase Households by 2,000



A different scenario is shown in Table 10 and Figure 24: how place types react to an increase of 2,000 households in all transit zones.[12] While use mix naturally changes dramatically with the influx of new households, this scenario's more significant finding is how increasing households affects different transit zones in different place types in different ways.

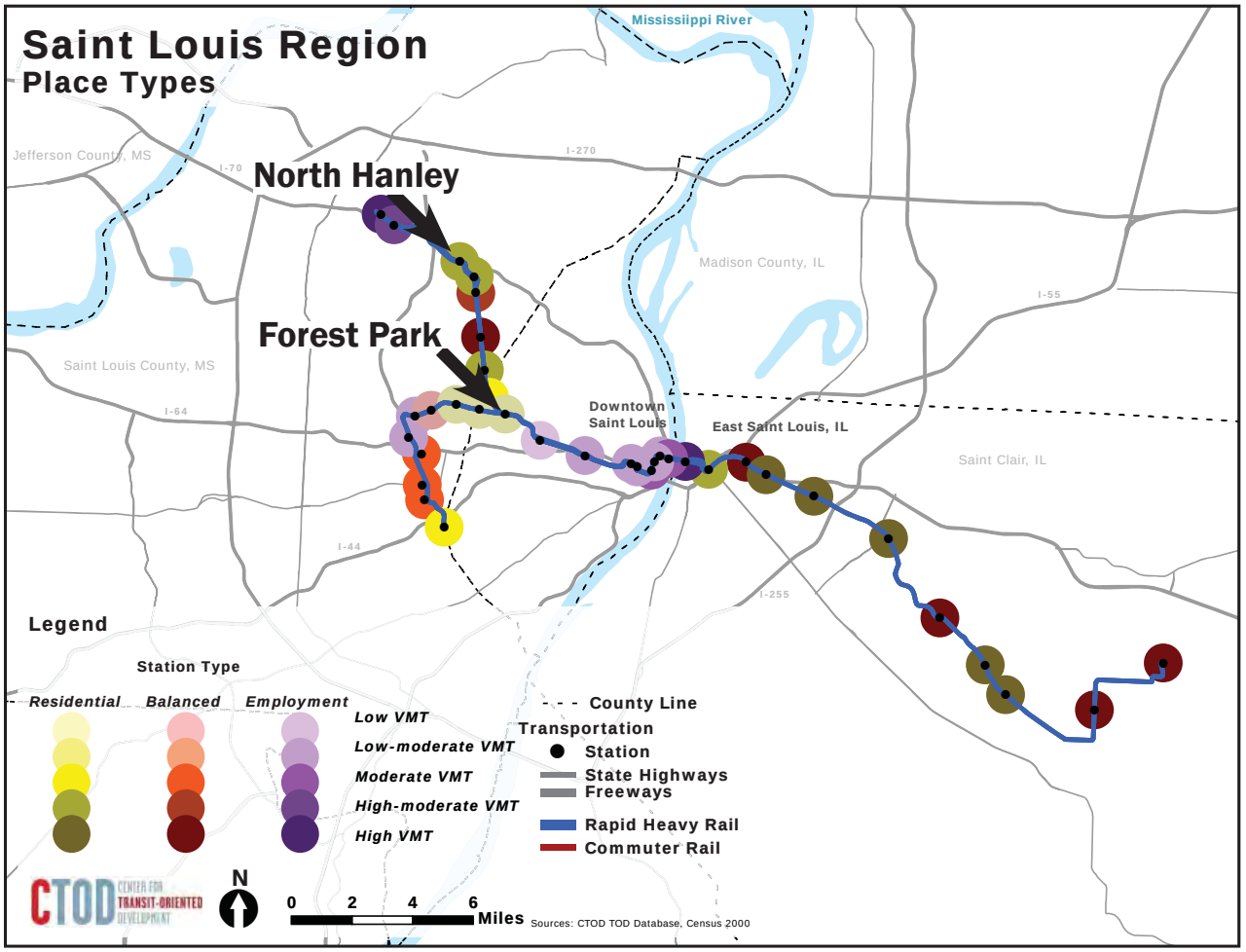
12 Note: This scenario is meant to be a simplified illustration of how adding 2000 households to different transit zones affects those transit zones in different ways. In reality, 2000 new households would create many other affects not accounted for in the model, including new retail or local services that would be attracted to the new residential population.

Example: Adding 2000 Households in St. Louis

In Saint Louis, adding 2,000 new households to the Forest Park transit zone (a low-moderate VMT, residential place) would result in the average household in that area driving about 40 miles less a year. That's a reduction from about 10,540 miles a year to about 10,500, which may seem insignificant until that reduction is multiplied by the 2,600 old and 2,000 new households now living in the transit zone. Assuming that the new households in the transit zone would otherwise live in places where the average household drove closer to the regional average for VMT (18,900), the total regional VMT savings would be about 16,904,000 miles annually.

Compare this example to adding 2,000 households to the North Hanley transit zone, a high-moderate VMT, residential place. The average household VMT would decrease by about 1,100 miles a year (from about 15,800 to 14,700.) New and existing households would collectively reduce regional VMT by about 2,725,250 miles annually. The overall VMT savings obtained from having new residential growth happen near transit stations is significant in both examples. But because the number of people living around Forest Park is much higher, the benefits from even small reductions in VMT is also higher.

Figure 25. Saint Louis Region Place Types



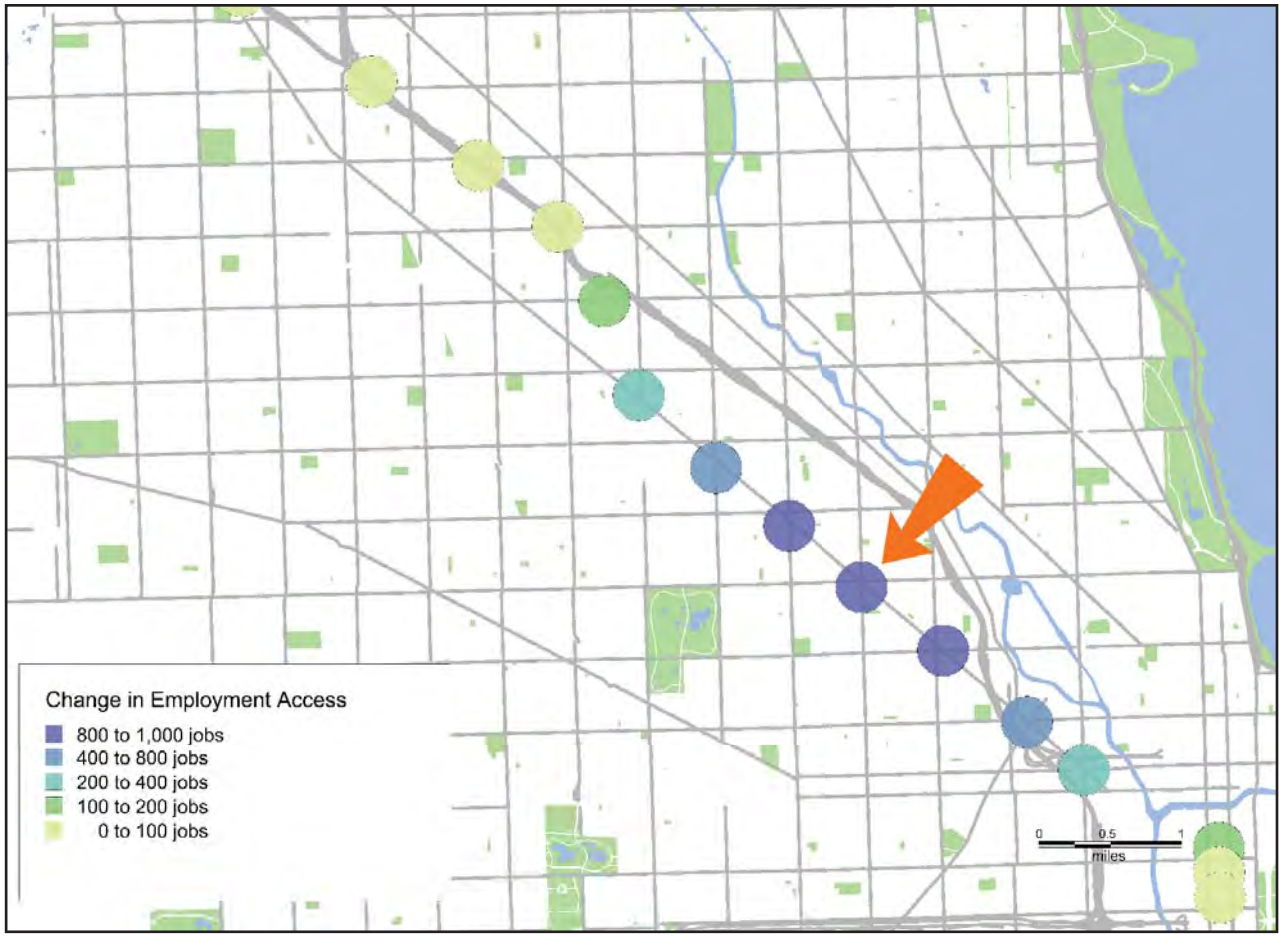
Changing Employment Access

As noted previously, increasing regional employment access has been found to be a stronger driver for reducing household VMT than changing the number of jobs within a transit zone. Increasing employment access by thousands of jobs might seem to be a daunting task at first. However, there are co-benefits to developing multiple station areas along a transit corridor.

As an example, Figure 26 shows the northwest branch of the Blue Line in Chicago. If 1,000 jobs are added to the Damen transit zone, then multiple adjacent stations along the line also see an increase in employment access. A cohesive development strategy along a transit corridor where development is taking place in multiple neighboring station areas could improve employment access in all transit zones, lowering the overall VMT of the entire corridor.

Another way to think about employment access follows. An increase in employment access of 5,000 jobs could be achieved by adding 5,000 jobs directly to the transit zone. However, adding jobs to existing employment centers nearby might be more realistic and can result in similar benefits. Adding 3,000 jobs within 1 mile of the transit zone, plus 2,000 jobs two miles away and another 9,000 jobs three miles away would result in the same overall increase in employment access and could benefit other nearby transit zones as well. In Chicago, even development two miles from the Damen station would likely have transit access, given the extensive rail system and connecting bus service.

Figure 26: Changing Employment Access at Damen Station in Chicago



Lessons Learned from Scenario Planning

1. Encouraging new development in transit zones, independent of the place type, can help reduce regional VMT, especially in regions where the average household VMT is higher than the average household VMT for even high VMT places.
2. High VMT transit zones (residential, balanced and employment) can see significant reductions in average household VMT from relatively moderate amounts of new development.
3. Prioritizing low VMT transit zones for new development can produce the largest reductions in total regional VMT.

VI. Possible Policy Implications and Uses

This Guidebook includes several tools for stakeholders interested in using performance-based measures to improve TOD outcomes in their communities. Each of the sections above (the Performance-Based TOD Typology, the Normative Metrics, the Case Studies, and the Scenario Planning) can be utilized in different ways.

This section discusses a couple of examples of the possible uses and policy implications for each tool. Many scales of planning (federal, state, regional and local) may use these tools, and they may be applied to many issue areas (from climate change planning, to public health, long range housing and job growth planning, equitable TOD planning, and more).

This is not a finite list of possible uses, but should help to spark ideas for stakeholders to implement in their own communities.

Performance-Based TOD Typology

Place Types help define and group together transit zones.

- **Understanding transit ridership:** Federal agencies may use the place types created by the typology to look at why some transit lines exceed ridership expectations while others struggle to meet their predicted service numbers. Examining the transit zones along high performing lines may reveal which place types result in higher ridership.
- **Comparing regions and transit networks:** Foundations and federal agencies (including the interagency partnership between FTA, HUD, and the EPA) may use the typology to determine how different regions and different transit networks compare.
- **Creating incentives to plan for reduced VMT:** The typology provides benchmark data that could be used to guide funding from federal agencies like HUD. Funding could be tied to planning for reduced VMT in the region, by rewarding regions implement strategies either to lower VMT in higher VMT transit zones or to concentrate housing and employment in lower VMT places.

Normative Metrics and Case Studies

Normative Metrics and Case Studies show how understanding underlying conditions in transit zones can be useful for policy decisions.

- **Improving public health:** Research has shown that people who take transit are more likely to reach the recommended amount of walking per day.[13] Understanding which place types support walking to transit (as well as walking and biking to destinations) can support investing public dollars in creating more low VMT places through supportive land use policies and infrastructure improvements.
- **Understanding transit ridership:** Metrics that increase the understanding of which elements support higher transit ridership around stations include commute share and transportation options. Employment access will be a particularly important metric for stakeholders interested in transit usage.
- **Upgrading station area design:** Vehicle ownership and the transit ridership metrics can help to guide parking, land use, and urban design policies in manners that address potential deficiencies and boost ridership. Over the last 60 years development has been focused around the automobile; however this has been the driver of increased emissions and reduced walkability. Stations that perform higher on some of these metrics can be used

13 Wener, Richard E. and Gary W. Evans, "A Morning Stroll: Levels of Physical Activity in Car and Mass Transit Commuting," Environment and Behavior, Vol. 39, No. 1, Pgs 62-74. Sage Publications, available at http://online.sagepub.com/cgi/citmgr?gca=speab;39/1/62.

to demonstrate successful examples of good pedestrian and bicycle design.

- **Linking VMT reduction strategies to equitable TOD:** Low- and moderate-income households can benefit from reduced transportation costs by living in lower VMT transit zones. Local advocates or national funders interested in supporting equitable TOD might use the Normative Metrics to determine how stations areas in a neighborhood or region perform in terms of these two metrics (median household income and transportation costs).

Scenario Planning

Scenario planning can help stakeholders understand the benefits and scale of increased residential density and employment proximity.

- **Directing regional growth:** Regional and municipal planners concerned with directing regional growth can use the scenario planning section to show how directing new residential and employment growth to transit zones may reduce regional VMT, or how particular transit zones may make more sense for certain kinds of growth.
- **Guiding visioning processes:** At the local level, the scenario exercises can guide community visioning and policy making by showing residents the benefits to making changes in residential density or employment.
- **Influence firm and federal facility location decisions:** The scenario planning shows why locating new employment growth to employment centers near transit is an important component of lowering VMT for transit zones and the region. At the federal level, this tool could be used to help guide where new federal facilities locate and where new jobs can be directed among existing centers. Both regionally and locally, the tool can assist with the planning of new employment centers and can help advance arguments for enhancing accessibility to existing employment centers.
- **Understand the impact of developing new housing near transit:** This tool allows stakeholders to discuss new housing development near transit intelligently, with information about existing units, income levels, and how new development can reduce average household VMT. Lower VMT stations should ensure that a range of housing options exist so households making a range of incomes will be able to enjoy the benefits of living in places with lower VMT and lower transportation costs. While new housing may not be desirable or appropriate in every transit zone, it is important to see how new housing can positively affect neighborhood change.
- **Influencing regional housing elements:** Regional housing elements could benefit from planning around stations that prioritize housing. In California, with GHG reduction mandates tied to housing allocations, station areas with lower VMT might have more housing allocated in the short term while higher VMT stations might be prioritized for investments in pedestrian improvements and amenities.
- **Coordinating VMT reduction strategies:** At the regional level, the tool can be used to coordinate VMT reduction strategies and regional housing and land use planning.

While these are not the only uses for the Performance-Based TOD Typology, they give a glimpse into what is possible with the information available in this Guidebook. Decisions made during local station area planning all the way up to federal grant making can be impacted by the knowledge that reductions in VMT can be affected by changes in baseline metrics locally. Additionally, it is within this venue that a better discussion can take place about the trade-offs necessary to achieve local and regional goals.

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VII. Detailed Case Studies

The Case Studies begin on the next page. They are four pages each and are in order from low VMT, residential places to high VMT, employment places.

Transit Station	Region	Place Type
Vermont/ Santa Monica	Los Angeles	Low-moderate VMT, Residential
Oak Park Station	Chicago	Moderate VMT, Residential
West Irving Station	Dallas	High-moderate VMT, Residential
East Liberty	Pittsburgh	Low-moderate VMT, Balanced Use
Downtown Berkeley	San Francisco Bay Area	Moderate VMT, Balanced Use
Gresham Transit Center	Portland	High VMT, Balanced Use
Essex Street	New Jersey, New York Tri-State	Low VMT, Employment
Buckhead	Atlanta	Moderate VMT, Employment
Rockville Station	Washington, DC	High-moderate VMT, Employment

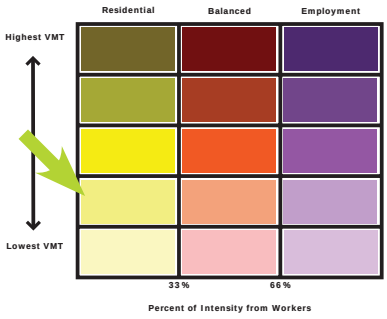
Low-Moderate VMT, Residential Place

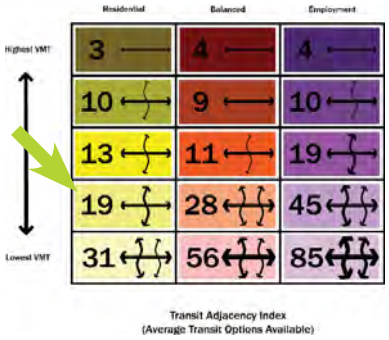
Low-Moderate VMT (9,100 - 11,600 miles per household per year)
Residential Neighborhood (0 - 33% jobs/jobs+residents)

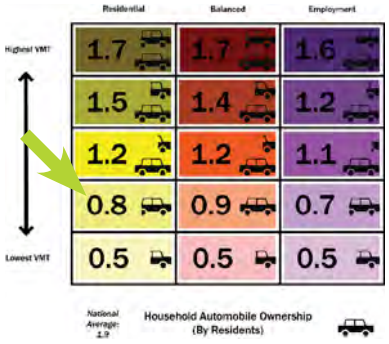
Vermont / Santa Monica
Los Angeles, CA

Place Type Case Studies

What does it mean to be a low-moderate VMT, residential place?

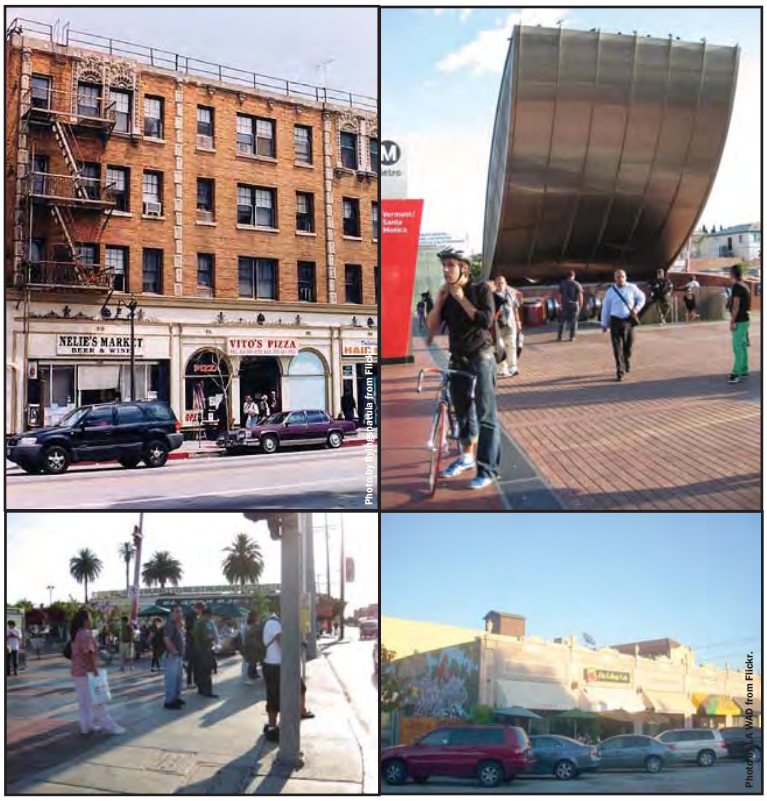






This place type includes transit zones that are primarily residential places, and have low-moderate VMT. Some stations that fall into this place type will have employment uses, but they are less likely to be major employment centers for the region. The normative metrics for each place type are discussed fully in the guidebook; this case study will look at a specific transit zone that falls into this category: Vermont / Santa Monica in Los Angeles, CA. As a low-moderate VMT transit zone, the average household will drive about 10,000 miles a year.

What is the Vermont / Santa Monica transit zone like?



- Vermont/ Santa Monica is primarily a residential area, bordered by older retail corridors. Older cities with extensive transit networks have many stations in this place type.
- In the Vermont/Santa Monica transit zone, residential density is about 19 units per acre, which takes the form of moderately dense 3-4 story apartment buildings.
- Streets around the Vermont/Santa Monica station are in a well-connected grid, though there are a few large blocks directly around the station.
- Both Vermont Ave. and Santa Monica Blvd. are retail corridors, but instead of more walkable, small scale retail, most of the stores are auto-oriented, and there are a few larger big box shops near the station itself.

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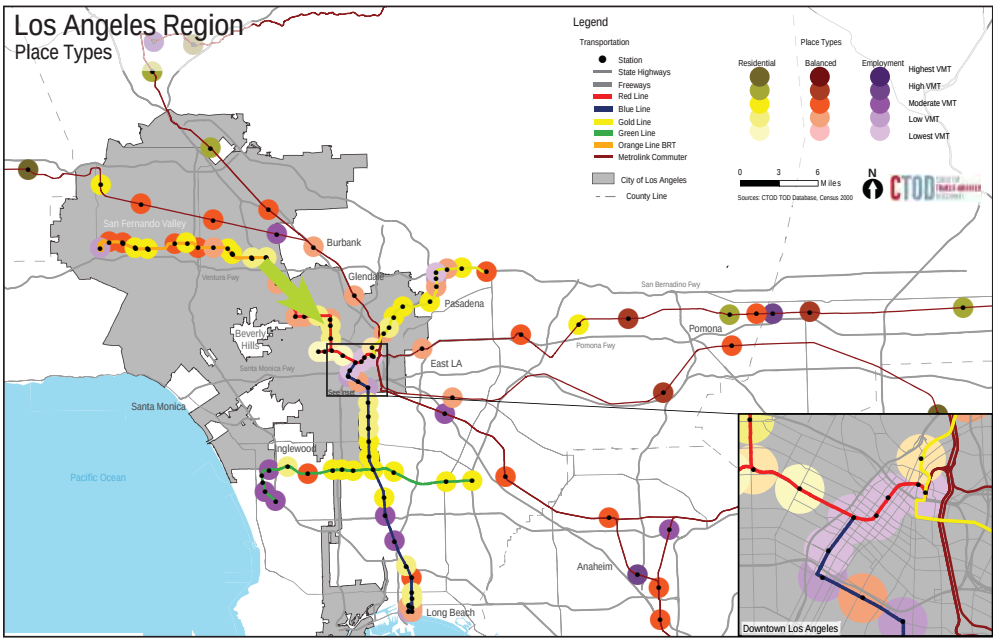
Low-Moderate VMT, Residential Place

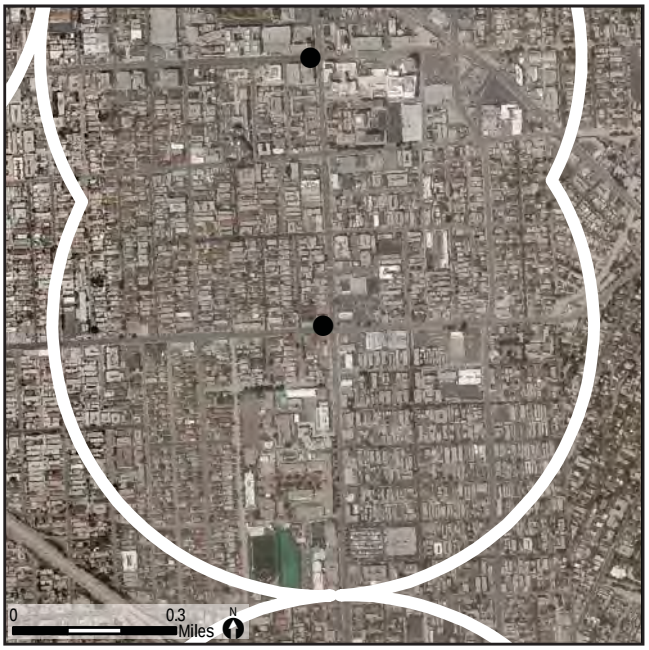
Low-Moderate VMT (9,100 - 11,600 miles per household per year)
Residential Neighborhood (0 - 33% jobs/jobs+residents)

Vermont / Santa Monica
Los Angeles, CA

Place Type Case Studies

How does Vermont / Santa Monica compare to the region?





Metric	Vermont/ Santa Monica	Region
VMT (miles/year)*	9,300	12,800
Transportation Costs*	$6,500	$8,600
Residential Density	20 du/ac	5 du/ac
Percent Renters	91%	46%

The Vermont / Santa Monica station is in the City of Los Angeles, four stops north of downtown LA on the Red Line subway. The Red Line started service in the mid-1990s and was the first major investment in fixed-guideway transit in Los Angles since the 1920s. Los Angeles City College is just half a block from the station entrance and is a major destination in the area. The four Red Line stops along Vermont are spaced close together, and Vermont / Santa Monica station area overlaps with Vermont / Beverly to the north, which is a more balanced neighborhood, with many medical offices and hospitals near the station.

The transit zones around the Red and Purple lines are home to some of the densest neighborhoods in Los Angeles, with grid-like streets, many 3-4 story apartment complexes, and retail uses lining the major arterials. Nearly 91 percent of people living within a half mile of the station are renters, a much higher percentage than in the region or the city. Vermont / Santa Monica is well-connected to some of the major job centers in Los Angeles, with an 8 minute commute (on the Red Line) to downtown LA and a 12 minute train ride to Universal City. The Los Angeles region has a diverse mix of transit zones, as shown in the map at the top left, though the lower VMT stations tend to be in the city of Los Angeles and the higher VMT places on commuter rail lines in more suburban locations.

The table to the left shows Vermont / Santa Monica compares to the region.

Low-Moderate VMT, Residential Place

Low-Moderate VMT (9,100 - 11,600 miles per household per year)
Residential Neighborhood (0 - 33% jobs/jobs+residents)

Vermont / Santa Monica
Los Angeles, CA

Metric	Vermont / Santa Monica	Compared to Normative Metric
Average VMT per Household*	9,300 miles/year	
Residential vs Employment Mix	28% workers (72% residents)	

Lower — Higher

What factors can lower VMT in Vermont / Santa Monica?

Higher VMT → **Lower VMT**

Metric	Vermont / Santa Monica	Compared to Normative Metric
Average Block Size	6.6 acres/block	
Residential Density	19 units/acre	
Employment Proximity*	127,000 jobs nearby	
Transit Access Index*	21 opportunities	

Lower than norm — Higher than norm

The chart above shows how Vermont / Santa Monica performs on some of the key factors that affect VMT. For transit access, Vermont / Santa Monica performs slightly better than the norm, and the number of jobs near the station is very similar to the norm. This transit zone differs the most from the norm on block size — blocks around Vermont / Santa Monica are nearly three times the size of typical low-moderate VMT, residential transit zone. To lower VMT, efforts could be focused on increasing residential density and improving employment proximity, discussed more fully in the Guidebook.

How does Vermont / Santa Monica compare to the norm on other transportation performance metrics?

Metric	Vermont / Santa Monica	Compared to Normative Metric
Avg Household Transportation Costs*	$ 6,500 per year	
Nonauto Commute From Transit Zone	31% of residents	
Nonauto Commute To Transit Zone	16% of workers	
Avg Autos per Household	0.96 vehicles	

Lower than norm — Higher than norm

Vermont / Santa Monica also has lower rates of walking, biking and taking transit to work than the average low-moderate VMT, residential place, which may reflect the dispersed travel patterns in the Los Angeles region. The rate of car ownership is slightly higher than the norm, while transportation costs in the transit zone are typical of this place type.

Low-Moderate VMT, Residential Place

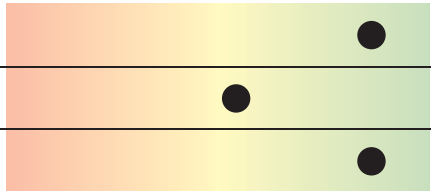
Low-Moderate VMT (9,100 - 11,600 miles per household per year)
Residential Neighborhood (0 - 33% jobs/jobs+residents)

Vermont / Santa Monica
Los Angeles, CA

Place Type Case Studies

Who lives and works in Vermont / Santa Monica?

Metric	Vermont / Santa Monica	Compared to Normative Metric
Total Transit Zone Intensity	32,400 people	
Total Residents	23,200 residents	
Total Workers	9,200 workers	



While Vermont / Santa Monica has the average number of residents as other transit zones in this place type, there are far more workers than the norm. While increasing the number of residents can help reduce the average VMT per household, having more jobs in the transit zone is also a key component.

Median Household Income	$ 22,500 per year	
Average Household Size	2.99 people/household	

Median household income is lower than the average station, while average household size is larger than the norm in the Vermont / Santa Monica area. Policies that make changes to these indicators are less likely to have a direct impact on VMT.

What are some other low-moderate VMT, residential places?

Station	City	Transit System	Region
Damen	Chicago	Blue Line, CTA	Chicago, IL
Forest Park	Saint Louis	Metrolink	Saint Louis, MO
8th Street	New Jersey	Hudson-Bergen LRT	New York Tri State
Carrollton and Willow	New Orleans	St. Charles Streetcar	New Orleans, LA
Palm Garden	Pittsburgh	LRT, South Busway	Pittsburgh, PA
Allapattah	Miami	Metrorail	Miami, FL
Porter Square	Cambridge	Red Line, MBTA	Boston, MA
30th and Downing	Denver	RTD	Denver, CO
Upton	Baltimore	Metro Subway	Baltimore, MD
Duboce and Noe	San Francisco	MUNI	San Francisco Bay, CA

*VMT and household transportation costs are estimated using the Housing and Transportation Index. The Transit Opportunity Index and Employment Proximity are components of the H + T ® Index.

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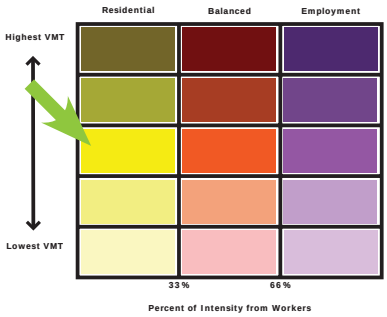
Moderate VMT, Residential Place

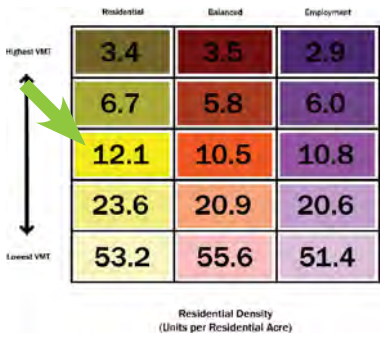
Moderate VMT (11,600 to 14,300 miles per household per year)
Balanced Neighborhood (0 - 33% jobs/jobs+residents)

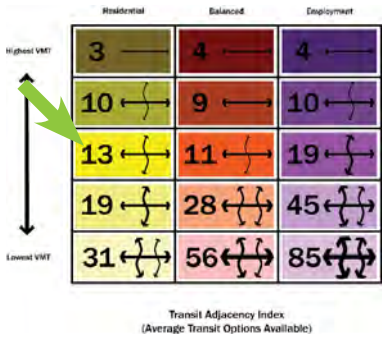
Oak Park
Chicago, IL

Place Type Case Studies

What does it mean to be a moderate VMT, residential place?







This place type is predominantly residential, and the typical household will drive between 11,600 and 14,300 miles a year, a moderate amount compared to transit zones across the country. The transit zone has some employment uses; usually around 20 percent of the total population of the zone are workers, but the presence of residents is much stronger. The normative metrics for each place type are discussed fully in the guidebook; this case study will look at one specific transit zone that falls into this category: Oak Park on the CTA Green Line outside of Chicago, IL.

What is the Oak Park transit zone like?

- Immediately around the Oak Park station is a mixed-use retail and office area. Single-family homes are common throughout the rest of the transit zone. Residential density in Oak Park is about 15 units/acre, just above the norm for this place type.
- Streets around this station are in a grid format and connect to Chicago's grid system, with major streets every mile or so and smaller residential streets in between.
- Oak Park itself is an older, inner-ring suburban downtown, and some of the moderate VMT, residential transit zones fit a similar profile.
- There are many retail uses around the station, including restaurants, specialty stores, a public library, post office, and educational, religious, and civic institutions.

CTOD CENTER FOR TRANSIT-ORIENTED DEVELOPMENT

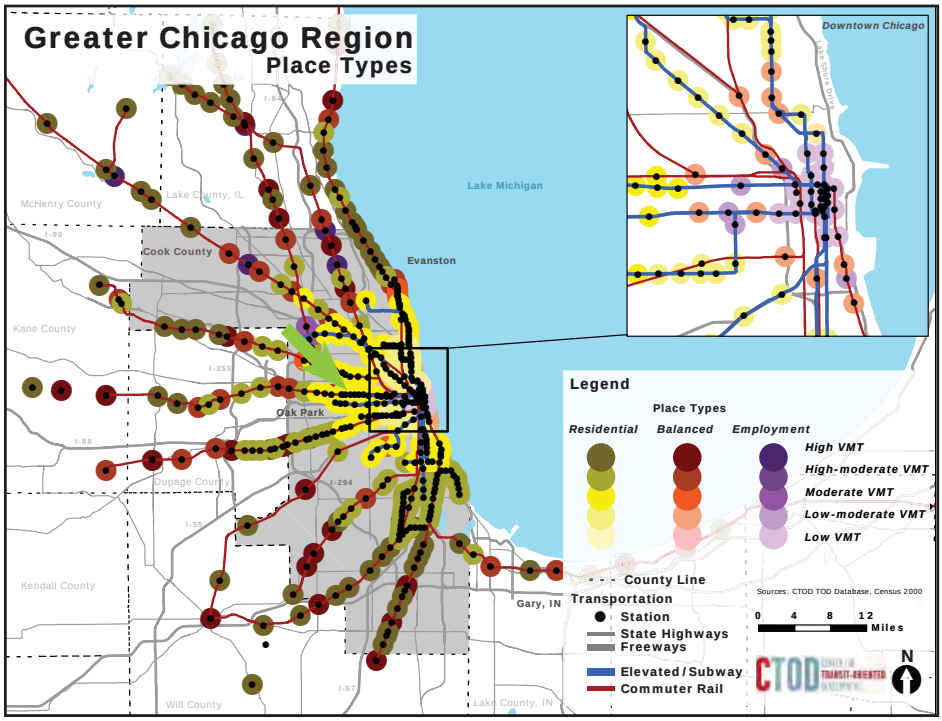
Moderate VMT, Residential Place

Moderate VMT (11,600 to 14,300 miles per household per year)
Balanced Neighborhood (0 - 33% jobs/jobs+residents)

Oak Park
Chicago, IL

Place Type Case Studies

How does Oak Park compare to the region?



The Oak Park transit zone is located in the Village of Oak Park, on the western border of the City of Chicago. The station is the second to last on the CTA's Green Line, an elevated heavy rail line whose stations are close together, about a half-mile apart. A commuter rail station is about a half mile from the Oak Park station and has a direct connection to the Green Line's terminal station. There is a narrow mixed-use corridor around the Green Line, with retail and office uses mixed with apartment and condo buildings. A single-family residential neighborhood with a diverse mix of housing types extends beyond that.

Oak Park has many transit connections to downtown Chicago, the major employment hub in the region, including the Green Line, Blue Line, and a Metra (commuter rail) corridor. The Metra Line continues west from Oak Park and together with PACE bus service provides a limited number of connections to several suburban employment centers.

Oak Park is fairly dense (15.2 households/acre, compared to the Chicago region (4.8 households/acre) and to the average residential density of other transit zones in the region (8.5 households/acre.) Median household income is slightly higher in Oak Park than the region and the area includes a diverse range of income groups. While housing in the Chicago region is predominantly owner-occupied, Oak Park has an even mix of renters and owners.

The table to the left shows how Oak Park compares to the region on a couple of key metrics.

Metric	Oak Park	Region
VMT (miles/year)*	12,500	16,600
Transportation Costs*	$6,500	$8,600
Median Income	$53,720	$51,860
Percent Renters	58%	35%

Moderate VMT, Residential Place

Moderate VMT (11,600 to 14,300 miles per household per year)
Balanced Neighborhood (0 - 33% jobs/jobs+residents)

Oak Park
Chicago, IL

Place Type Case Studies

Metric	Oak Park	Compared to Normative Metric
Average VMT per Household*	12,500 miles/year	
Residential vs Employment Mix	33% workers (66% residents)	

Lower Higher

What factors can lower VMT in Oak Park?

Higher VMT → **Lower VMT**

Metric	Oak Park	Compared to Normative Metric
Average Block Size	5.7 acres/block	
Residential Density	15.2 units/acre	
Employment Proximity*	75,100 jobs nearby	
Transit Access Index*	12 transit opportunities	

Lower than norm Higher than norm

The chart above shows how the Oak Park transit zone performs on some of the key factors that affect VMT. Overall, Oak Park is very close to the norm for moderate VMT, residential places. While the transit zone is slightly more dense and has more jobs nearby, there are fewer traditional transit opportunities here than in the typical moderate VMT, residential place. To lower VMT in this transit zone, efforts could be focused on improving transit connections, increasing residential density, and improving employment proximity, discussed more fully in the Guidebook.

How does Oak Park compare to the norm on other transportation performance metrics?

Metric	Oak Park	Compared to Normative Metric
Avg Household Transportation Costs*	$8,450 per year	
Nonauto Commute From Transit Zone	30% of residents	
Nonauto Commute To Transit Zone	19% of workers	
Avg Autos per Household	1.11 vehicles	

Lower than norm Higher than norm

Oak Park also performs similar to the norm on average yearly transportation costs and commute patterns. A slightly higher proportion of people who live around the station take transit, bike, or walk or work, and the same proportion of people who work in the transit zone take those nonauto modes as the typical moderate VMT, residential place.

Moderate VMT, Residential Place

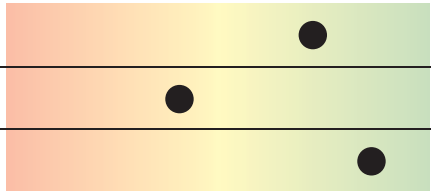
Moderate VMT (11,600 to 14,300 miles per household per year)
Balanced Neighborhood (0 - 33% jobs/jobs+residents)

Oak Park
Chicago, IL

Place Type Case Studies

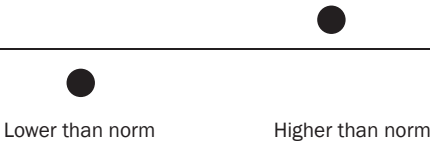
Who lives and works in Oak Park?

Metric	Oak Park	Compared to Normative Metric
Total Transit Zone Intensity	14,860 people	
Total Residents	9,990 residents	
Total Workers	4,870 workers	



While the total population of the Oak Park transit zone is higher than the typical station in this place type, there are actually more workers and fewer residents than a typical moderate VMT, residential place. Increasing the number of residents able to live near the station could help reduce overall VMT.

Median Household Income	$53,720 per year	
Average Household Size	1.77 people/household	



Median household income in Oak Park is lower than the average moderate VMT, residential transit zone, though household size is smaller. Policies that make changes to these indicators are less likely to have a direct impact on VMT.

What are some other moderate VMT, residential places?

Station	City	Transit System	Region
Rhode Island Ave.	Washington, DC	Red Line, WMATA	Washington, DC
California Avenue	Palo Alto	Caltrain	Bay Area, CA
Mount Baker	Seattle	Central Link Light Rail	Seattle, WA
North Elizabeth	Elizabeth	New Jersey Coast Line	New York Tri-State
Elmwood District	Philadelphia	Trolley, Route 36	Philadelphia, PA
City College	Sacramento	Blue Line	Sacramento, CA
Killingsworth St.	Portland	MAX Yellow Line	Portland, OR
Mt Lebanon	Mt Lebanon	Light Rail,	Pittsburgh, PA
Shaker Square	Cleveland	Green Line, GCRTA	Cleveland, OH
Mondawmin	Baltimore	Metro Subway	Baltimore, MD

*VMT and household transportation costs are estimated using the Housing and Transportation Index. The Transit Opportunity Index and Employment Proximity are components of the H + T ® Index.

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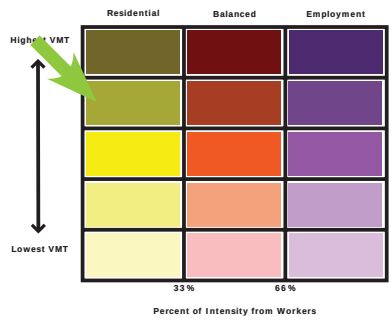
High-Moderate VMT, Residential Place

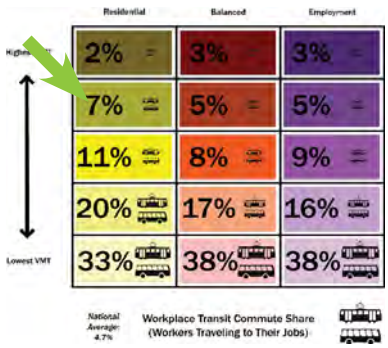
High-Moderate VMT (14,300 - 17,200 miles per household per year)
Residential Neighborhood (0 - 33% jobs/jobs+residents)

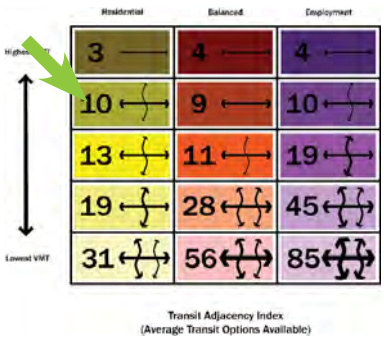
West Irving
Dallas-Fort Worth, TX

Place Type Case Studies

What does it mean to be a high-moderate VMT, residential place?







High-moderate VMT, residential places have proportionally more residents than workers, but residents in these zones drive more in a year than the average household living within a half mile of transit. The normative metrics for each place type are discussed fully in the guidebook; this case study will look at one specific transit zone that falls into this category: West Irving station in Irving, Texas, between Dallas and Forth Worth. The average household in the West Irving transit zone drives about 17,000 miles in a year.

What is the West Irving transit zone like?

- The housing around the West Irving station is suburban in style, with single family homes on winding roads that often end in cul-de-sacs. Residential density is fairly low at 4.5 households per acre.
- West Irving is one station along the Trinity Railway Express (TRE), a commuter line that links Fort Worth and Dallas and runs on an existing freight right-of-way. The station sits near a small arterial that hosts primarily small scale industrial and warehousing uses. However, there is no direct access to this street from the station for pedestrians or vehicles.
- The station is primarily a park-and-ride facility and also provides bus connections to major destinations outside of walking distance, including North Lake College and Las Colinas.

CTOD CENTER FOR TRANSIT-ORIENTED DEVELOPMENT

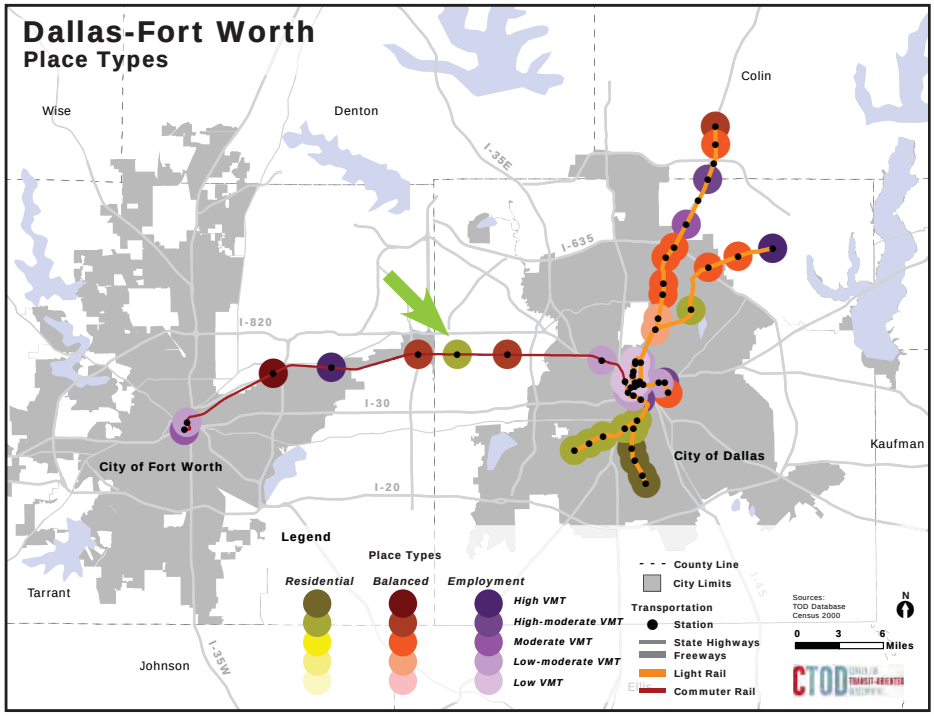
High-Moderate VMT, Residential Place

High-Moderate VMT (14,300 - 17,200 miles per household per year)
Residential Neighborhood (0 - 33% jobs/jobs+residents)

West Irving
Dallas-Fort Worth, TX

Place Type Case Studies

How does West Irving compare to the region?



The West Irving station is on the commuter rail line for the Dallas-Forth Worth region, the Trinity Railway Express that connects downtown Fort Worth to downtown Dallas along with the smaller communities that lie between them. The West Irving station is about a 30 minute transit trip on the TRE to either downtown and is 26 miles away from downtown Fort Worth and 18 miles from downtown Dallas. The transit provides valuable connections to some of the major employment centers in the metropolitan region.

Transit zones in the region include many different place types, with the lowest VMT places usually located closer to downtowns. West Irving is the only residential station on the TRE line, but transit zones along the southern portions of the Red and Blue light rail lines fall into the high-moderate and high VMT, residential place types as well.

West Irving is a fairly typical transit zone for the region along other metrics as well. Regionally, residential density is about 3.5 household per acre and West Irving is just slightly higher at 4.5 households per acre. The median income of households living in the transit zone is also quite similar to the region as a whole, as is the proportion of renters. In the region, a slightly higher proportion of households own their homes rather than renting, but both the region and the West Irving transit zone have an even mix of renters and owners.

The table to the left shows how West Irving compares to the region.

Metric	West Irving	Region
VMT (miles/year)*	17,080	18,160
Median Income	$41,760	$47,420
Percent Renters	47.2%	39.5%

High-Moderate VMT, Residential Place

High-Moderate VMT (14,300 - 17,200 miles per household per year)
Residential Neighborhood (0 - 33% jobs/jobs+residents)

West Irving
Dallas-Fort Worth, TX

Metric	West Irving	Compared to Normative Metric
Average VMT per Household*	17,080 miles/year	
Residential vs Employment Mix	33% workers (66% residents)	

Lower — Higher

What factors can lower VMT in West Irving?

Higher VMT → **Lower VMT**

Metric	West Irving	Compared to Normative Metric
Average Block Size	27.3 acres/block	
Residential Density	4.5 units/acre	
Employment Proximity*	34,900 jobs nearby	
Transit Access Index*	5 transit opportunities	

Lower than norm — Higher than norm

West Irving's transit zone falls toward the high end of the high-moderate VMT category. The factors that contribute to VMT in this transit zone are all below the norm for a high-moderate VMT residential place, though the very large block sizes in the transit zone are where this area diverges the most from the norm. The average high-moderate VMT, residential place has about 8 acre blocks. To lower VMT in this transit zone, efforts could be focused on increasing residential density and improving employment proximity, discussed more fully in the Guidebook.

How does West Irving compare to the norm on other transportation performance metrics?

Metric	West Irving	Compared to Normative Metric
Avg Household Transportation Costs*	$9,760 per year	
Nonauto Commute From Transit Zone	3.4% of residents	
Nonauto Commute To Transit Zone	3.5% of workers	
Avg Autos per Household	1.6 vehicles	

Lower than norm — Higher than norm

Again, overall the West Irving transit zone performs worse than the typical high-moderate VMT, residential place. Transportation costs are higher for the average household, households own more cars, and fewer residents and workers in the transit zone use transit, walk, or bike to get to work.

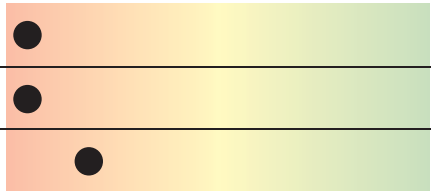
High-Moderate VMT, Residential Place

High-Moderate VMT (14,300 - 17,200 miles per household per year)
Residential Neighborhood (0 - 33% jobs/jobs+residents)

West Irving
Dallas-Fort Worth, TX

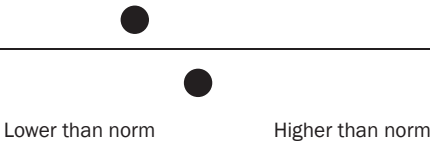
Who lives and works in West Irving?

Metric	West Irving	Compared to Normative Metric
Total Transit Zone Intensity	2,300 people	
Total Residents	1,540 residents	
Total Workers	760 workers	



West Irving hosts many fewer residents than the typical high-moderate VMT, residential transit zone. The average transit zone in this place type has about 6,000 residents, and West Irving has less than a third of that number. While the number of workers in the half mile around the station is similar, increasing the number of residents could help reduce VMT.

Median Household Income	$41,760 per year	
Average Household Size	2.5 people/household	



Median household income in West Irving is slightly lower than the norm for this place type, while average household size is about the same. Policies that make changes to these indicators are less likely to have a direct impact on VMT.

What are some other high-moderate VMT, residential places?

Station	City	Transit System	Region
Warrensville	Shaker Heights	Green Line, GCRTA	Cleveland, OH
Fairmount	Boston	Fairmount Line, MBTA	Boston, MA
San Bernadino	San Bernadino	Metrolink	Los Angeles, CA
Kenton/N Denver	Portland	MAX Yellow Line, TriMet	Portland, OR
South Shore	Chicago	Metra Electric	Chicago, IL
Prince George's Plaza	Hyattsville	Green Line, Metro	Washington, DC
Judah/Ocean Beach	San Francisco	SF MUNI	San Francisco Bay, CA
Port Washington	Port Washington	Long Island Railroad	New York Tri-State
Willow	Pittsburgh	Light Rail, PAT	Pittsburgh, PA
Patapsco	Baltimore	MTA Light Rail	Baltimore, MD

*VMT and household transportation costs are estimated using the Housing and Transportation Index. The Transit Opportunity Index and Employment Proximity are components of the H + T ® Index.

CTOD CENTER FOR TRANSIT-ORIENTED DEVELOPMENT

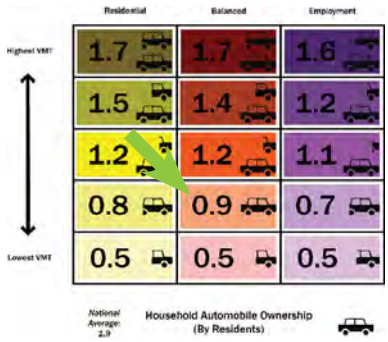
Low-Moderate VMT, Balanced Use Place

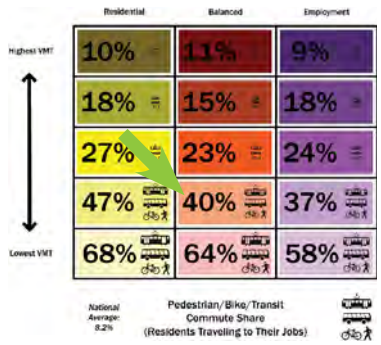
Low-Moderate VMT (9,100 - 11,400 miles per household per year)
Balanced Use Neighborhood (33 - 66% jobs/jobs+residents)

East Liberty
Pittsburgh, PA

Place Type Case Studies

What does it mean to be a low-moderate VMT, balanced use place?





Low-moderate VMT, balanced use places have an even mix of workers and residents, and the average household drives fewer miles in a year than the typical resident of a transit zone. There is a mix of land uses, including residential, retail, and office in these places, at a mix of densities. The normative metrics for each place type are discussed fully in the guidebook; this case study will look at one specific transit zone that falls into this category: East Liberty station in Pittsburgh, PA.

What is the East Liberty transit zone like?

- North of the station, there is a medium-sized retail center, with primarily smaller scale retail uses and a few big box stores. These kinds of uses may be typical for other low-moderate VMT, balanced use place.
- Residential uses around the station are mostly single family homes with 2-3 story apartments closer to the station. There are also a few larger apartment buildings near major arterials.
- Several grids come together around the East Liberty station, meaning that blocks on average are small, but there are some barriers to walking, including the busway itself, which runs below grade in this transit zone.
- There is an older industrial area to the southwest of the station, some of which is being transformed into upscale shopping and office space.

CTOD CENTER FOR TRANSIT-ORIENTED DEVELOPMENT

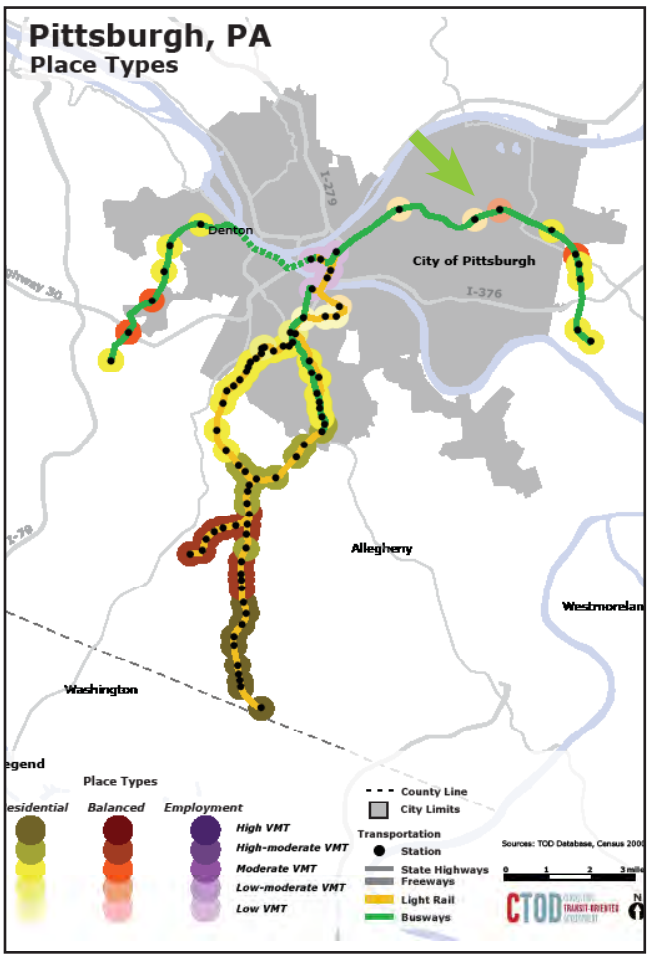
Low-Moderate VMT, Balanced Use Place

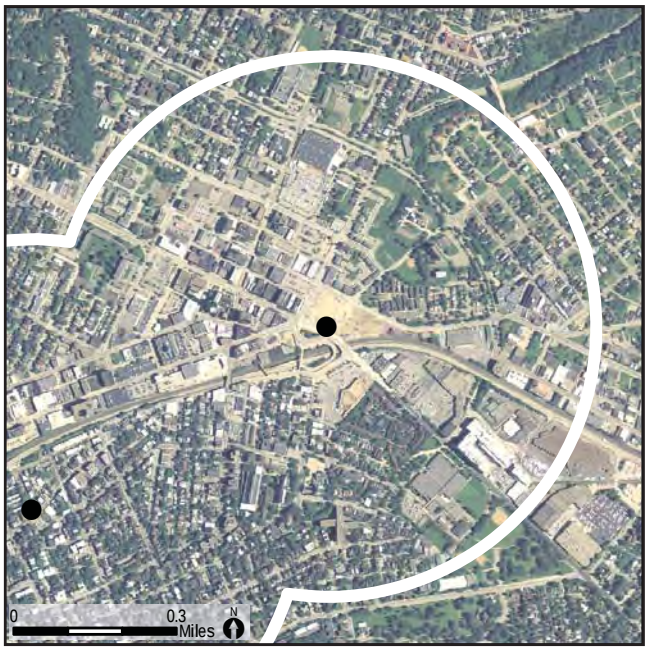
Low-Moderate VMT (9,100 - 11,400 miles per household per year)
Balanced Use Neighborhood (33 - 66% jobs/jobs+residents)

East Liberty
Pittsburgh, PA

Place Type Case Studies

How does East Liberty compare to the region?





East Liberty is on Pittsburgh's East Busway. East Liberty was once a second downtown for Pittsburgh and attracted high-end shoppers until urban renewal efforts cleared much of the neighborhood for high density public housing. The busway provides a grade-separated path for several bus routes that stop at stations along the busway, reducing delays due to congestion and providing a more streamlined transit experience. The East Liberty station is 5 miles away from downtown Pittsburgh and about a 15 minute trip on the busway, which improves job access for residents in the transit zone. Residents living in the East Liberty transit zone are using transit to get to work too—32 percent use public transportation to get to work compared to 6 percent regionally.

Transit zones in the Pittsburgh region are a mix of residential places and balanced use places, with a few employment-heavy transit zones in downtown Pittsburgh. The transit zones tend to be in the moderate to high VMT categories, as the map to the left shows. East Liberty is one of the few lower VMT, balanced use transit zones, though two of the other stations along the East Busway are slightly lower VMT and also balanced use places.

Residential density is much higher in the East Liberty transit zone than the region overall, and the proportion of renters (to owners) is nearly three times as high in East Liberty as in the region. Median income for households in East Liberty is significantly lower than the regional average.

The table below shows how East Liberty compares to the region.

Metric	East Liberty	Region
VMT (miles/year)*	9,640	17,960
Residential Density	15.5 du/ac	3.5 du/ac
Median Income	$27,460	$37,470
Percent Renters	75.7%	28.7%

Low-Moderate VMT, Balanced Use Place

Low-Moderate VMT (9,100 - 11,400 miles per household per year)
Balanced Use Neighborhood (33 - 66% jobs/jobs+residents)

East Liberty
Pittsburgh, PA

Metric	East Liberty	Compared to Normative Metric
Average VMT per Household*	9,640 miles/year	
Residential vs Employment Mix	51% workers (49% residents)	

Lower — Higher

What factors can lower VMT in East Liberty?

Higher VMT → **Lower VMT**

Metric	East Liberty	Compared to Normative Metric
Average Block Size	3.2 acres/block	
Residential Density	15.5 units/acre	
Employment Proximity*	64,760 jobs nearby	
Transit Access Index*	71 transit opportunities	

Lower than norm — Higher than norm

This section shows how the East Liberty transit zone performs on some of the key factors that affect VMT. The transit zone has more than twice as many transit opportunities as the typical low-moderate VMT, balanced use place, and the average block size is about half as small. However, residential density is a little lower around East Liberty station than the typical place, and there are half as many jobs nearby. To lower VMT in this transit zone, efforts could be focused on increasing residential density and improving employment proximity, discussed more fully in the Guidebook.

How does East Liberty compare to the norm on other transportation performance metrics?

Metric	East Liberty	Compared to Normative Metric
Avg Household Transportation Costs*	$6,330 per year	
Nonauto Commute From Transit Zone	40.1% of residents	
Nonauto Commute To Transit Zone	15.9% of workers	
Avg Autos per Household	0.79 vehicles	

Lower than norm — Higher than norm

The East Liberty transit zones performs better than the typical low-moderate VMT, balanced use place on the average transportation cost per household (lower in this transit zone than is typical) and the average number of vehicles owned by a household. Residents living in the transit zone use transit, bike, and walk at the same rate as residents in the typical place, but workers are less likely to use these nonauto modes.

Low-Moderate VMT, Balanced Use Place

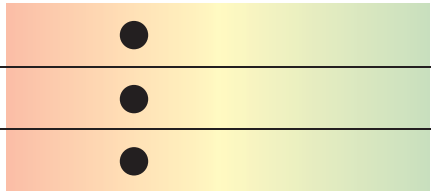
Low-Moderate VMT (9,100 - 11,400 miles per household per year)
Balanced Use Neighborhood (33 - 66% jobs/jobs+residents)

East Liberty
Pittsburgh, PA

Place Type Case Studies

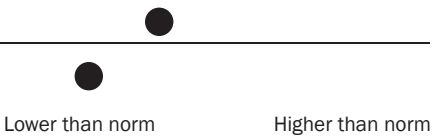
Who lives and works in East Liberty?

Metric	East Liberty	Compared to Normative Metric
Total Transit Zone Intensity	14,750 people	
Total Residents	7,150 residents	
Total Workers	7,600 workers	



There are fewer people both living and working in the half mile around the East Liberty station than is typical for transit zones in the low-moderate VMT, balanced use category. However, this transit zone has more people than the typical moderate VMT, balanced use category, so it falls between the two on these metrics. Adding more population (workers or residents) might be one way of lowering VMT in the area.

Median Household Income	$27,460 per year	
Average Household Size	1.7 people/household	



Median household income in the East Liberty transit zone is about $10,000 less than the typical low-moderate VMT, balanced use place, and the average household size in the area is also lower than the average. Policies that make changes to these indicators are less likely to have a direct impact on VMT.

What are some other low-moderate VMT, balanced use places?

Station	City	Transit System	Region
North/Clybourn	Chicago	Red Line, CTA	Chicago, IL
Burbank	Burbank	Metrolink	Los Angeles, CA
Pleasant Street	Boston	Green Line, MBTA	Boston, MA
7th Ave/ Camelback	Phoenix	Metro Light Rail	Phoenix, AZ
U Street	Washington, DC	Green Line, Metro	Washington, DC
St George	Staten Island	Staten Island Railroad	New York Tristate
Coconut Grove	Miami	Metrorail	Miami, FL
16th St Mission	San Francisco	BART	San Francisco Bay, CA
Johns Hopkins Hospital	Baltimore	Metro Subway	Baltimore
Mockingbird	Dallas	Blue Line, DART	Dallas-Fort Worth, TX

*VMT and household transportation costs are estimated using the Housing and Transportation Index. The Transit Opportunity Index and Employment Proximity are components of the H + T ® Index.

CTOD CENTER FOR TRANSIT-ORIENTED DEVELOPMENT

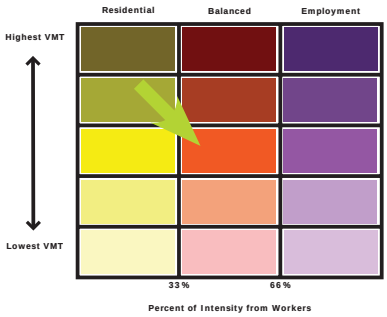
Moderate VMT, Balanced Use Place

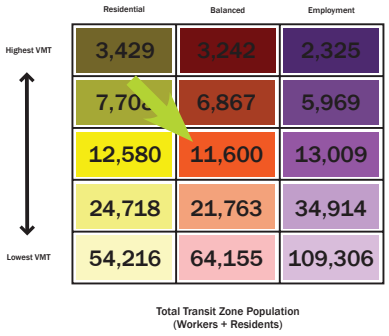
Moderate VMT (11,600 to 14,300 miles per household per year)
Balanced Neighborhood (33 - 66% jobs/jobs+residents)

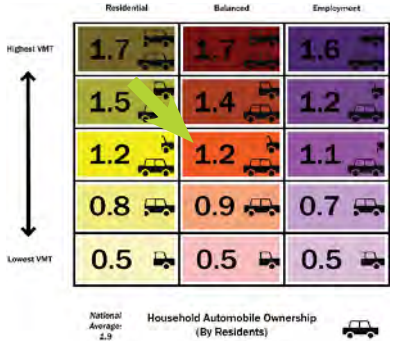
Downtown Berkeley
San Francisco Bay Area, CA

Place Type Case Studies

What does it mean to be a moderate VMT, balanced use place?







As a balanced use transit zone, Downtown Berkeley has an even mix of workers and residents, who activate the transit zone continuously from early in the morning to later at night. The normative metrics for each place type are discussed fully in the guidebook; this case study will look at a specific transit zone that falls into this category: Downtown Berkeley station in the San Francisco Bay Area. As a moderate VMT transit zone, the average household will drive about 13,000 miles a year.

What is the downtown Berkeley transit zone like?

- Downtown Berkeley is a medium-sized, urban downtown in the San Francisco Bay Area. Some stations in this place type are in small to medium sized downtowns, and some are regionally significant employment centers like downtown Berkeley.
- In downtown Berkeley, residential density is about 16 units per acre, which takes the form of moderately dense single family homes with some higher density housing directly around the station.
- Downtown Berkeley has a tightly knit street grid, with a small average block size, making it easy to walk around.
- There are many retail uses within a half mile of the downtown Berkeley station, including restaurants and smaller scale shopping.

CTOD CENTER FOR TRANSIT-ORIENTED DEVELOPMENT

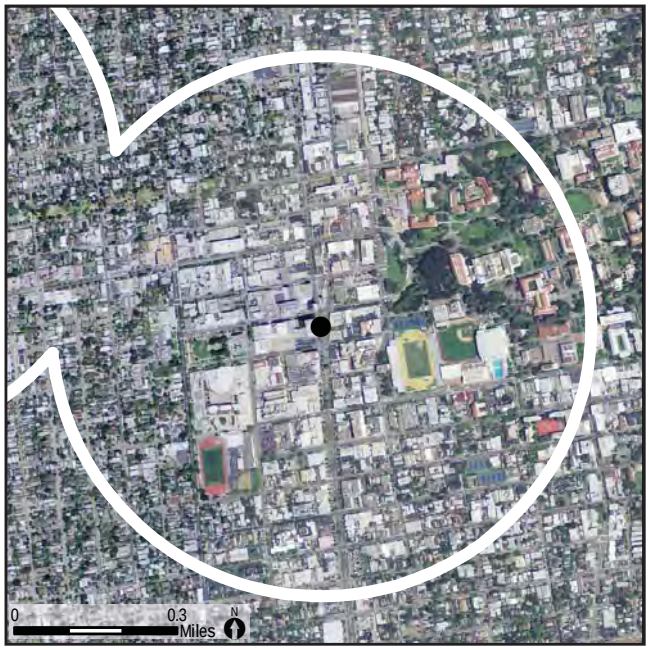
Moderate VMT, Balanced Use Place

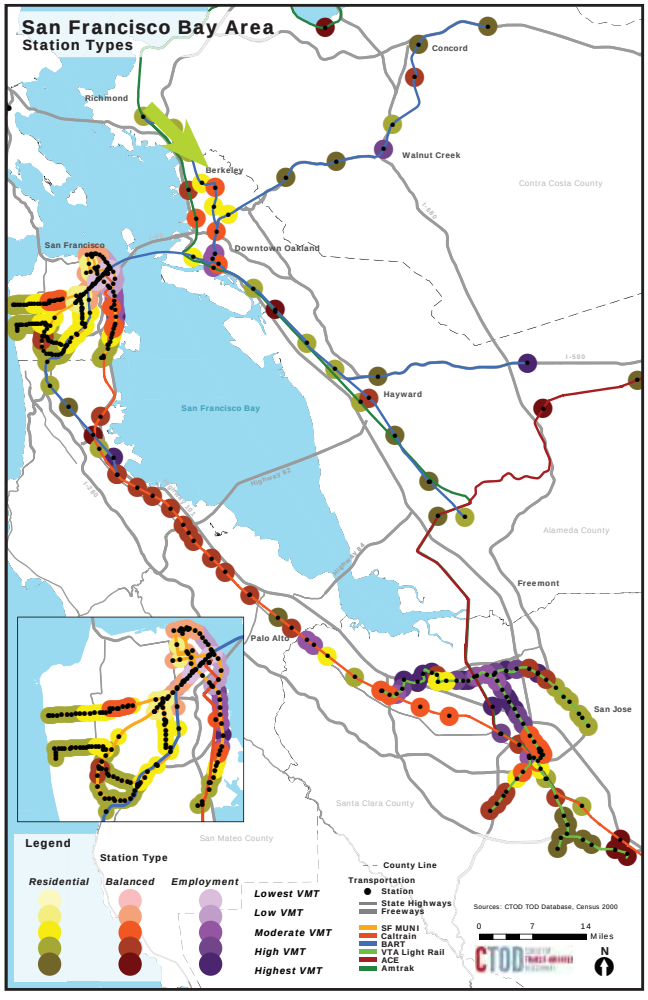
Moderate VMT (11,600 to 14,300 miles per household per year)
Balanced Neighborhood (33 - 66% jobs/jobs+residents)

Downtown Berkeley
San Francisco Bay Area, CA

Place Type Case Studies

How does Downtown Berkeley compare to the region?





Located in the East Bay of the San Francisco Bay Area, downtown Berkeley is on the Bay Area Rapid Transit (BART) heavy rail system. Downtown Berkeley is one of the more urban stations in the BART network, with a mix of office buildings, moderate to higher density residential, and a plethora of restaurants, bars, and shops. This station is also in close proximity to the University of California at Berkeley campus, which is a major employer and activity generator.

Downtown Berkeley is well-connected to regional job centers. The transit zone is within a 20 minute transit ride to downtown San Francisco and a 10 minute ride to downtown Oakland. The transit zone itself is also an important job center for the region, with nearly 18,000 workers in the half mile around the station alone. Downtown Berkeley has the highest percentage of workers who commute by walking, nearly 14%, in part due to the many housing opportunities in proximity to these jobs.

The Bay Area has a diverse mix of transit zones, as shown in the map to the left, and Downtown Berkeley falls in the middle in terms of VMT. Many stations in the city of San Francisco fall into the low-moderate and low VMT categories, while the Peninsula and the South Bay (where San Jose and Silicon Valley are located) have more transit zones in the higher VMT places.

The table below shows Downtown Berkeley compares to the region as a whole.

Metric	Downtown Berkeley	Region
VMT (miles/year)*	13,000	18,930
Transportation Costs*	$8,400	$10,650
Household Income	$23,550	$63,400
Residential Density	21 du/ac	5.2 du/ac
Percent Renters	89.1%	42.7%
Nonauto commuters	59.8%	14.6%

Moderate VMT, Balanced Use Place

Moderate VMT (11,600 to 14,300 miles per household per year)
Balanced Neighborhood (33 - 66% jobs/jobs+residents)

Downtown Berkeley
San Francisco Bay Area, CA

Metric	Downtown Berkeley	Compared to Normative Metric
Average VMT per Household*	13,000 miles/year	
Residential vs Employment Mix	59% workers (41% residents)	

Lower — Higher

What factors can lower VMT in Downtown Berkeley?

Higher VMT → **Lower VMT**

Metric	Downtown Berkeley	Compared to Normative Metric
Average Block Size	5.2 acres/block	
Residential Density	21.0 units/acre	
Employment Proximity*	77,800 jobs nearby	
Transit Access Index*	25 transit opportunities	

Lower than norm — Higher than norm

The chart above shows how downtown Berkeley performs on some of the key factors that affect VMT. For average block size and residential density, Downtown Berkeley performs as well as the next lowest VMT place, and transit access in downtown Berkeley is twice as high as the average moderate VMT, balanced use transit zone. Improving employment proximity could have a significant impact on the potential VMT of the transit zone, explained in greater detail in the Guidebook. Access to more jobs means residents will drive shorter distances to get to work and may take alternative forms of transportation to get there.

How does Downtown Berkeley compare to the norm on other transportation performance metrics?

Metric	Downtown Berkeley	Compared to Normative Metric
Avg Household Transportation Costs*	$8,400 per year	
Nonauto Commute From Transit Zone	60% of residents	
Nonauto Commute To Transit Zone	38% of workers	
Avg Autos per Household	0.76 vehicles	

Lower than norm — Higher than norm

The Downtown Berkeley transit zone has higher rates of walking, biking, and taking transit than the average moderate VMT, balanced use place. The average number of vehicles per household is similar to low-moderate VMT transit zones, but transportation costs are still in the moderate VMT range.

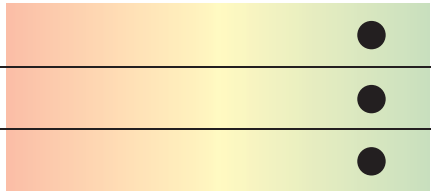
Moderate VMT, Balanced Use Place

Moderate VMT (11,600 to 14,300 miles per household per year)
Balanced Neighborhood (33 - 66% jobs/jobs+residents)

Downtown Berkeley
San Francisco Bay Area, CA

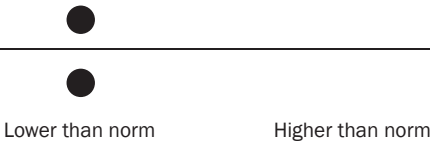
Who lives and works in Downtown Berkeley?

Metric	Downtown Berkeley	Compared to Normative Metric
Total Transit Zone Intensity	30,860 people	
Total Residents	12,750 residents	
Total Workers	18,100 workers	



Downtown Berkeley also has more residents and workers in the half mile around the station than the typical moderate VMT, balanced use place. These indicators look more like low-moderate VMT places than moderate VMT transit zones, and increasing them further could reduce potential VMT.

Median Household Income	$23,550 per year	
Average Household Size	1.75 people/household	



Median household income is lower than the typical moderate VMT, balanced use place, possibly due to the many students who live in the transit zone. Household size is also smaller than the norm in Downtown Berkeley. Policies that make changes to these indicators are less likely to have a direct impact on VMT.

What are some other moderate VMT, balanced use places?

Station	City	Transit System	Region
W 117-Madison	Cleveland	Red Line, GCRTA	Cleveland, OH
Davis	Evanston	Purple Line, CTA	Chicago, IL
MLK Station	Dallas	Green Line, DART	Dallas, TX
Great Neck	Great Neck	Long Island RR	Greater New York, NY
Crenshaw	Hawthorne	Green Line, Metro	Los Angeles, CA
Woodbury	Baltimore	Light Rail, MTA	Baltimore, MD
Trenton	Trenton	NJ Transit	Philadelphia, PA
Del Paso	Sacramento	Blue Line, RT	Sacramento, CA
Clarendon	Arlington	Orange Line, Metro	Washington, DC
Northside	Miami	Metrorail	Miami, FL

*VMT and household transportation costs are estimated using the Housing and Transportation Index. The Transit Opportunity Index and Employment Proximity are components of the H + T ® Index.

CTOD CENTER FOR TRANSIT-ORIENTED DEVELOPMENT

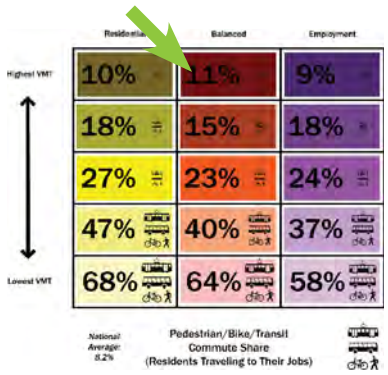
High VMT, Balanced Use Place

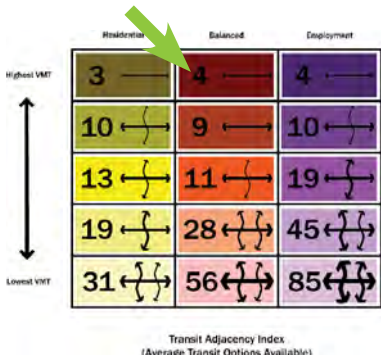
High VMT (17,200 + miles per household per year)
Balanced Neighborhood (33 - 66% jobs/jobs+residents)

Gresham Central
Portand, OR

Place Type Case Studies

What does it mean to be a high VMT, balanced use place?





This place type includes areas with the highest VMT of all of the transit zones in the US. While this existing condition means it may be more difficult for residents to get around without a car, these transit zones have the most potential to reduce overall VMT because small changes can have big impacts. As a balanced use place, these transit zones include an equal number of residents and employees. The normative metrics for each place type are discussed fully in the guidebook; this case study will look at one specific transit zone that falls into this category: Gresham Central Transit station outside of Portland, OR.

What is the Gresham Central transit zone like?

- Residential uses around the Gresham Central station are primarily small single family homes, though there are some apartment complexes or townhomes that are oriented towards the street. Residential density in the transit zone is low, 4.2 households per acre, typical of this place type.
- Downtown Gresham is a few blocks southwest of the station and is the more jobs-oriented portion of the transit zone. The small scale retail along Main Street transitions into a big box shopping complex towards the western edge of the transit zone.
- Streets in Gresham Central are in a basic grid, though it is broken by diagonal streets. Many of the residential streets and some of the streets directly around the station do not have sidewalks.

CTOD CENTER FOR TRANSIT-ORIENTED DEVELOPMENT

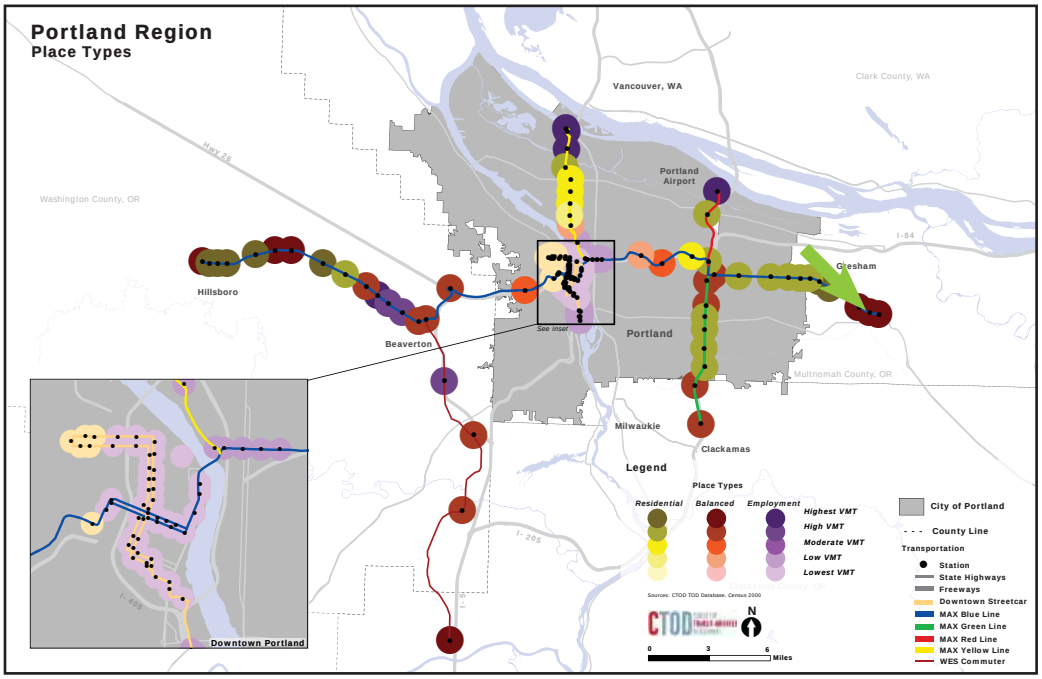
High VMT, Balanced Use Place

High VMT (17,200 + miles per household per year)
Balanced Neighborhood (33 - 66% jobs/jobs+residents)

Gresham Central
Portand, OR

Place Type Case Studies

How does Gresham Central compare to the region?



Metric	Gresham Central	Region
VMT (miles/year)*	17,600	18,000
Residential Density	3.6 du/ac	4.2 du/ac
Median Income	$35,000	$47,060
Percent Renters	79%	37%

The Gresham Central station is on the MAX Blue Line in the City of Gresham, just outside of Portland, Oregon. The station sits close between two other stations at the end of the Blue Line, all located within the city of Gresham. Downtown Gresham is located to the southwest of the Gresham Central station, and Gresham High School takes up a large portion of the land north of the station.

Transit enhances Gresham Central's access to regional job centers; the transit zone is about a 30 minute train ride away from downtown Portland, and the Blue Line connects to some of the industrial and tech jobs west of downtown between Beaverton and Hillsboro. The City of Gresham itself is a smaller job center in the region, and most of the jobs are in the retail sector.

The map of the Portland region shows a distinct difference between transit zones in downtown Portland, which tend to fall into the lower VMT categories, and the transit zones outside of the city, which are higher VMT places. The Gresham Central transit zone has a low residential density, much like the region overall. However, the proportion of renters is much higher in the transit zone than the region, and median household income is lower in around Gresham Central than in the region.

The table to the left shows Gresham Central compares to the region.

High VMT, Balanced Use Place

High VMT (17,200 + miles per household per year)
Balanced Neighborhood (33 - 66% jobs/jobs+residents)

Gresham Central
Portand, OR

Place Type Case Studies

Metric	Gresham Central	Compared to Normative Metric
Average VMT per Household*	17,600 miles/year	
Residential vs Employment Mix	52% workers (48% residents)	

Lower Higher

What factors can lower VMT in Gresham Central?

Higher VMT → **Lower VMT**

Metric	Gresham Central	Compared to Normative Metric
Average Block Size	6.1 acres/block	
Residential Density	4.2 units/acre	
Employment Proximity*	20,700 jobs nearby	
Transit Access Index*	11 transit opportunities	

Lower than norm Higher than norm

The chart above shows how the Gresham Central transit zone performs on some of the key factors that affect VMT. The typical high VMT, balanced use station has very large blocks, over 20 acres per block, but in the Gresham Central transit zone, block size is relatively small, closer to the block size in a typical low-moderate VMT, balanced use station. Transit access near the station is also much higher than the typical high VMT place. To lower VMT in this transit zone, efforts could be focused on increasing residential density and improving employment proximity, discussed more fully in the Guidebook.

How does Gresham Central compare to the norm on other transportation performance metrics?

Metric	Gresham Central	Compared to Normative Metric
Avg Household Transportation Costs*	$9,760 per year	
Nonauto Commute From Transit Zone	11.5% of residents	
Nonauto Commute To Transit Zone	6.8% of workers	
Avg Autos per Household	1.4 vehicles	

Lower than norm Higher than norm

The Gresham Central transit zone performs more like a typical high VMT, balanced use place on some of the other transportation metrics. Transit use for commuting to work is fairly low for both residents living in the transit zone and employees working in the area. Gresham Central does perform slightly better on transportation costs and auto ownership, looking more like a high-moderate VMT place.

High VMT, Balanced Use Place

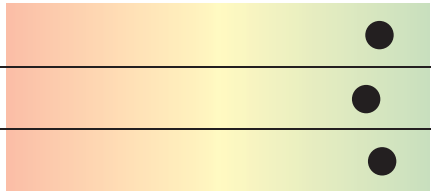
High VMT (17,200 + miles per household per year)
Balanced Neighborhood (33 - 66% jobs/jobs+residents)

Gresham Central
Portand, OR

Place Type Case Studies

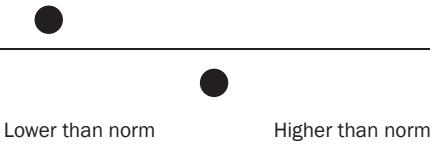
Who lives and works in Gresham Central?

Metric	Gresham Central	Compared to Normative Metric
Total Transit Zone Intensity	6,650 people	
Total Residents	3,210 residents	
Total Workers	3,440 workers	



There are nearly twice as many people living and working in the Gresham Central transit zone than in the typical high VMT, balanced use place. These numbers are more typical of the next lowest VMT place, showing that along with block size and transit access, this transit zone already has some of the pieces necessary to lowering VMT in the area.

Median Household Income	$35,000 per year	
Average Household Size	2.5 people/household	



Households in the Gresham Central transit zone earn nearly half as much as a household in a typical high VMT, balanced use place, though household size is similar to the average. Policies that make changes to these indicators are less likely to have a direct impact on VMT.

What are some other high VMT, balanced use places?

Station	City	Transit System	Region
Camarillo	Camarillo	Metrolink	Los Angeles, CA
Greenwich CT	Greenwich	Metro North RR	New York Tri-State
Largo Town Center	Largo	Blue Line, Metro	Washington, DC
Lakewood/Ft Mcpherson	Atlanta	New Jersey Coast Line	Atlanta, GA
Gwynedd Valley	Ambler	R5, SEPTA	Philadelphia, PA
Emerson Park	St. Louis	Metrolink	St. Louis, MO
Encinitas Station	Encinitas	Coaster, MTS	San Diego, CA
Littleton/Mineral	Littleton	Light Rail, RTD	Denver, CO
Riverside	Auburndale	Green Line, MBTA	Boston, MA
Calumet	East Hazel Crest	Metra Electric	Chicago, IL

*VMT and household transportation costs are estimated using the Housing and Transportation Index. The Transit Opportunity Index and Employment Proximity are components of the H + T ® Index.

CTOD CENTER FOR TRANSIT-ORIENTED DEVELOPMENT

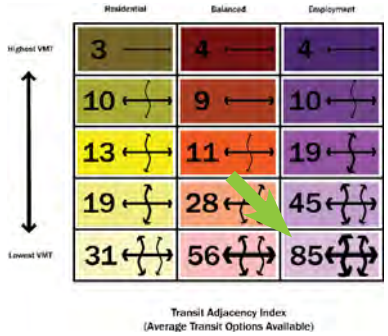
Low VMT, Employment Place

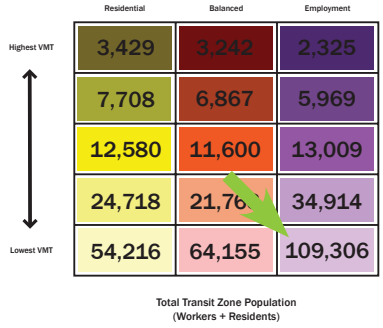
Low VMT (< 9,100 miles per household per year)
Employment Neighborhood (66 - 100% jobs/jobs+residents)

Essex Street
New York Tri-State Area, NY-NJ-CT

Place Type Case Studies

What does it mean to be a low VMT, employment place?





Transit zones that fall into the low VMT, employment place type are generally dense employment centers where residents drive less than 10,000 miles a year. These places may be in the downtowns of major cities, or in other areas with dense employment uses. The normative metrics for each place type are discussed fully in the guidebook; this case study will look at one specific transit zone that falls into this category: Essex Street station along the Hudson-Bergen light rail in Jersey City, NJ, across the Hudson River from New York City.

What is the Essex Street transit zone like?

- Tall office and residential buildings are mixed with three to four story apartment and condo walkups and complexes, which may be true in other low VMT, employment places.
- The density of residential land is very high, nearly 60 households per acre.
- Smaller retail uses, restaurants, coffee shops, and more, are scattered among the residential and office buildings in the transit zone.
- The Essex Street station is located on the east side of Jersey City, and is surrounded by water on two sides.
- Streets within the transit zone form a tight grid pattern that creates small, walkable blocks.
- There are five other transit stops within a half mile of the Essex Street station, showing the type of service offered by the Hudson-Bergen Line.

CTOD CENTER FOR TRANSIT-ORIENTED DEVELOPMENT

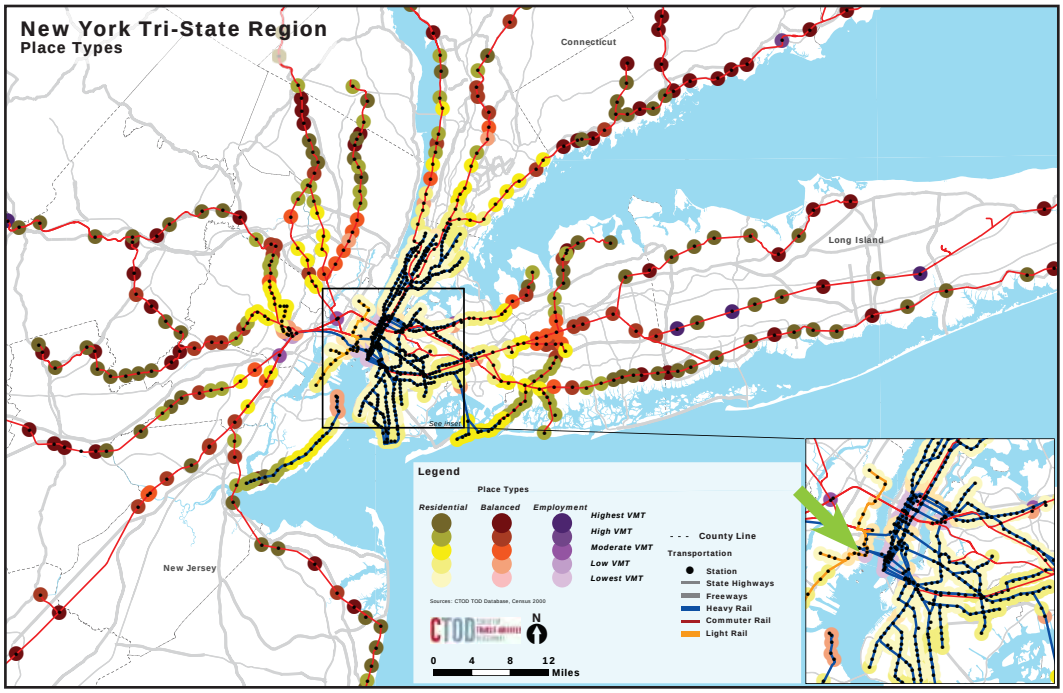
Low VMT, Employment Place

Low VMT (< 9,100 miles per household per year)
Employment Neighborhood (66 - 100% jobs/jobs+residents)

Essex Street
New York Tri-State Area, NY-NJ-CT

Place Type Case Studies

How does Essex Street compare to the region?



Metric	Essex Street	Region
VMT (miles/year)*	7,440	8,320
Residential Density	58.2 du/ac	6.0 du/ac
Median Income	$47,910	$50,740
Percent Renters	81.3%	47.0%

Located just across the Hudson River from Manhattan, the Essex Street station sits on New Jersey's Hudson-Bergen light rail line that connects Jersey City to Bayonne, Hoboken, Weehawken, Union City and North Bergen. The PATH train (less than half a mile to the north of the station) carries commuters across the river to Manhattan.

Essex St. serves as an employment center itself, with several major employers, including Goldman Sachs. The majority (63%) of residents living in the Essex Street transit zone take transit to work, more than twice the regional average of 25%.

The New York Tri-State region includes a diverse array of transit zones around over 900 existing stations. The map of the region shows how more suburban places, farther from the core of Manhatten tend to fall into higher VMT categories, while the Essex Street transit zone is more like stations in lower Manhattan.

Residential density is much higher in the Essex Street transit zone than the region overall, and the proportion of renters (to owners) is nearly twice as high in the transit zone as in the region. Median income for households in Essex Street is slightly lower than the regional average.

The table to the left shows how the Essex Street transit zone compares to the region.

Low VMT, Employment Place

Low VMT (< 9,100 miles per household per year)
Employment Neighborhood (66 - 100% jobs/jobs+residents)

Essex Street
New York Tri-State Area, NY-NJ-CT

Place Type Case Studies

Metric	Essex Street	Compared to Normative Metric
Average VMT per Household*	7,440 miles/year	
Residential vs Employment Mix	69% workers (31% residents)	

Lower Higher

What factors can lower VMT in Essex Street?

Higher VMT → **Lower VMT**

Metric	Essex Street	Compared to Normative Metric
Average Block Size	7.3 acres/block	
Residential Density	58.2 units/acre	
Employment Proximity*	415,980 jobs nearby	
Transit Access Index*	27 transit opportunities	

Lower than norm Higher than norm

This section shows how the Essex Street transit zone performs on some of the key factors that affect VMT. On residential density and employment proximity, the transit zone performs slightly better than the typical low VMT, employment place. However, the average block size is comparatively high, and the number of transit opportunities comparatively low. To lower VMT in this transit zone, efforts could be focused on increasing residential density and improving employment proximity, discussed more fully in the Guidebook.

How does Essex Street compare to the norm on other transportation performance metrics?

Metric	Essex Street	Compared to Normative Metric
Avg Household Transportation Costs*	$4,420 per year	
Nonauto Commute From Transit Zone	73.0% of residents	
Nonauto Commute To Transit Zone	53.4% of workers	
Avg Autos per Household	0.65 vehicles	

Lower than norm Higher than norm

The Essex Street transit zone performs better than the typical low VMT, balanced use place on the average transportation cost per household (lower in this transit zone than is typical) and the proportion of residents who take transit, bike, or walk to work. Workers traveling to the transit zone use those nonauto modes at the same rate as the norm, while residents own slightly more cars per household.

Low VMT, Employment Place

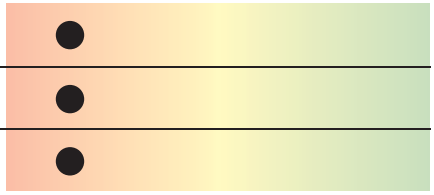
Low VMT (< 9,100 miles per household per year)
Employment Neighborhood (66 - 100% jobs/jobs+residents)

Essex Street
New York Tri-State Area, NY-NJ-CT

Place Type Case Studies

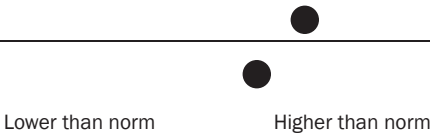
Who lives and works in the Essex Street transit zone?

Metric	Essex Street	Compared to Normative Metric
Total Transit Zone Intensity	19,700 people	
Total Residents	6,100 residents	
Total Workers	13,600 workers	



Compared to the average low VMT, employment place, the Essex Street transit zone has many fewer residents and workers. The typical populations (workers + residents) is about 100,000 people, and this area has less than one quarter of that. Part of the difference for this transit zone might be because water and other non-developable land take up a significant portion of the half mile circle around the station.

Median Household Income	$47,910 per year	
Average Household Size	1.8 people/household	



Median household income in the Essex Street transit zone is about $10,000 more than the typical low VMT, employment place, and the average household size in the area is also higher than the average. Policies that make changes to these indicators are less likely to have a direct impact on VMT.

What are some other low VMT, employment places?

Station	City	Transit System	Region
Jackson/State	Chicago	Red Line, CTA	Chicago, IL
11th at Main	Kansas City	MAX BRT	Kansas City, MO
Downtown Crossing	Boston	Orange Line, MBTA	Boston, MA
6th and Market	Portland	Streetcar, TRIMET	Portland, OR
First Avenue	Pittsburgh	Light Rail, PAT	Pittsburgh, PA
Walnut-Locust	Philadelphia	Broad Street Line	Philadelphia, PA
Poydras	New Orleans	Riverfront Streetcar	New Orleans, LA
Little Italy/County Center	San Diego	Blue Line, MTS	San Diego, CA
Settlers Landing	Cleveland	Waterfront Line	Cleveland, OH
Mckinney And Pearl	Dallas	M-Line Streetcar	Dallas-Fort Worth, TX

*VMT and household transportation costs are estimated using the Housing and Transportation Index. The Transit Opportunity Index and Employment Proximity are components of the H + T ® Index.

CTOD CENTER FOR TRANSIT-ORIENTED DEVELOPMENT

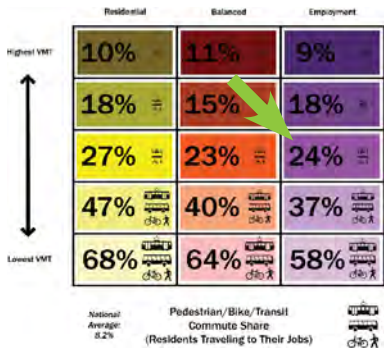
Moderate VMT, Employment Place

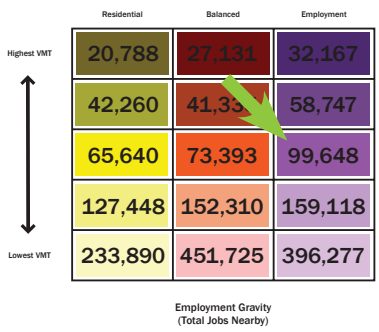
Moderate VMT (11,400 - 14,300 miles per household per year)
Employment Neighborhood (66 - 100% jobs/jobs+residents)

Buckhead
Atlanta, GA

Place Type Case Studies

What does it mean to be a moderate VMT, employment place?





Moderate VMT, employment places include transit zones where there are more workers than residents, and the land uses are primarily office, industrial, or retail, rather than residential. While these places are not the highest VMT ones, people do often use cars to get around. The normative metrics for each place type are discussed fully in the guidebook; this case study will look at one specific transit zone that falls into this category: Buckhead station on Metro's Red Line in Atlanta, GA. The average household in the Buckhead, Atlanta transit zone drives about 12,200 miles every year.

What is the Buckhead transit zone like?

- Tall office buildings surround the Buckhead station, which is located along a major arterial (Highway 400). This kind of land use may be typical of other employment place types.
- Buckhead is also close to a large shopping mall, and has many auto-oriented retail centers in the area. As a moderate VMT place, people will drive to many of these destinations.
- There is a small residential area within the transit zone, where residential density is very low, only 3.4 households per acre.
- The streets are curvilinear without a clear grid; there are few intersections, and there are no direct paths from residential areas to the transit station or mall, making walking from the residential area to the mall extremely challenging.

CTOD CENTER FOR TRANSIT-ORIENTED DEVELOPMENT

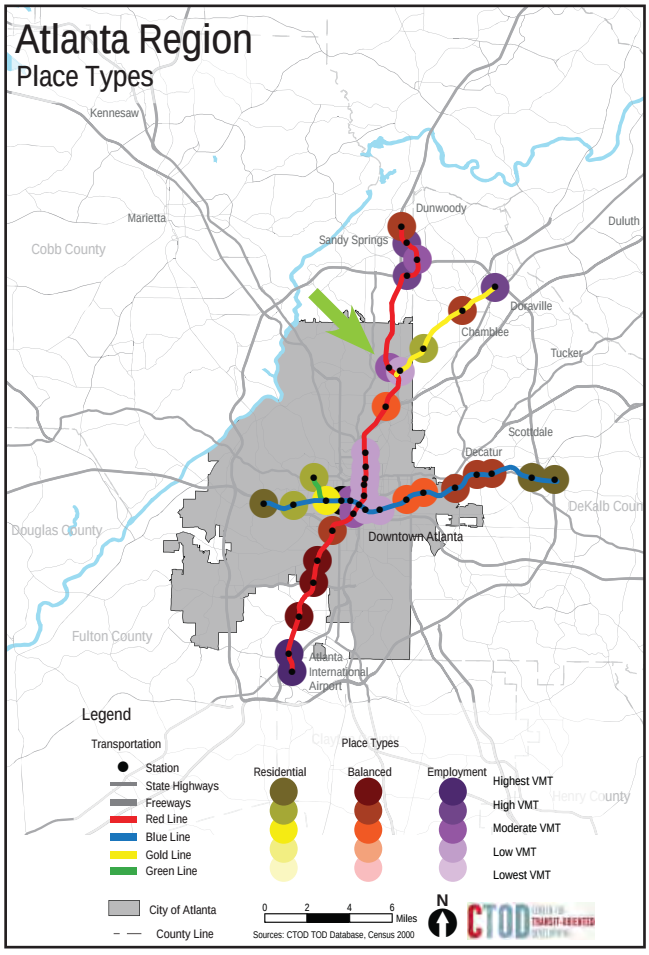
Moderate VMT, Employment Place

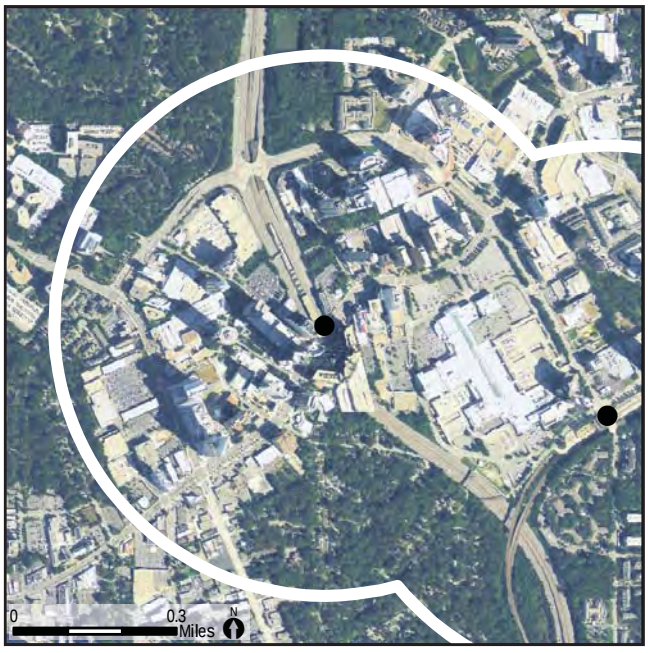
Moderate VMT (11,400 - 14,300 miles per household per year)
Employment Neighborhood (66 - 100% jobs/jobs+residents)

Buckhead
Atlanta, GA

Place Type Case Studies

How does Buckhead compare to the region?





The Buckhead station sits on the Red Line, just after it separates from the Yellow Line, inside the city limits of Atlanta. The transit zone is just over 10 miles from downtown Atlanta, about a 15 minute ride on the MARTA transit system.

Buckhead is one of Atlanta's major employment centers, with over 60,000 employees. The density of workers is fairly high as well, especially compared to other job centers in the region, with about 22 workers per acre. Residents living in this transit zone not only have access to these jobs and the many amenities in the mall and retail centers scattered around the employment center, but are also connected to the two largest employment centers in the region: downtown Atlanta to the south and Dunwoody Springs to the north.

The map of the Atlanta region shows that most transit zones are in the higher VMT categories. The only areas that are in low VMT place types are close to downtown Atlanta, and those transit zones are all employment places–not residential or balanced use places. This comes in part because of the generally very low residential density throughout the region. While Buckhead's 3.8 households per acre is low, even compared to the average moderate VMT, employment place, the region's average residential density is even lower at 2.4 households per acre.

The Buckhead transit zone has a higher median income than the region overall, but in many ways it resembles the region, including the proportion of residents who rent rather than own, and the percent of people who drive to work.

The table below shows how Buckhead compares to the region.

Metric	Buckhead	Region
VMT (miles/year)*	12,200	21,300
Residential Density	3.8 du/ac	2.4 du/ac
Median Income	$85,070	$51,948
Percent Renters	37.6%	33.6%

Moderate VMT, Employment Place

Moderate VMT (11,400 - 14,300 miles per household per year)
Employment Neighborhood (66 - 100% jobs/jobs+residents)

Buckhead
Atlanta, GA

Place Type Case Studies

Metric	Buckhead	Compared to Normative Metric
Average VMT per Household*	12,200 miles/year	
Residential vs Employment Mix	92% workers (8% residents)	

Lower — Higher

What factors can lower VMT in Buckhead?

Higher VMT → **Lower VMT**

Metric	Buckhead	Compared to Normative Metric
Average Block Size	27.8 acres/block	
Residential Density	3.8 units/acre	
Employment Proximity*	101,500 jobs nearby	
Transit Access Index*	3 transit opportunities	

Lower than norm — Higher than norm

The chart above shows how the Buckhead transit zone performs on some of the key factors that affect VMT. For several of these indicators, the transit zone does not perform as well as the norm for a moderate VMT, employment place. The average block around Buckhead is larger than the norm, while residential density is lower and transit options are fewer. To lower VMT in this transit zone, efforts could be focused on increasing residential density and improving employment proximity, discussed more fully in the Guidebook.

How does Buckhead compare to the norm on other transportation performance metrics?

Metric	Buckhead	Compared to Normative Metric
Avg Household Transportation Costs*	$9,220 per year	
Nonauto Commute From Transit Zone	11.4% of residents	
Nonauto Commute To Transit Zone	7.0% of workers	
Avg Autos per Household	1.4 vehicles	

Lower than norm — Higher than norm

The Buckhead transit zone overall performs slightly worse than the typical moderate VMT, employment place. Transportation costs for the average household are slightly higher, fewer people use transit, including both those who live in the transit zone and those who work in the area, and the average household owns more cars than the norm.

Moderate VMT, Employment Place

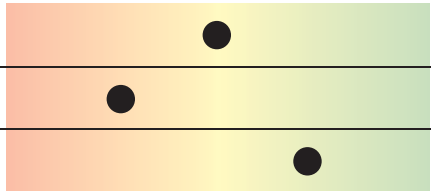
Moderate VMT (11,400 - 14,300 miles per household per year)
Employment Neighborhood (66 - 100% jobs/jobs+residents)

Buckhead
Atlanta, GA

Place Type Case Studies

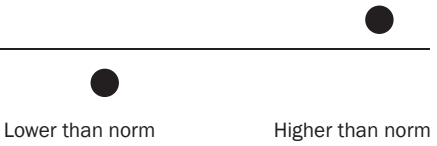
Who lives and works in Buckhead?

Metric	Buckhead	Compared to Normative Metric
Total Transit Zone Intensity	12,310 people	
Total Residents	980 residents	
Total Workers	11,330 workers	



Buckhead's transit zone has about half as many residents as the average moderate VMT, employment place, meaning that increasing residential density may be a key step to lowering VMT in the area. The total number of workers is slightly higher than average.

Median Household Income	$85,070 per year	
Average Household Size	1.8 people/household	



Median household income in the Buckhead transit zone is significantly higher than the norm, and average household size is smaller. Policies that make changes to these indicators are less likely to have a direct impact on VMT.

What are some other moderate VMT, employment places?

Station	City	Transit System	Region
Arapaho Center	Richardson	Red Line, DART	Forth Worth-Dallas, TX
Rosemont	Des Plaines	Blue Line, CTA	Chicago, IL
Orchard	Greenwood Village	RTD	Denver, CO
38th and Washington	Phoenix	Metro Light Rail	Phoenix, AZ
World Trade Center	Boston	Silver Line, MBTA	Boston, MA
Stanford	Palo Alto	Caltrain	San Francisco Bay, CA
Convention Center	Tacoma	Tacoma Link LRT	Seattle, WA
Rosslyn	Arlington	Orange Line, Metro	Washington, DC
Central Pointe	South Salt Lake	UTA	Salt Lake City, UT
2nd at Center	Little Rock	River Rail Streetcar	Little Rock, AK

*VMT and household transportation costs are estimated using the Housing and Transportation Index. The Transit Opportunity Index and Employment Proximity are components of the H + T ® Index.

CTOD CENTER FOR TRANSIT-ORIENTED DEVELOPMENT

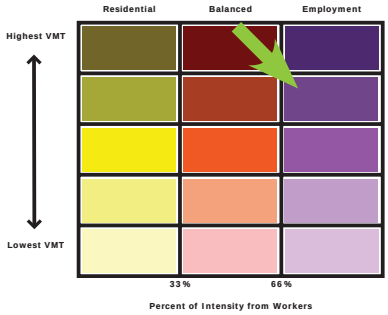
High-Moderate VMT, Employment Place

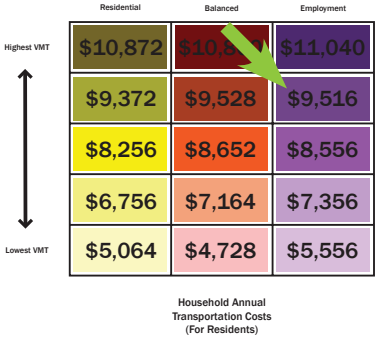
High-Moderate VMT (14,300 - 17,200 miles per household per year)
Employment Neighborhood (66 - 100% jobs/jobs+residents)

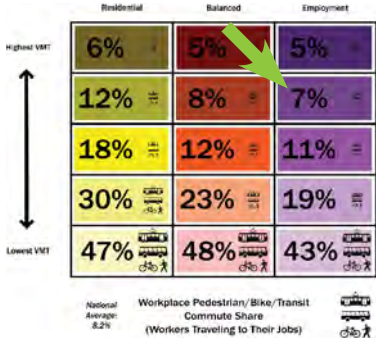
Rockville
Washington, DC

Place Type Case Studies

What does it mean to be a high-moderate VMT, employment place?







Residents living in transit zones that fall into this category drive more than the average household in the transit zone. Higher VMT places have more potential to reduce overall VMT by making incremental changes to employment proximity, density and other factors that affect VMT. As employment places, these transit zones may be in major regional job centers, as well as more peripheral industrial or office parks. The normative metrics for each place type are discussed fully in the guidebook; this case study will look at one specific transit zone that falls into this category: Rockville station in the suburbs of Washington, DC.

What is the Rockville transit zone like?

- Residential uses surrounding the Rockville station are primarily single family homes in neighborhoods with curving, suburban-style streets that often end in cul-de-sacs.
- On the other side of a major arterial, a new retail and residential center was developed on land that once housed an unoccupied indoor shopping mall. In addition to new retail uses, the center also houses a new public library. The multi-family apartment and condo buildings here are very different than the traditional housing offered in the transit zone.
- A few large office buildings stand on the other side of the retail center, including some major local government employers.
- Some smaller industrial uses also exist in the station area.

CTOD CENTER FOR TRANSIT-ORIENTED DEVELOPMENT

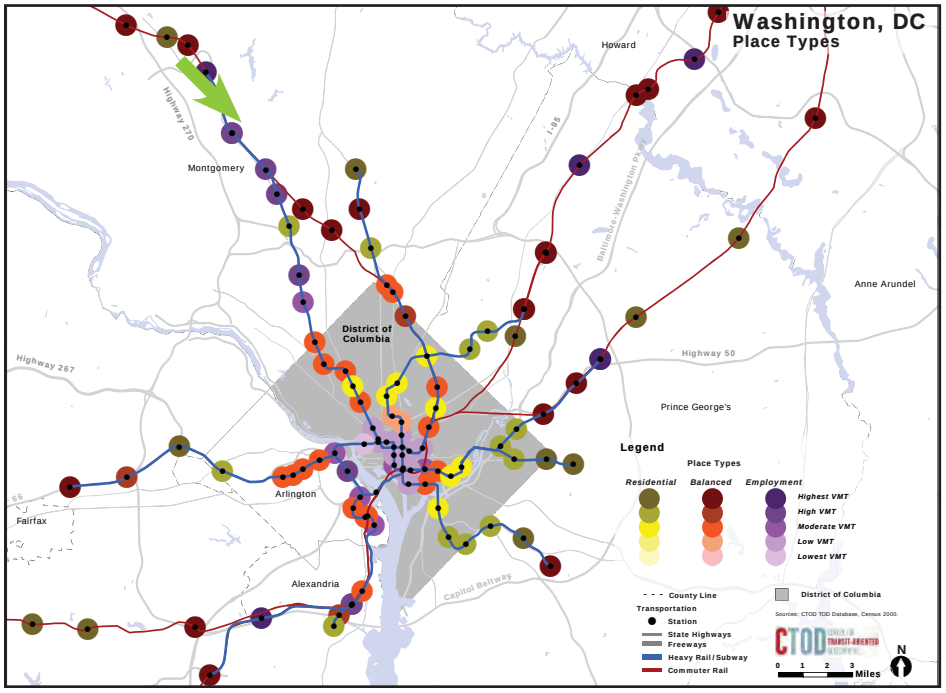
High-Moderate VMT, Employment Place

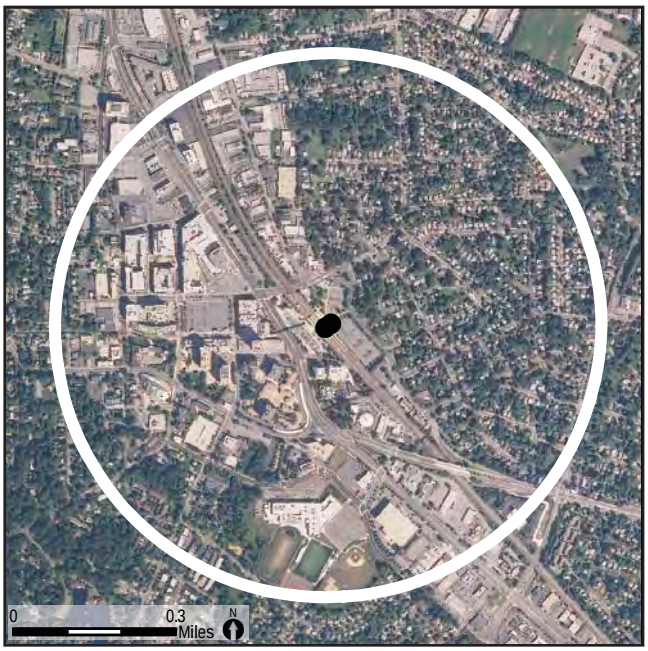
High-Moderate VMT (14,300 - 17,200 miles per household per year)
Employment Neighborhood (66 - 100% jobs/jobs+residents)

Rockville
Washington, DC

Place Type Case Studies

How does Rockville compare to the region?





Metric	Rockville	Region
VMT (miles/year)*	16,350	19,880
Residential Density	5.3 du/ac	3.9 du/ac
Median Income	$47,910	$62,370
Percent Renters	38.6%	36.0%

Rockville is the second to last stop on the western branch of the DC Metro's Red Line. MARC commuter trains and Amtrak's daily Capitol Limited also make stops at the Rockville station.

Several large companies have offices in the transit zone, along with government offices for Rockville and Montgomery County. Downtown DC is about 30 minutes away on the Red Line. Bethesda, the Bethesda Naval Medical Center, and the National Institutes of Health are also located on this branch of the Red Line. About a quarter of residents in the Rockville transit zone use transit, bike, or walk to work, a higher rate than in the region overall.

While downtown DC has transit zones in the lower end of the VMT spectrum, most transit zones in the region are in higher VMT categories, especially stations that are further away from the core like Rockville.

The Rockville transit zone performs slightly better than the region overall on the average VMT per household (slightly lower in Rockville) and residential density (slightly higher in Rockville.) It looks very similar to the region on the proportion of renters vs owners, while median household income in the transit zone is about $15,000 less than in the region overall. The average household in the region owns slightly more cars that the averagehousehold in Rockville (1.7 in the region vs 1.3 in Rockville.) The table to the left shows how the Rockville transit zone compares to the region.

High-Moderate VMT, Employment Place

High-Moderate VMT (14,300 - 17,200 miles per household per year)
Employment Neighborhood (66 - 100% jobs/jobs+residents)

Rockville
Washington, DC

Place Type Case Studies

Metric	Rockville	Compared to Normative Metric
Average VMT per Household*	16,350 miles/year	
Residential vs Employment Mix	72% workers (28% residents)	

Lower Higher

What factors can lower VMT in Rockville?

Higher VMT → **Lower VMT**

Metric	Rockville	Compared to Normative Metric
Average Block Size	6.8 acres/block	
Residential Density	5.3 units/acre	
Employment Proximity*	65,520 jobs nearby	
Transit Access Index*	4 transit opportunities	

Lower than norm Higher than norm

This section shows how the Rockville transit zone performs on some of the key factors that affect VMT. For the most part, Rockville looks like the typical high-moderate VMT, employment station: with low residential density, few transit options, and moderate employment proximity. However, the average block size in the transit zone is very small compared to the norm. To lower VMT in this transit zone, efforts could be focused on increasing residential density and improving employment proximity, discussed more fully in the Guidebook.

How does Rockville compare to the norm on other transportation performance metrics?

Metric	Rockville	Compared to Normative Metric
Avg Household Transportation Costs*	$9,900 per year	
Nonauto Commute From Transit Zone	26.6% of residents	
Nonauto Commute To Transit Zone	7.5% of workers	
Avg Autos per Household	1.3 vehicles	

Lower than norm Higher than norm

Rockville performs similar to the average high-moderate VMT, employment station on other transportation metrics as well. However, residents in the Rockville transit zone have a higher rate of using transit, biking, and walking to work than in the typical place.

High-Moderate VMT, Employment Place

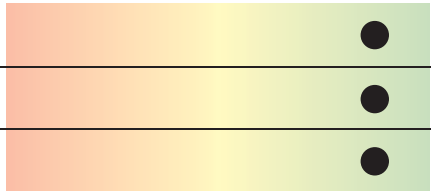
High-Moderate VMT (14,300 - 17,200 miles per household per year)
Employment Neighborhood (66 - 100% jobs/jobs+residents)

Rockville
Washington, DC

Place Type Case Studies

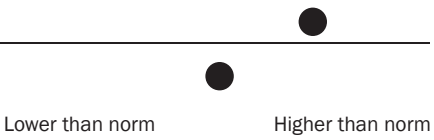
Who lives and works in Rockville?

Metric	Rockville	Compared to Normative Metric
Total Transit Zone Intensity	13,630 people	
Total Residents	3,810 residents	
Total Workers	9,820 workers	



Compared to the average high-moderate VMT, employment place, the Rockville transit zone has many more residents and workers. The typical populations (workers + residents) is about 6,000 people, and this area has more than twice that. With more people, the transit zone has the potential to be in a lower VMT category, but other factors may need to change in order to capture that potential.

Median Household Income	$50,550 per year	
Average Household Size	2.3 people/household	



Median household income in the Rockville transit zone is about $10,000 more than the typical high-moderate VMT, employment place, while the average household size in the area is almost exactly the same. Policies that make changes to these indicators are less likely to have a direct impact on VMT.

What are some other high-moderate VMT, employment places?

Station	City	Transit System	Region
28th Avenue	Minneapolis	Hiawatha Line	Twin Cities, MN
Medical Center	Sandy Springs	North-South Line	Atlanta, GA
Chestnut Hill	Boston	Green Line, MBTA	Boston, MA
Maple At Broadway	Little Rock	River Rail Streetcar	Little Rock, AK
Fannin South	Houston	Red Line, METRO	Houston, TX
Oxford	Sheridan	Southwest Corridor	Denver, CO
SODO	Seattle	Central Link Light Rail	Seattle, WA
Murray Central Station	Salt Lake City	UTA	Salt Lake City, UT
Irvine	Irvine	Metrolink	Los Angeles, CA
Cedars	Dallas	Red Line, DART	Dallas-Fort Worth, TX

*VMT and household transportation costs are estimated using the Housing and Transportation Index. The Transit Opportunity Index and Employment Proximity are components of the H + T ® Index.

CTOD CENTER FOR TRANSIT-ORIENTED DEVELOPMENT

VIII. Appendix

Table 11: Normative Metrics

Metric	Source	Description
Urban Form		
Average Block Size	Census 2000, SF1 (derived)	Average size of blocks in acres within station area
Households	Census 2000, SF1	Count of households
Workers	CTPP 2000, Part 2	Count of workers working in station area
Intensity	Census 2000, SF1 + CTPP Part 2	Sum of workers and residents (taken from SF1)
Use Mix	Census 2000, SF1 + CTPP Part 2	Percentage of intensity due to employment: 100*workers/intensity
Gross Household Density	Census 2000, SF1	Households per acre
Residential Household Density	Census 2000, SF1	Households per residential acre. Land is considered residential if there exists at least one household per acre.
Employment Access	CTPP 2000, Part 2 (derived)	Gravity-based measure of local employment. See textbox in Normative Metrics section for details.
Transportation		
Transit Access	Individual transit agencies	The number of bus routes and train stations within ¼ mile and ½ mile respectively, reported at census block group level.
Journey to Work by mode	CTPP, Part 1	Percentage of residents commuting to work by a given mode
Workplace Journey to Work by mode	CTPP, Part 1	Percentage of workers who work in the station area commuting by a given mode
VMT per Household	CNT H+T® Affordability Index	See text for details
Household Characteristics		
Average Median Income (1999)	Census 2000, SF3	The median income of all households within a half mile of the transit station.
Vehicle Ownership	Census 2000, SF3	Autos per household
Household Age	Census 2000, SF1	Median age of residents in households
Annual Household Transportation Costs	CNT H+T® Affordability Index	See text for details
Commuters per Household	Census 2000, SF3	Workers who do not work at home per household, excluding group quarters
Average Household Size	Census 2000, SF1	Residents per household
Travel Time to Work	Census 2000, SF1	Median travel time to work, all modes

How are VMT per household and Annual Transportation Costs are calculated?

The Center for Neighborhood Technology has developed a model of household travel behavior as a part of its Housing and Transportation (H+T®) Affordability Index . The household transportation model is based on a multidimensional regression analysis, in which a formula describes the relationship between three dependent variables (auto ownership, auto use, and transit use) and nine main independent household and local environment variables. Neighborhood level (Census block group) data on household income (both average and median), household size, commuters per household, journey to work time (for all commuters, transit commuters, and non-transit commuters), household density (both residential and gross), block size, transit access, and job access were utilized as the independent, or predictor variables.

The model for auto use, which predicts annual household VMT, was calibrated using annual odometer readings from households representing a cross section of urban, suburban and rural areas. These data were regressed against the predictor variables, as measured at the level of census block groups. This model was then used to predict the household VMT for the block groups that overlap the station areas considered for this study. The average VMT for each station area is the average household VMT for these block groups, weighted by count of households and overlap with half-mile station area buffer. To control for the effects of income on household travel, the area median income was used, rather than the income at each individual station area.

Annual transportation costs are predicted by combining VMT with the number of autos owned and the number of transit trips taken annually by a typical household. For greater detail on the H+T® Affordability Index, please consult the documentation available online.

Self-Assessment Tool

Place Type Case Studies

Metric	[Insert Transit Zone here.]	Compared to Normative Metric
Average VMT per Household*		
Residential vs Employment Mix		

Lower Higher

What factors can lower VMT in [insert transit zone here]?

Higher VMT → Lower VMT

Metric	[Insert Transit Zone here.]	Compared to Normative Metric
Average Block Size		
Residential Density		
Employment Proximity*		
Transit Access Index*		

Lower Higher

How does [insert transit zone here] compare to the norm on other transportation performance metrics?

Metric	[Insert Transit Zone here.]	Compared to Normative Metric
Avg Household Transportation Costs*		
Nonauto Commute From Transit Zone		
Nonauto Commute To Transit Zone		
Avg Autos per Household		

Lower Higher

Who lives and works in [insert transit zone here]?

Metric	[Insert Transit Zone here.]	Compared to Normative Metric
Total Transit zone Population		
Total Residents		
Total Workers		
Median Household Income	$23,500 per year	
Average Household Size	1.75 people/household	

Lower Higher

CTOD TRANSIT-ORIENTED DEVELOPMENT

Normative Metric Graphics

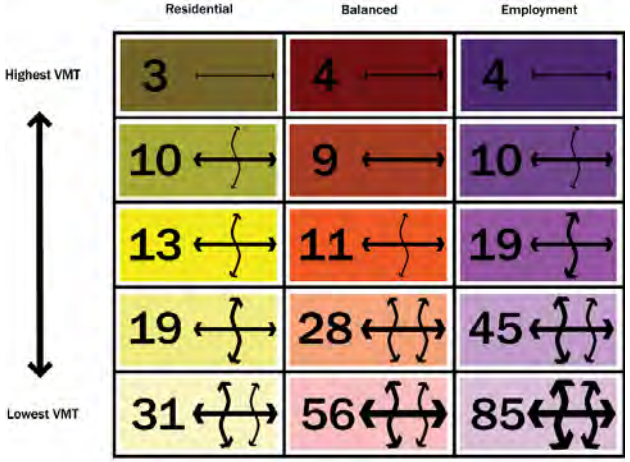
Employment Gravity
(Total Jobs Nearby)

Residential Density
(Units per Residential Acre)

National Average: 1.9

Household Automobile Ownership
(By Residents)

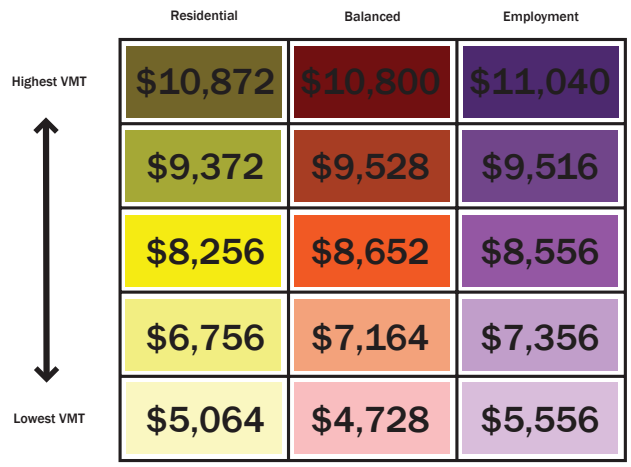
Total Transit Zone Population
(Workers + Residents)



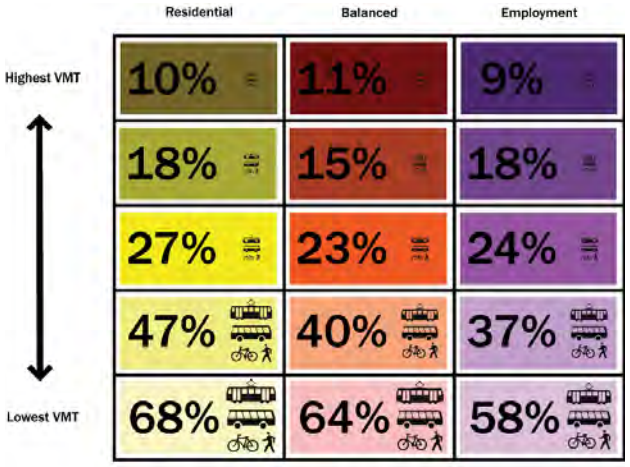
Transit Adjacency Index
(Average Transit Options Available)

National Average: 4.7%

Transit Commute Share
(Residents Traveling to Their Jobs)

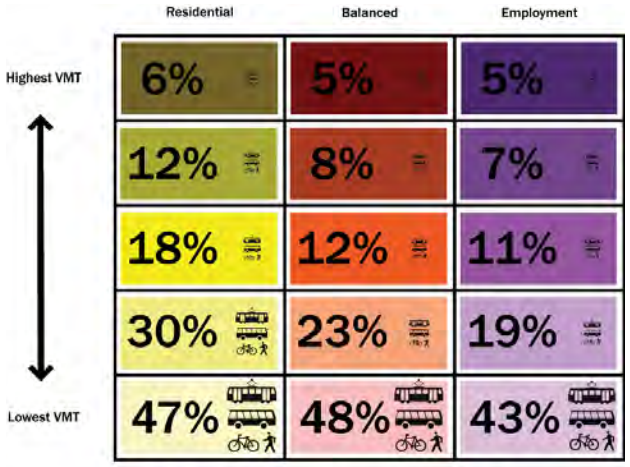


Household Annual Transportation Costs (For Residents)



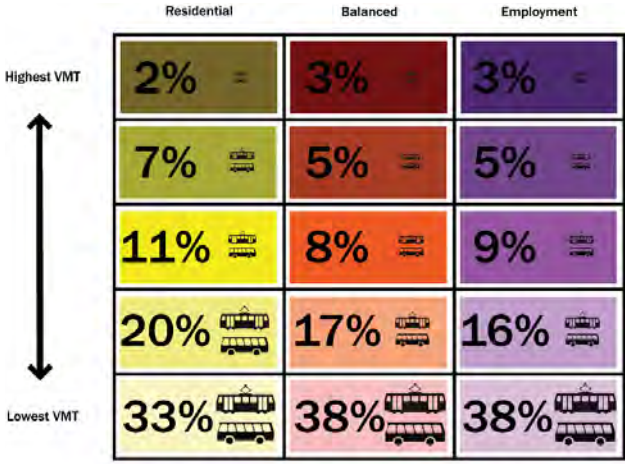
National Average: 8.2%

Pedestrian/Bike/Transit Commute Share (Residents Traveling to Their Jobs)



National Average: 8.2%

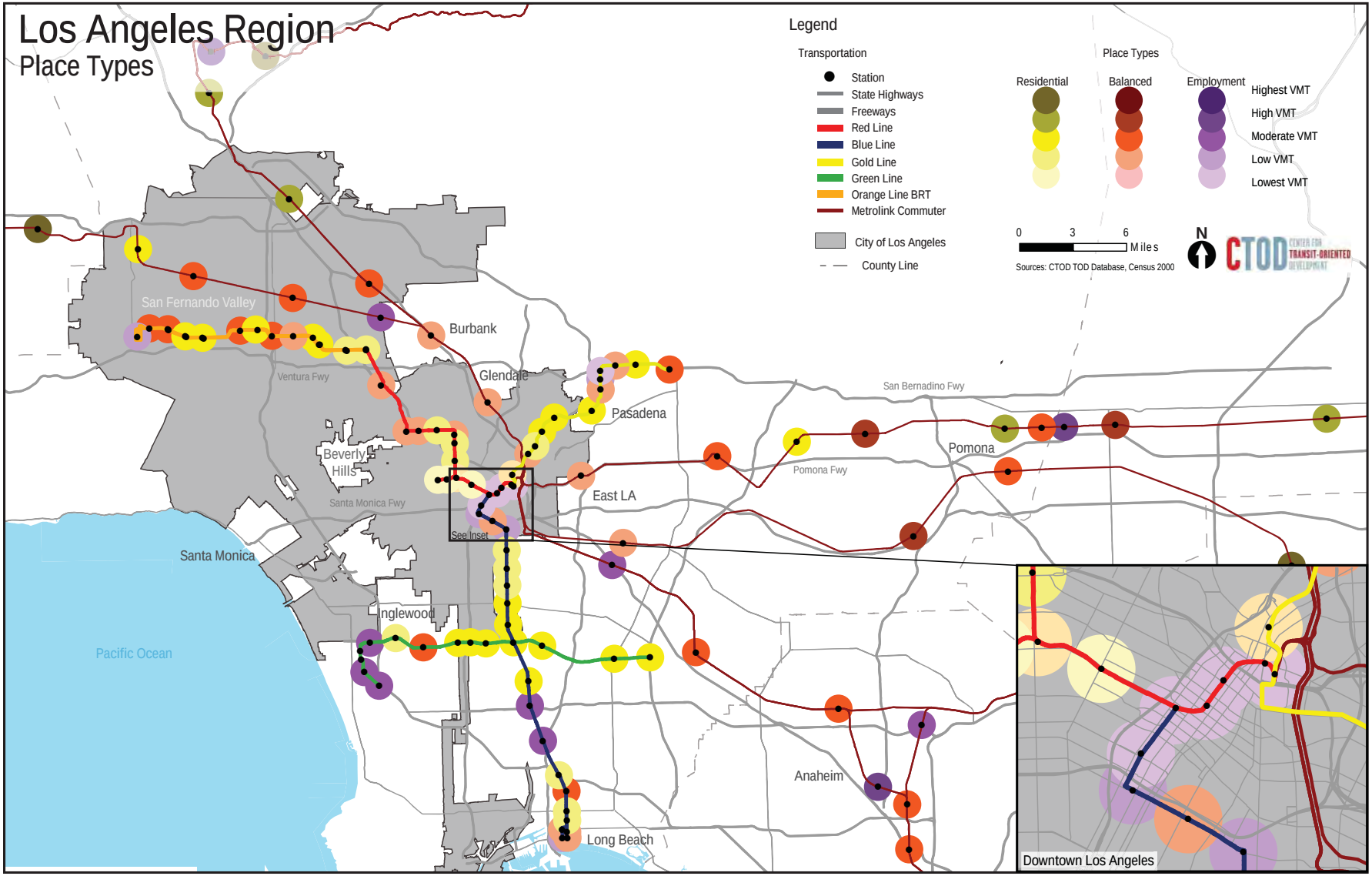
Workplace Pedestrian/Bike/Transit Commute Share (Workers Traveling to Their Jobs)

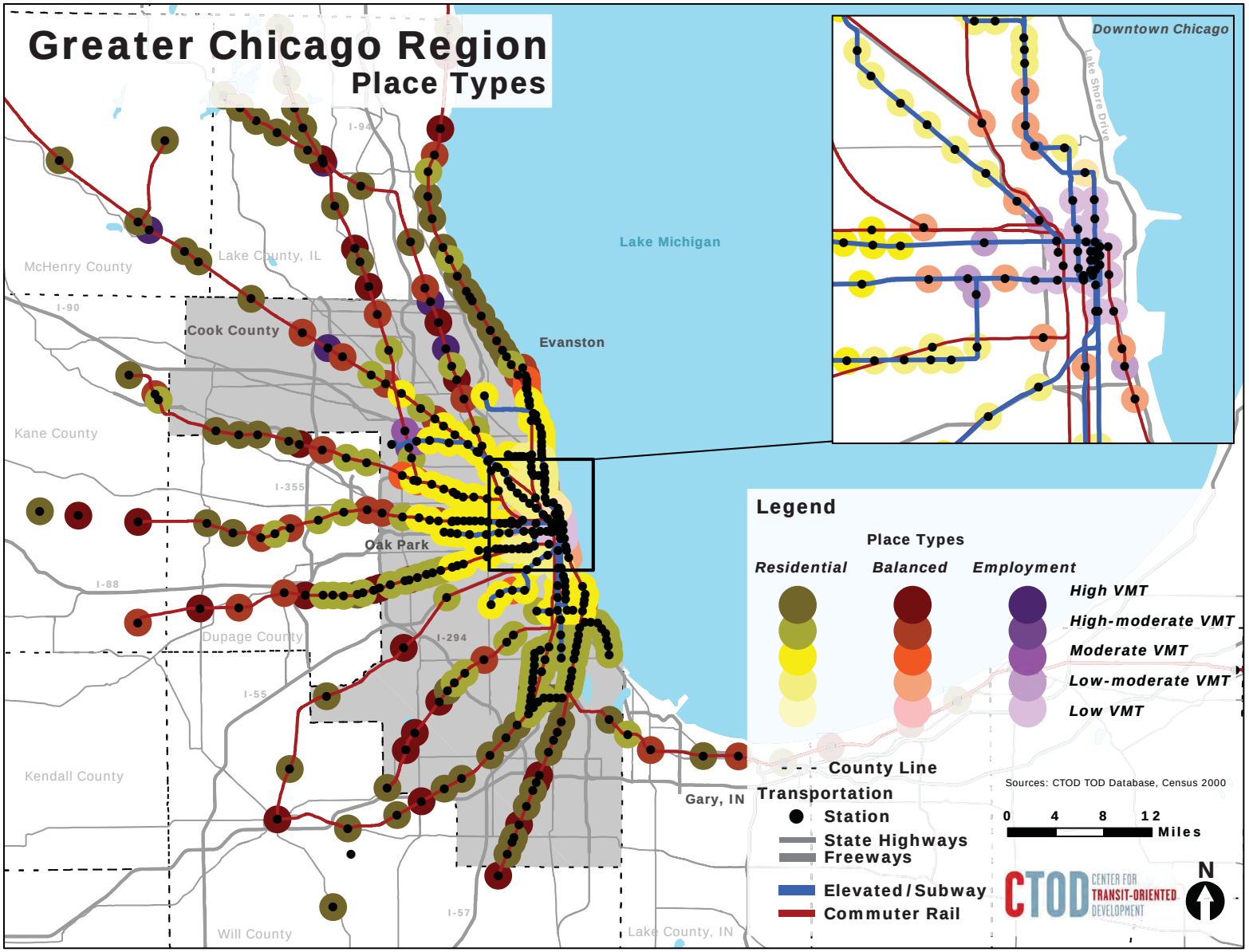


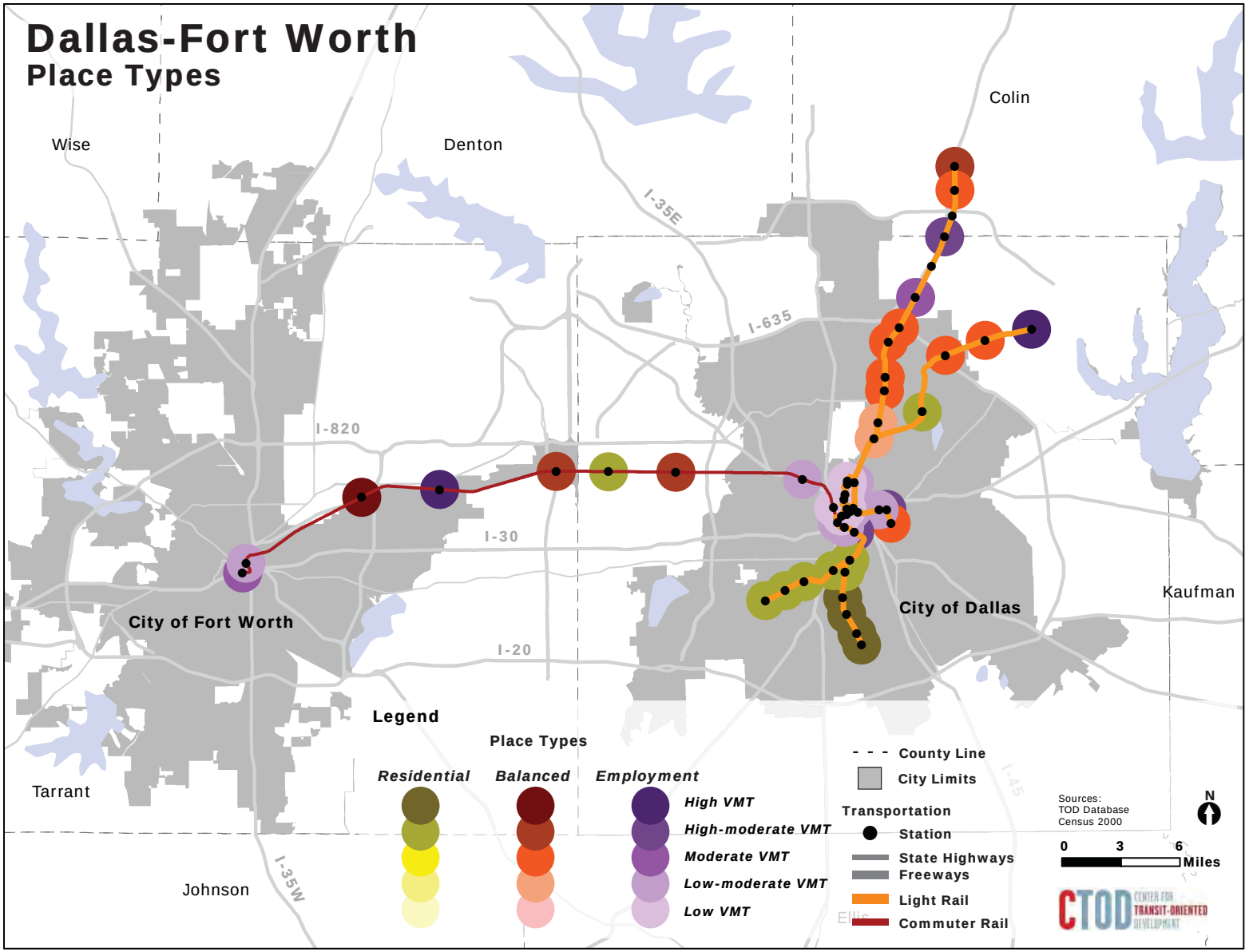
National Average: 4.7%

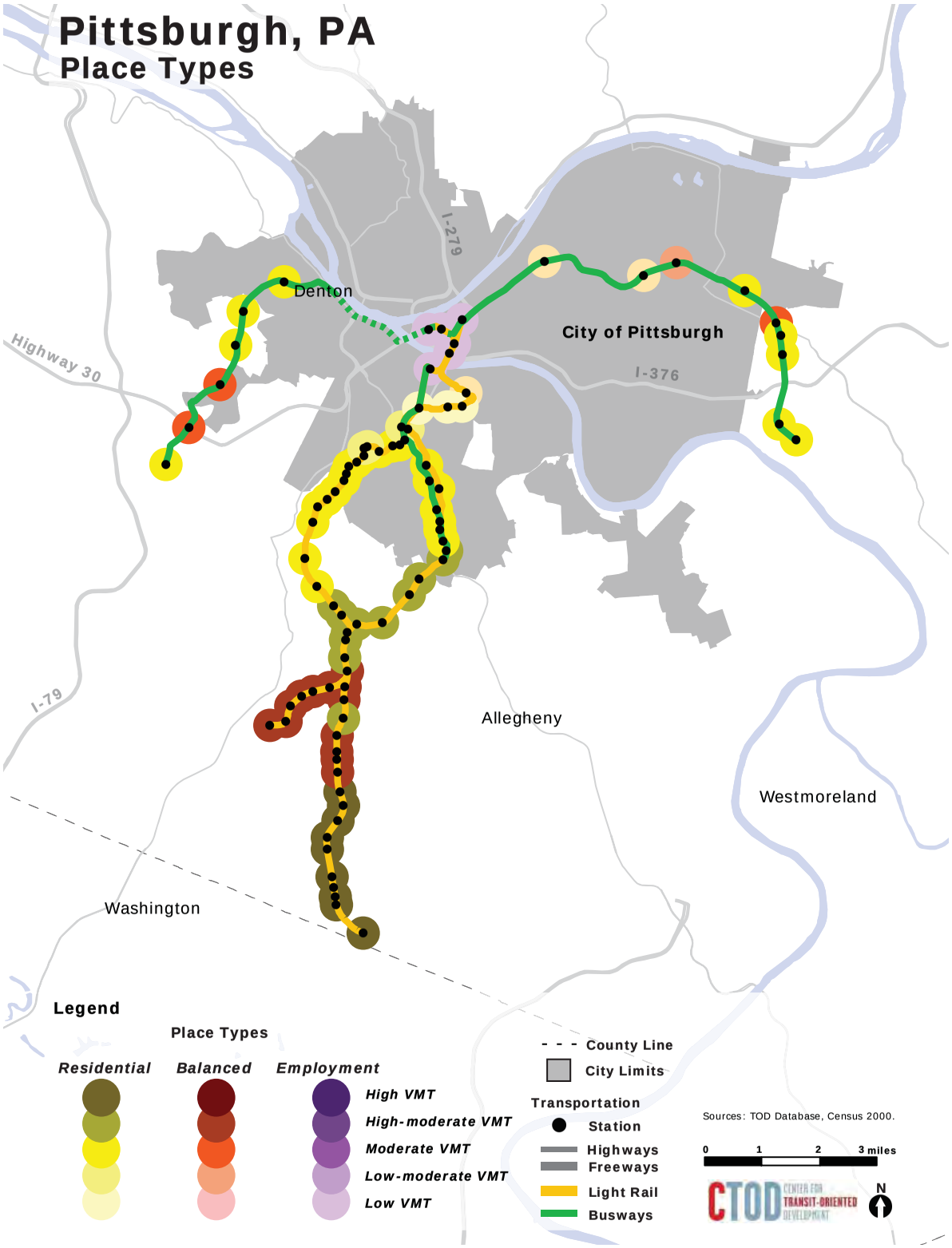
Workplace Transit Commute Share (Workers Traveling to Their Jobs)

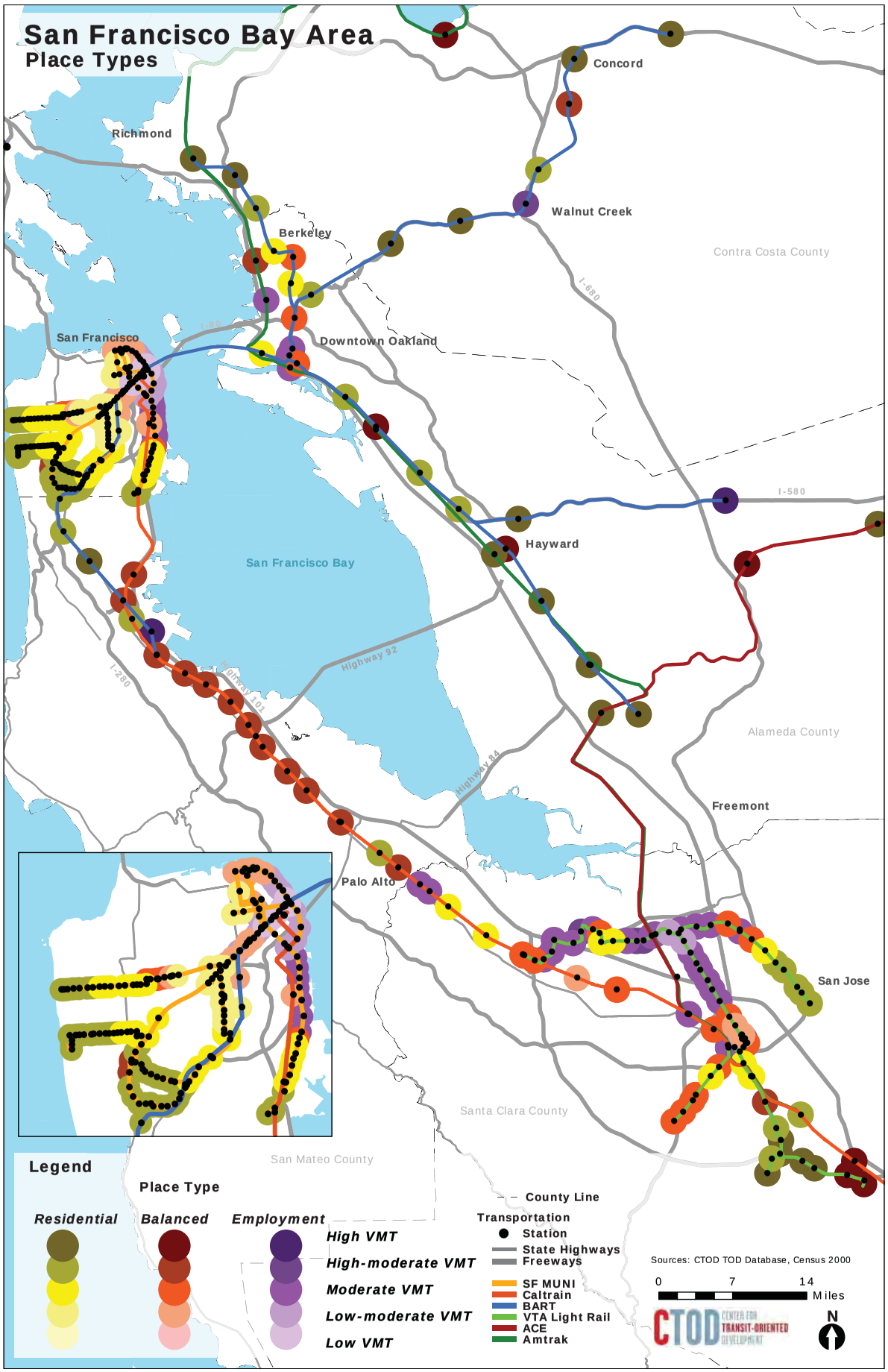
Regional Place Types Maps

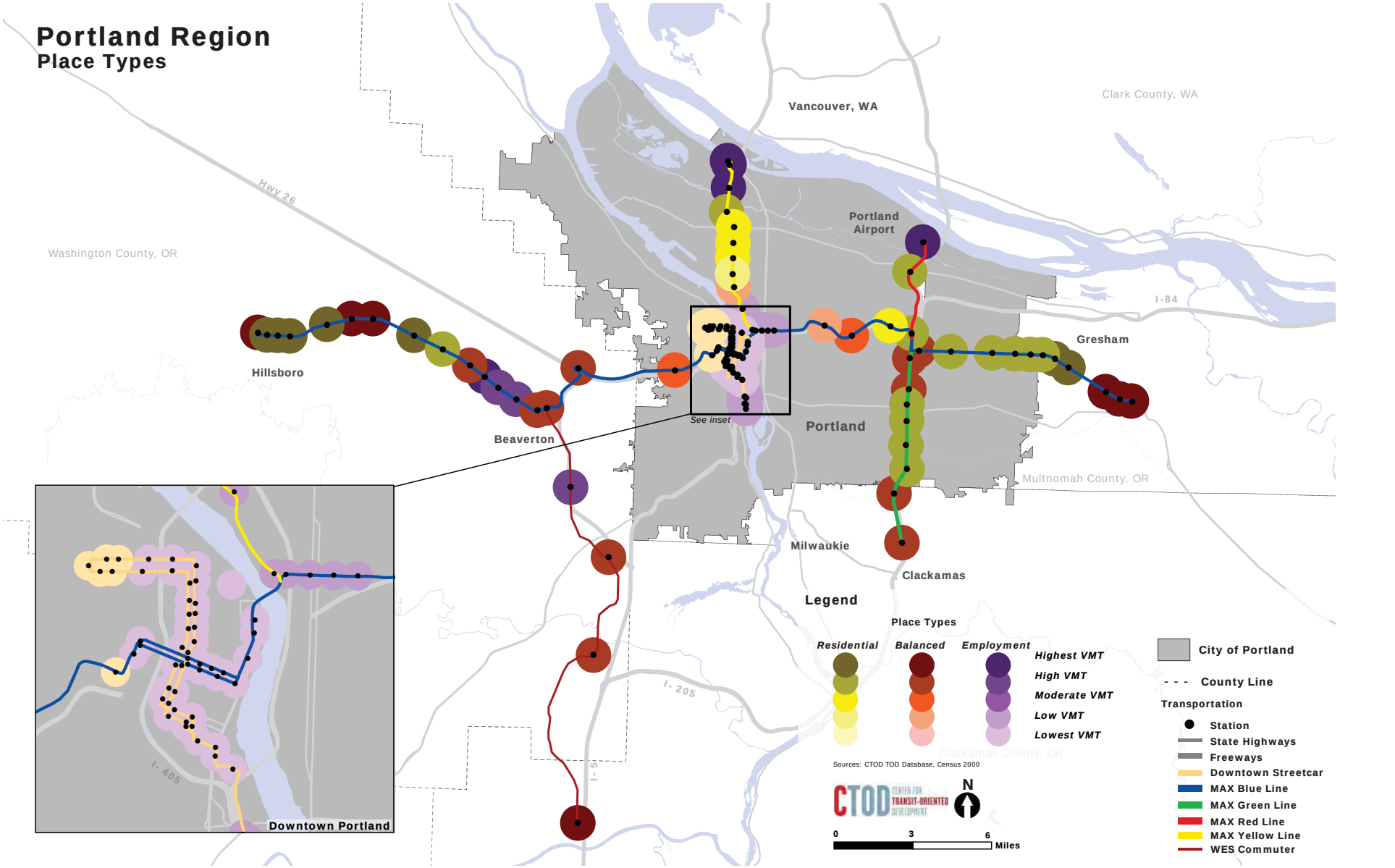


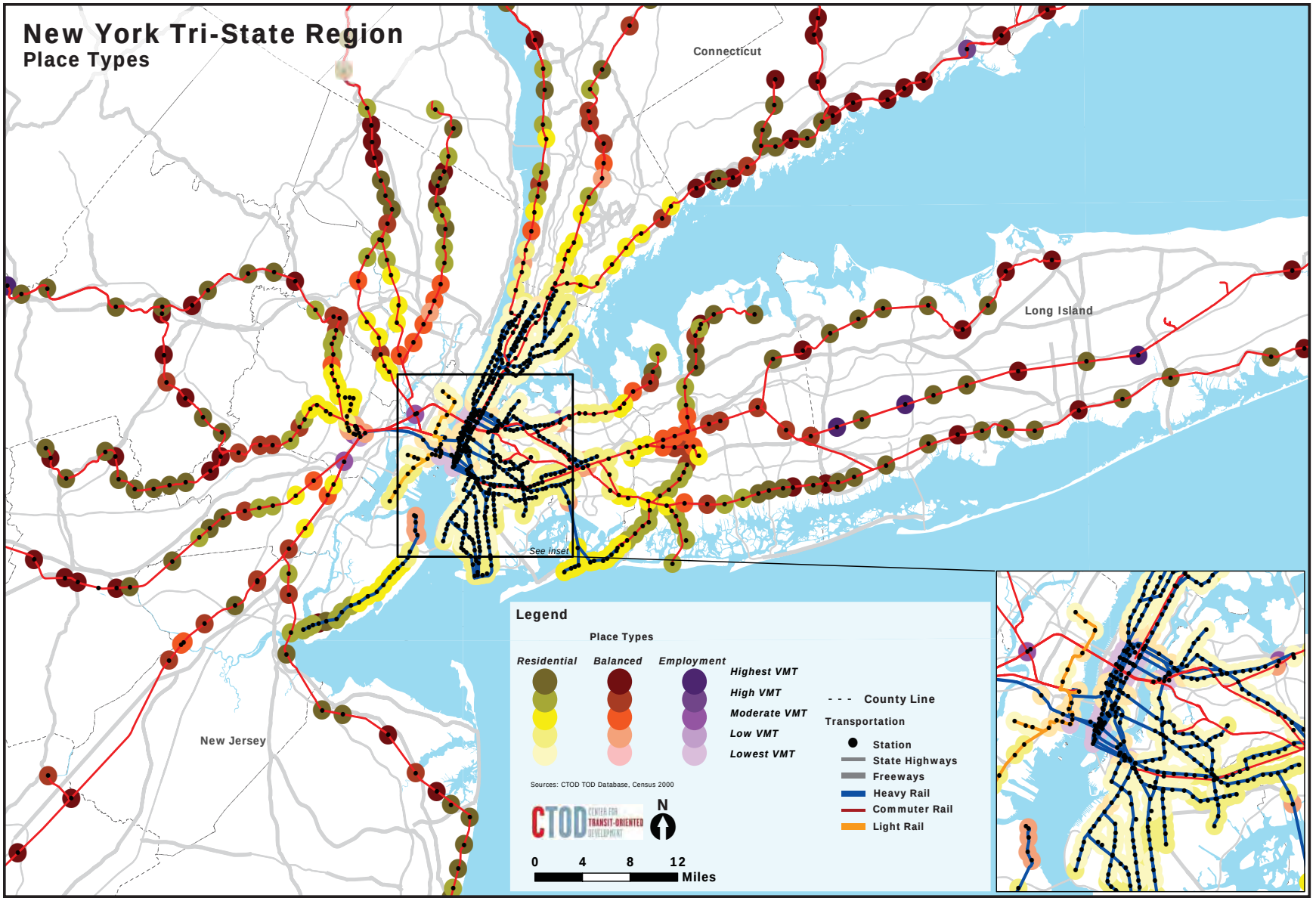

Greater Chicago Region
Place Types
Downtown Chicago
Lake Shore Drive
Lake Michigan
McHenry County
Lake County, IL
Cook County
Evanston
Kane County
Oak Park
Dupage County
Kendall County
Gary, IN
Will County
Lake County, IN
I-94
I-90
I-355
I-88
I-294
I-55
I-57
Legend
Place Types
Residential
Balanced
Employment
High VMT
High-moderate VMT
Moderate VMT
Low-moderate VMT
Low VMT
County Line
Transportation
Station
State Highways
Freeways
Elevated / Subway
Commuter Rail
Sources: CTOD TOD Database, Census 2000
0 4 8 12
Miles
N
CTOD CENTER FOR TRANSIT-ORIENTED DEVELOPMENT

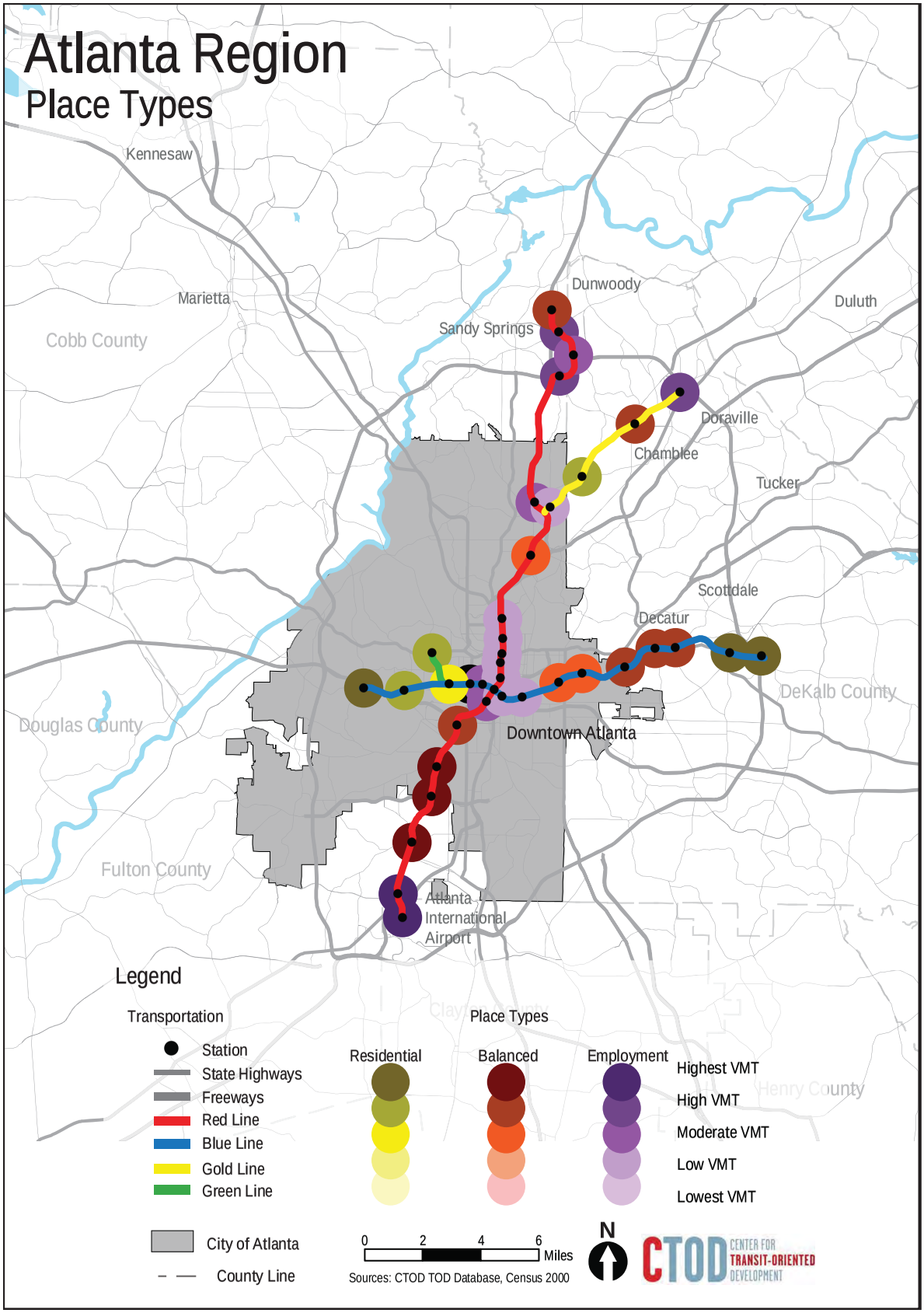

Dallas-Fort Worth
Place Types
Wise
Denton
Colin
I-35E
I-635
I-820
I-30
I-20
I-35W
I-45
City of Fort Worth
City of Dallas
Kaufman
Tarrant
Johnson
Ellis
Legend
Place Types
Residential
Balanced
Employment
High VMT
High-moderate VMT
Moderate VMT
Low-moderate VMT
Low VMT
County Line
City Limits
Transportation
Station
State Highways
Freeways
Light Rail
Commuter Rail
Sources:
TOD Database
Census 2000
N
0 3 6
Miles
CTOD
CENTER FOR TRANSIT-ORIENTED DEVELOPMENT

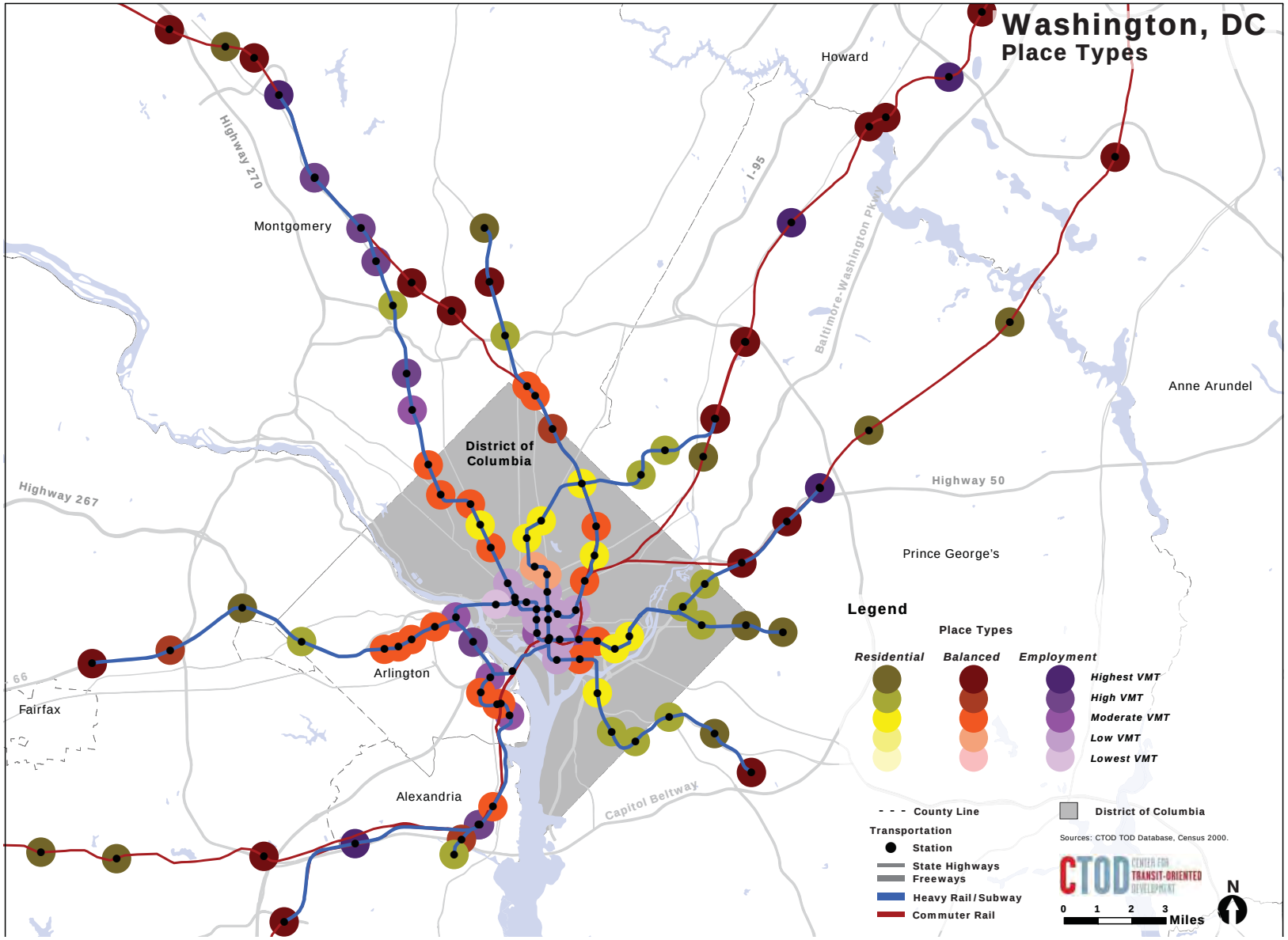

Pittsburgh, PA
Place Types
Denton
City of Pittsburgh
I-279
I-376
Highway 30
I-79
Allegheny
Westmoreland
Washington
Legend
Place Types
Residential
Balanced
Employment
High VMT
High-moderate VMT
Moderate VMT
Low-moderate VMT
Low VMT
County Line
City Limits
Transportation
Station
Highways
Freeways
Light Rail
Busways
Sources: TOD Database, Census 2000.
0 1 2 3 miles
N


San Francisco Bay Area
Place Types
Concord
Richmond
Walnut Creek
Berkeley
Contra Costa County
I-680
I-80
San Francisco
Downtown Oakland
I-580
Hayward
San Francisco Bay
Highway 92
I-280
Highway 101
Alameda County
Highway 84
Freemont
Palo Alto
San Jose
Santa Clara County
San Mateo County
Legend
Place Type
Residential
Balanced
Employment
High VMT
High-moderate VMT
Moderate VMT
Low-moderate VMT
Low VMT
County Line
Transportation
Station
State Highways
Freeways
SF MUNI
Caltrain
BART
VTA Light Rail
ACE
Amtrak
Sources: CTOD TOD Database, Census 2000
0
7
14
Miles
N
CTOD CENTER FOR TRANSIT-ORIENTED DEVELOPMENT


Portland Region
Place Types
Vancouver, WA
Clark County, WA
Hwy 26
Washington County, OR
Portland Airport
I-84
Gresham
Hillsboro
See inset
Beaverton
Portland
Multnomah County, OR
Milwaukie
Clackamas
Legend
Place Types
Residential
Balanced
Employment
Highest VMT
High VMT
Moderate VMT
Low VMT
Lowest VMT
City of Portland
County Line
Transportation
Station
State Highways
Freeways
Downtown Streetcar
MAX Blue Line
MAX Green Line
MAX Red Line
MAX Yellow Line
WES Commuter
I-205
I-5
I-405
Clackamas County, OR
Downtown Portland
Sources: CTOD TOD Database, Census 2000
N
0
3
6
Miles


New York Tri-State Region
Place Types
Connecticut
Long Island
New Jersey
See inset
Legend
Place Types
Residential
Balanced
Employment
Highest VMT
High VMT
Moderate VMT
Low VMT
Lowest VMT
County Line
Transportation
Station
State Highways
Freeways
Heavy Rail
Commuter Rail
Light Rail
Sources: CTOD TOD Database, Census 2000
CTOD
N
0 4 8 12
Miles


Atlanta Region
Place Types
Kennesaw
Marietta
Cobb County
Dunwoody
Sandy Springs
Duluth
Doraville
Chamblee
Tucker
Scottdale
Decatur
DeKalb County
Douglas County
Downtown Atlanta
Fulton County
Atlanta International Airport
Henry County
Legend
Transportation
Station
State Highways
Freeways
Red Line
Blue Line
Gold Line
Green Line
City of Atlanta
County Line
Place Types
Residential
Balanced
Employment
Highest VMT
High VMT
Moderate VMT
Low VMT
Lowest VMT
0 2 4 6 Miles
Sources: CTOD TOD Database, Census 2000
N
CTOD CENTER FOR TRANSIT-ORIENTED DEVELOPMENT


Washington, DC
Place Types
Howard
Montgomery
Anne Arundel
Prince George's
District of Columbia
Arlington
Alexandria
Fairfax
Highway 270
I-95
Baltimore-Washington Pkwy
Highway 267
Highway 50
Capitol Beltway
Legend
Place Types
Residential
Balanced
Employment
Highest VMT
High VMT
Moderate VMT
Low VMT
Lowest VMT
County Line
District of Columbia
Transportation
Station
State Highways
Freeways
Heavy Rail/Subway
Commuter Rail
Sources: CTOD TOD Database, Census 2000.
CTOD CENTER FOR TRANSIT-ORIENTED DEVELOPMENT
0 1 2 3 Miles
N