POLICY BRIEF

Impacts of Residential Transit Access (Distance to Transit)

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Program Description

This project reviews and summarizes empirical evidence for a selection of transportation and land use policies, infrastructure investments, demand management programs, and pricing policies for reducing vehicle miles traveled (VMT) and greenhouse gas (GHG) emissions. The project explicitly considers social equity (fairness that accounts for differences in opportunity) and justice (equity of social systems) for the strategies and their outcomes. Each brief identifies the best available evidence in the peer-reviewed academic literature and has detailed discussions of study selection and methodological issues.

VMT and GHG emissions reduction is shown by effect size, defined as the amount of change in VMT (or other measures of travel behavior) per unit of the strategy, e.g., a unit increase in density. Effect sizes can be used to predict the outcome of a proposed policy or strategy. They can be in absolute terms (e.g., VMT reduced), but are more commonly in relative terms (e.g., percent VMT reduced). Relative effect sizes are often reported as the percent change in the outcome divided by the percent change in the strategy, also called an elasticity.

Summary

Strategy Description

Increasing transit access has the potential to shift trips from cars to transit, which can reduce vehicle miles traveled (VMT) and greenhouse gas emissions. Transit agencies can increase transit access by providing new service or rerouting existing services to new areas, thereby bringing transit closer to potential users. Transit access also increases when communities increase the density of housing and other land-uses within walking distance of stations and stops (hereafter referred to jointly as "transit," unless otherwise specified), through what is called transit-oriented development (TOD). Both transit provision and TOD are discussed in separate policy briefs (Handy et al., 2013; Barbour, 2025). This brief focuses on how the distance between residences and transit – a key indicator of transit access – affects VMT. The proximity to transit of non-home trip destinations – like the workplace – also affects VMT, but more research is needed to quantify the effect.

Behavioral Effect Size

The evidence shows a strong effect of residential transit proximity on household VMT. Two separate meta-analyses of multiple empirical studies both estimated an elasticity of VMT with respect to transit proximity of -0.05, which translates to a 1.25% reduction in household VMT per mile closer to a transit stop. However, neither meta-analysis differentiated between rail station and bus stop proximity. Based on the three additional studies we found that looked at rail transit proximity explicitly,

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the estimated effect sizes range from a 0.75% decrease to a 4.3% decrease in VMT per mile closer to rail stations (Boarnet et al., 2020; Lee & Lee, 2020; Bailey et al., 2008). The lone study we found that examined the effect of bus transit proximity found a 1.5% decrease in VMT per ¼ mile closer to a bus stop (Bailey et al., 2008). That translates to a larger elasticity than for rail transit, but a smaller maximum total effect than for rail transit (6% versus 13% reduction in VMT) due to the greater radius within which rail transit has a VMT-reducing effect.

The effect size can also vary based on household sociodemographics and other factors. For example, two recent studies show that higher-income households reduce VMT more than lower-income households when living near transit (Boarnet et al., 2020; Chatman et al., 2019).

Strategy Extent

The maximum distance from residences at which transit has an effect on VMT is likely greater for rail transit than bus transit – on the order of 4 miles for rail transit and 1 mile for bus transit (Boarnet et al., 2020; Bailey et al., 2008; Wu et al., 2019). As a result, the maximum potential effect of rail transit proximity is likely substantially greater than that of bus stop proximity. However, the actual effect of proximity to rail or bus transit on VMT will also depend on transit level of service, trip destinations (and transit proximity to those destinations), relative driving times, employment density, and other factors.

Strategy Synergy

The separate briefs on strategies to increase transit access (Barbour, 2025; Handy et al., 2013) discuss the relevant synergies in more detail. In general, transit proximity will likely have a greater effect on VMT with higher-quality transit service, lower transit cost, access to more destinations (and greater transit proximity to those destinations), and higher cost or greater inconvenience of auto use.

Equity Effects

Distance to transit is a measurement, not itself an implementable strategy. The equity effects (such as displacement and gentrification) of strategies to increase transit access (like TOD) are examined in separate policy briefs (Barbour, 2025; Handy et al., 2013).

Strategy Description

Improving transit access has the potential to shift trips from cars to transit, which can reduce vehicle trips, VMT and greenhouse gas (GHG) emissions. Transit agencies can increase transit access by providing new service or rerouting existing services to new areas, thereby bringing transit closer to potential users. Transit access also increases when communities increase the density of housing and other land-uses within walking distance of transit, through TOD. Other factors also affect access to transit. Street and network design, for example, can improve access to transit by reducing travel times and lowering physical and social barriers, such as fear of crime. The efficacies of transit system expansion and TOD are examined in separate policy briefs (Barbour, 2025; Handy et al., 2013).

This policy brief focuses on how the distance between residences and transit stops – a key indicator of transit access – affects VMT. The proximity to transit of non-home trip destinations – like the workplace – also affects VMT, but more research is needed to quantify the effect.

Planners generally assume that most transit users will not walk more than 0.25 miles to bus stops and 0.75 miles to rail stations (Kuby et al., 2004; O'Neill et al. 1992; Zhao et al., 2003), though empirical studies indicate a somewhat wider range. For example, Schlossberg et al. (2007) found that 25% of pedestrians arriving at a rail transit station walked more than 0.68 miles, with a maximum distance of 1.88 miles. The access radius can be even larger for transit users who drive, bicycle, or use another form of transportation besides walking to reach transit.

Overall, though, when residents are farther away from transit, they are less likely to use public transit and more likely to drive to the station or stop when they do. Thus, reduced distances from residents' homes to transit can reduce vehicle trips and VMT by encouraging a shift from driving to public transit, but also by encouraging transit users to walk or bicycle to the station or stop rather than drive.

Strategy Effects

Behavioral Effect Size

Table 1 summarizes the results from the studies we located that used empirical data for households to estimate how residential transit proximity affects VMT, controlling for other built environment features and sociodemographic characteristics. We only include studies that either reported the effect in terms of change in VMT per change in miles to transit or reported sufficient information for us to estimate the effect in this form, as detailed in the technical and background information section below. Numerous other studies also show that households living within a short distance from transit (usually using a radius of ¼ mile to 1 kilometer or so) drive less than households located farther away (Barajas et al., 2020; Chatman et al., 2019; Spears et al., 2016).

Stevens (2017) conducted a meta-regression of 12 studies that examined the effect of transit proximity on VMT. He estimated an elasticity of -0.05, which translates to a 1.25% reduction in household VMT per mile closer to transit. A prior meta-analysis also estimated an elasticity of -0.05 (Ewing & Cervero, 2010). However, neither analysis differentiates between distance to rail and distance to bus transit.

We located three additional empirical studies that examined the effect of transit proximity on VMT, but were not included in either of the meta-analyses. Estimated effect sizes for the three studies that looked at rail transit range from a 0.75% decrease to a 4.3% decrease in VMT per mile closer to rail transit stations (Boarnet et al., 2020; Lee & Lee, 2020; Bailey et al., 2008). The lone study that examined the effect of bus transit proximity found a 1.5% decrease in VMT per ¼ mile closer to a bus stop (Bailey et al., 2008). That translates to a larger elasticity than for rail transit, but the study found that the maximum total effect of rail transit proximity is more than double that of bus stop proximity (13% versus 6% reduction in VMT) due to the greater radius within which rail transit has a VMT-reducing effect.

The effect size can also vary based on household sociodemographics. For example, two recent studies show that higher-income households reduce VMT more than lower-income households when living near transit (Boarnet et al., 2020; Chatman et al., 2019). These findings are especially relevant to transit access strategies – like TOD – that could cause displacement of lower-income households. Chatman et al. (2019) conducted a scenario analysis of neighborhood change for four Census tracts near rail stations in California (San Francisco, Los Angeles County, and Santa Clara County). They found regional VMT reductions in all four scenarios, even in the two neighborhoods in which the number of lower-income households decreased over the study period (1990-2013). Regional VMT reduced because (1) higher-income households tend to reduce their auto use more than lower-income households when living near transit, and (2) the total population increased in all four transit-accessible Census tracts, including the population of higher-income households in all tracts and the population of lower-income households in two of the tracts.

The actual effect on VMT will also depend on transit level of service, trip destinations (and transit proximity to those destinations), relative driving times, employment density, and other factors. Little is known about how the effect might vary across urban or rural areas, as the evidence in this literature is largely from urban places.

Greenhouse Gas Emissions

No available studies provide direct evidence of the effect of distance to transit on GHG emissions. However, to the extent that it reduces vehicle use, improving transit access may help reduce GHG emissions.

Co-benefits

Improved transit access, in the form of reduced distance from residences to transit, offers many potential benefits beyond a reduction in VMT and GHG emissions. Improved access to transit means improved access to jobs and services, especially for segments of the population without access to cars, thereby producing important equity benefits. To the degree that improved transit access leads to increased transit use and particularly if it leads to increased walking to and from transit, it can increase levels of physical activity and yield significant health benefits (Besser & Dannenberg, 2005). Shifting trips from cars to transit has many environmental benefits beyond a reduction in GHG emissions, including less local air pollution and water pollution, and might also help to alleviate automobile congestion, particularly in urban centers (Fang & Volker, 2017).

Table 1: Distance to Transit and VMT: Results from Studies of Individual or Household Travel

			Results		
Study	**Study Location**	**Study Year(s)**	*Distance to Transit Variable*	*VMT Reduction for Reduction in Distance to Transit*	*Elasticity*
Boarnet et al. (2020)	Los Angeles, Sacramento, San Diego, and San Francisco metropolitan areas	2010-2012	1 mile closer to rail transit, within approximately 4 miles of station	≥-3%	
Lee & Lee (2020)	121 largest urbanized areas in the US	2009	1 mile closer to rail transit, with no outer distance for the effect	-0.75%	-0.03
Stevens (2017)	Multiple US and international locations	Multiple years, from 1985	1 mile closer to transit, with no distinction for rail and bus, and no outer distance for the effect	-1.25%	-0.05
Ewing and Cervero (2010)	Multiple US and international locations	Multiple years, from 1985	1 mile closer to transit, with no distinction for rail and bus, and no outer distance for the effect	-1.25%	-0.05
Bailey et al. (2008)	US	2001	1 mile closer to rail station, within 3 miles of station	-4.3%	
			¼ mile closer to bus stop, within 1 mile of bus stop	-1.5%	

Strategy Extent

The maximum distance at which transit has an effect on VMT is likely greater for rail transit than bus transit, given the higher quality of service that rail offers. Boarnet et al. (2020) found that proximity to rail transit affects household VMT up to 4 miles away from the nearest station. This compares to a distance threshold estimated by other studies of around 1 mile for bus stops (Bailey et al., 2008; Wu et al., 2019). As a result, the maximum total effect of rail transit proximity is likely substantially greater than that of bus stop proximity. Bailey et al. (2008), for example, estimated a maximum VMT reduction of 13% for rail transit proximity, versus a 6% reduction for bus stop proximity.

The actual effect on VMT will depend on transit level of service, trip destinations (and transit proximity to those destinations), relative driving times, employment density, and other factors. Little is known about how the effect might vary across urban or rural areas, as the evidence in this literature is largely from urban places.

Equity Effects

This policy brief focuses on the effect of the distance between residences and transit stops on VMT. Distance to transit is not itself an implementable strategy; it is a measurement. As a result, it does not itself have equity effects. The equity effects accrue from the strategies used to increase transit access, such as providing new transit service, rerouting existing services to new areas, or increasing the density of housing and other land uses within walking distance of stations through TOD. The equity effects of those strategies, such as displacement and gentrification, are examined in separate policy briefs (Barbour, 2025).

Strategy Synergy

This policy brief focuses on the effect of the distance between residences and transit stops on VMT. In general, transit proximity will likely have a greater effect on VMT with higher-quality transit service, lower transit cost (without a commensurate reduction in service quality), access to more destinations (especially job centers), and higher cost or greater inconvenience of auto use. The separate briefs on strategies to increase transit access, including transit service additions or modifications (Handy et al., 2013) and TOD (Barbour, 2025), discuss the relevant synergies in more detail.

Confidence

Evidence Quality

The studies in Table 1, as well as the 12 studies synthesized in the meta-analyses, use accepted statistical methods to analyze high quality data for individual households. While the listed studies provide the best available evidence of the effect of distance to transit on VMT, they do have some limitations. For one, neither of the two meta-analyses differentiated between distance to rail and distance to bus transit (Stevens, 2017; Ewing & Cervero, 2010). However, the results from the other three studies indicate a strong distance effect for both rail (Boarnet et al., 2020; Lee & Lee, 2020; Bailey et al., 2008) and bus transit (Bailey et al., 2008). The available evidence also indicates that the maximum distance at which transit has an effect on VMT is likely greater for rail transit (Boarnet et al., 2020; Bailey et al., 2008) than bus transit (Bailey et al., 2008; Wu et al., 2019).

Another limitation is that three of the studies, including both meta-analyses, do not specify a starting distance for the effect, i.e., the point beyond which a reduction in distance to transit has no effect (Lee & Lee, 2020; Stevens, 2017; Ewing & Cervero). We thus used distance thresholds estimated in other studies – 4 miles for rail transit (Boarnet et al., 2020) and 1 mile for bus transit (Bailey et al., 2008; Wu et al., 2019) – to calculate the per-mile effect sizes for those three studies, as detailed in the technical and background information section below.

As with other potential strategies for reducing VMT, there is some question about whether access to transit in fact causes a reduction in VMT or is simply associated with lower VMT. Of particular concern is the possibility that residents living closer to transit have chosen to live there because they plan to use public transit, a phenomenon known as self-selection. If so, the estimated effect sizes are likely to overstate the effect of providing new transit service to an existing residential area where current residents might not be inclined to use it. However, many of the studies at least partially control for self-selection, including five of the studies synthesized in Stevens' (2017) meta-analysis.

Caveats

Policies that increase access to transit by reducing distances to transit are generally implemented as part of a larger package of land use and transportation measures, making it difficult to isolate the effect of transit access. The efficacy of transit access is highly dependent on transit level of service, travel times by car, local land use patterns, and location within the region. External factors such as gas prices and the local and global economy may change the reported effect significantly. For example, all of the studies in Table 1 predated the COVID-19 pandemic. The pandemic decimated transit ridership (though it has rebounded in many locations) and accelerated the rise in telecommuting, which has also been found to reduce ridership (Zheng et al., 2024). Those reductions in transit ridership could, in turn, dampen the effect of transit access on VMT, though the direction and magnitude of the change in effect depends on where the ridership reductions have occurred (e.g., predominately amongst households living farther from transit, or more equally distributed across the transit access spectrum). Existing context and conditions should be considered when choosing a specific effect size from within the range reported here.

It is also important to note that the effects reported here are based on the distance from home to transit. More than one study argues that distance to the destination and specifically to the workplace may have a much higher impact on VMT, given that workers generally do not have access to a car to get from the transit station to the worksite. As a result, transit use may depend on workplaces being within walking distances of stations and on other conditions that facilitate walking, even when the home is within walking distance of transit. However, more research is needed to quantify the effect on VMT of the proximity to transit of non-home trip destinations, like the workplace.

Technical & Background Information

Study Selection

The key criterion for including studies in this policy brief was reporting of the effects of distance to transit on VMT, while controlling for other built environment and sociodemographic characteristics. If the study did not report the effect in terms of change in VMT per change in miles to the transit station, then it had to report sufficient information to enable an estimation of the effect in this form. We only included empirical studies based on observed data, rather than theoretical studies or those that use simulation modeling. Additional considerations for the reviewed studies included using data from the United States, being published since 1990 (to help ensure current relevance), and using data collected from a sample of residents of both areas with transit supply and areas without it.

We started with the studies cited in the original 2014 policy brief on the impacts of transit access, as well as Stevens' (2017) meta-analysis. We then searched Google Scholar for additional relevant articles that had been published since Stevens' (2017) meta-analysis. We searched within the articles that cited Stevens' (2017) study using the search terms: "distance to transit" AND "VMT." That search yielded 102 results. We reviewed the abstracts for all 102 results to make an initial determination of relevancy. For those that appeared likely to meet our aforementioned selection criteria, we reviewed the entire article. We found two additional relevant studies beyond Stevens (2017) and the studies reviewed in the original 2014 brief on the impacts of transit access (Boarnet et al., 2020; Lee & Lee, 2020). We also removed two of the studies reviewed in the original 2014 brief (Pushkar et al., 2000; Bento et al., 2005) because they are both included in Stevens' (2017) meta-analysis.

Methodological Considerations

Effect Size Calculations

None of the included studies report effect size as change in VMT per change in miles from the transit station. We thus used the reported data to estimate the effect size, as follows.

1. *Boarnet et al. (2020)*: This study investigates the joint effects of distance to rail stations and household income on VMT in the four largest metropolitan areas in California – Los Angeles, Sacramento, San Diego, and San Francisco. It analyzes travel data from the 2010-2012 California Household Transportation Survey using a censored regression model (tobit). The study reports two specific distance-based predictions from its model. First, it predicts that households with the highest income level (>$100,000) would reduce their daily VMT by 4.5 miles if they moved from 3-4 miles away from the nearest rail station to within 0-1 miles of a station. That equals an approximately 7.5% reduction in total daily VMT, based on a predicted average of 60 daily VMT for those households (pg. 16). Dividing that 7.5% reduction by the 3-mile (3.5-0.5) difference in rail station proximity yields a per mile reduction of 2.5%. Second, the model predicts that households with the lowest income level (<$25,000) would reduce their daily VMT by 2.7 miles under the same scenario. That equals an approximately 9% reduction in total daily VMT, based on a predicted average of 30 daily VMT for those households (pg. 16). Dividing that 79% reduction by the 3-mile (3.5-0.5) difference in rail station proximity yields a per mile reduction of 3%. The study does not estimate an income-agnostic distance-based VMT effect. As a result, for purposes of this report, Table 1 presents the larger (3%) of the two per-mile VMT reduction estimates as an upper bound. The study also found that proximity to rail transit affects household VMT up to 4 miles away from the nearest station. This compares to a distance threshold estimated by other studies of around 1 mile for bus stops (Bailey et al., 2008; Wu et al., 2019). We use those threshold values to guide the effect size calculations for other reviewed studies that do not themselves incorporate a distance threshold.

2. *Lee and Lee (2020)*: This study investigates the effects of household-, local-, and regional-level variables on household-level VMT in the 121 largest urbanized areas in the US. It analyzes travel data from the 2009 National Household Travel Survey using an array of multilevel regression models. Three of seven models for which the study reports results include distance to the closest rail transit station as predictor variable. The three models estimated elasticities of VMT with respect to rail transit proximity of 0.026, 0.033, and 0.034. The maximum distance at which rail transit has an effect is not reported in this study, but if a distance of 4 miles is assumed (based on Boarnet et al., 2020) then moving from having no rail transit service (i.e., nearest station is 4 miles away) to 2 miles, a 50% reduction in distance to transit, leads to a 1.5% reduction in VMT, or 0.75% per mile. One caveat for this study is that transit proximity is measured as the distance to the nearest rail transit station from the centroid of the Census tract in which each household is located, rather than from each household's address. This could be one reason that the estimated effect size of transit proximity on VMT is lower than those from the other studies reported in Table 1.

3. *Stevens (2017)*: This study reports results from a meta-regression of studies from around the world from the 20-year period 1996-2015 that quantitatively estimate the effect on VMT of compact development (specifically, distance to the nearest transit stop and 9 other variables related to the built environment). The meta-regression produces an estimate of the average elasticity for each of the 10 "D" variables if residential self-selection is controlled for and selective reporting bias (i.e., reporting only statistically significant results or those in line with conventional theory) is removed. The study reports an elasticity of -0.05 for distance to the nearest transit stop, based on 12 empirical studies. That means that a 1% increase in proximity (decrease in distance) to transit leads to a 0.05% decrease in household VMT. The study does not differentiate between distance to rail and distance to bus transit. This elasticity

implies that a 100% reduction in distance, from the point at which transit access has no effect on VMT to the site of the station or bus stop, leads to a 5% reduction in VMT. The maximum distance at which transit has an effect is not reported in this study, but if a maximum distance of 4 miles is assumed (based on Boarnet et al., 2020) then moving from having no transit service (i.e., nearest station is 4 miles away) to 2 miles, a 50% reduction in distance to transit, leads to a 2.5% reduction in VMT, or 1.25% per mile. Note that the 4-mile threshold is based on a study of rail station proximity, which yields a conservative (low) estimate. Using a lower threshold, as indicated for bus stop proximity, would yield a greater effect size.

4. *Ewing and Cervero (2010)*: This study reports results from a meta-analysis of studies from around the world from 1996-2009 that quantitatively estimate the effect of compact development on VMT. Elasticities from individual studies are weighted by the sample sizes of the studies and averaged to produce a single elasticity for transit access. The study reports an elasticity of -0.05 for transit access, meaning that a 1% increase in proximity (decrease in distance) to transit leads to a 0.05% decrease in VMT. The study does not differentiate between distance to rail and distance to transit. This elasticity implies that a 100% reduction in distance, from the point at which transit access has no effect on VMT to the site of the station or bus stop, leads to a 5% reduction in VMT. The maximum distance at which transit has an effect is not reported in this study, but if a distance of 4 miles is assumed (based on Boarnet et al., 2020) then moving from having no transit service (i.e., nearest station is 4 miles away) to 2 miles, a 50% reduction in distance to transit, leads to a 2.5% reduction in VMT, or 1.25% per mile. Note that the 4-mile threshold is based on a study of rail station proximity, which yields a conservative (low) estimate. Using a lower threshold, as indicated for bus stop proximity, would yield a greater effect size.

5. *Bailey, Mokhtarian, Little (2008)*: This study employs structural equations modeling to examine the relationship between transit access and household VMT. The study uses data from the 2001 National Household Travel Survey and separately examines the impact of distance to bus stations and distance to rail stations. The study estimates transit access using log-transformed availability measures whose values drop most sharply around 0.75 miles from rail stations and 0.25 miles from bus stations, which are commonly assumed to be the maximum distances that people will walk to access transit. The study then uses a structural equations model to estimate the effect of transit availability and other factors on household VMT. According to this analysis, access to rail effectively ends at 3 miles from the station and access to bus at 1.0 miles from the nearest stop. According to Table 5 in the study, the impact on VMT of "going from no availability to having a rail stop next door" (pg. 21) is -5.8 miles; the impact on VMT for bus is -2.6 miles. Given average household VMT of 43.75 miles, we calculated the maximum percentage impact of access to transit as about 13% (5.8/43.75) for rail and about 6% (2.6/43.75) for bus. To simplify the calculation of a VMT effect size, we assume a simple linear relationship between distance to transit and VMT for rail from 0 to 3 miles from the station and for bus from 0 to 1 mile from the station. Assuming an impact of zero at 3 miles and 1 mile respectively, we then calculated the effect size as 4.3% per mile for rail (13%/3 miles) and 1.5% per 0.25 mile for bus (6%/1 mile/4; note that we calculate the effect size on a quarter-mile basis because the effect ends at 1 mile).

Other Methodological Considerations

In applying the estimated effects, it is important to consider that the nature of transit service varies considerably from community to community. As shown in the Bailey et al. (2008) study, the maximum effect of access to transit on VMT is greater for rail transit (≤13% VMT reduction) than for bus transit (≤6% reduction). Relatedly, the distance threshold for the VMT-reducing effect is greater for rail than bus. Boarnet et al. (2020) found that proximity to rail transit affects household VMT up to 4 miles away from the nearest station. This compares to a distance threshold estimated by other studies of around 1 mile for bus stops (Bailey et al., 2008; Wu et al., 2019). Other characteristics of transit service, such as service frequency or the quality of transit stations and vehicles, likely also moderate the VMT effect. The studies included here do not control for such differences. All five studies listed in Table 1 make use of data from a wide range of geographic areas and thus yield what could be considered average effect sizes, reflecting a wide range of transit systems. It is possible that including New York City – as do all of the studies except Boarnet et al. (2020) – biases the effect size upward, give the city's high level of transit use. However, the effect size (-3%) estimated from Boarnet et al. (2020) for the four biggest metropolitan regions in California is greater than all except one other estimate (-4.3% for rail transit, from Bailey et al., 2008).

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