Impacts of Employment Density on Passenger Vehicle Use and Greenhouse Gas Emissions

Policy Brief

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Policy Description

While much attention has been given to increased residential densities as a strategy for reducing vehicle miles traveled (VMT) and greenhouse gas (GHG) emissions from transportation, increased employment densities may have similar effects. Policies to increase employment densities include changes to zoning ordinances to allow more building floor space on each parcel and reductions in parking requirements. In most cases, these policies are coordinated with a combination of infrastructure investments and/or financial incentives that, for example, promote increased accessibility by public transportation and development around transit stations.

Employment density is usually measured as the ratio of the number of employees divided by land area (e.g., employees per acre or employees per square mile). Employment density can be measured at different scales, for example, at the level of the census tract, traffic-analysis zone (TAZ), neighborhood, or city. In some studies, employment and population are sometimes summed to compute an overall *activity density* per areal unit.

Employment density is often correlated with a number of characteristics of the built environment that are associated with VMT, including mixed land uses, transit access, the quality of the pedestrian environment, and proximity to residential areas. While density is easily measured, many planning researchers believe that policy attention should focus not only on density but on a more holistic set of land use characteristics (e.g. Chatman, 2008). Yet for the purposes of summarizing the evidence on employment density and VMT, unless otherwise noted, the evidence here focuses on the effect of employment density alone on VMT.

Impacts of Employment Density

The impact of employment density on VMT has been less studied than the impact of residential density. Many researchers discuss the probable role of employment density on travel behavior but do not explicitly report a numerical value for the impact of employment density on VMT. Two studies, summarized in Table 1, met the selection

criteria of computing the effects of employment density using disaggregated data after controlling for the impact of other land use variables.

Effect Size

The selected studies show that the impact of employment density on VMT is relatively weak and varies depending on the specific area of study: a doubling of employment density (100 percent increase) is associated with at most a 3 percent reduction in VMT in low density areas, and in some cases can be associated with an *increase* in VMT. Consistent with these findings, a meta-analysis by Ewing and Cervero (2010) concluded that the effect of employment density on VMT is close to zero.

Table 1. Impact of Employment Density on VMT

Study	Study location	Study year	Results	
			Employment Density Variable	*% VMT Change for 1% Increase in Employment Density*
Zhou and Kockelman (2008)	Austin, TX	1998-1999	Jobs per square mile	
			Central Business District/Urban areas	+0.074
			Suburban/Rural areas	-0.030
Zhang et al. (2012)	Four U.S. cities	2005-2009	Jobs per square mile	-0.011 to +0.013

The mix of positive and negative effects is notable. Zhang et al. (2012) found that VMT decreased with an increase in employment density in three U.S. metropolitan regions but VMT increased as employment density increased in the fourth metropolitan region. Zhou and Kockelman (2008) found that VMT increased in higher density areas within the Austin region, but VMT decreased in lower density areas. The degree of competition for space between jobs and housing may explain these results: in a job-rich and high-density area, adding additional jobs may push housing farther away, thereby increasing commute distances; in a job-poor and low-density area, adding additional jobs might put jobs and housing in closer proximity, thereby decreasing commute distances. In other words, the impact of increases in employment density is likely to depend on the existing density and job-housing balance of an area.

The effects reported in Table 1 are smaller than the effects of employment density on VMT found in earlier studies (for discussions on this topic, see Badoe and Miller, 2000;

Leck, 2006; Ewing and Cervero, 2001; Ewing and Cervero, 2010). One likely explanation is that recent studies control for more land use characteristics than the earlier studies did, and thus do a better job of isolating the effect of employment density. Overall, the literature suggests that characteristics typically found in areas with higher employment density such as the density of the street network, transit access, quality of the pedestrian environment, and job-housing balance have a more important effect on travel behavior than employment density itself (Ewing and Cervero, 2010).

Even if the changes in VMT directly associated with an increase in employment density are not large, it is possible that significant changes in travel demand will result through indirect effects. Changes in employment density are often accompanied by changes in other land use characteristics (e.g. residential density, land use mix) and transportation infrastructure (e.g. improved public transit service, reduced parking availability and increased parking fees). The combined effects of these changes might result in much larger changes in VMT than suggested by the effect sizes shown in Table 1 (National Research Council, 2009). One study, using aggregate data, suggests that changes in employment density produce larger effects in Canadian and European cities than in the United States (van de Coevering & Schwanen, 2006). Thus, the impacts of employment density on VMT may vary considerably across cities depending on unique local conditions.

Evidence Quality

The studies in Table 1 use statistical methods to analyze disaggregated data for individual households while controlling for the impact of additional land use variables and sociodemographic characteristics. However, the associations found in these studies do not necessarily show a causal effect of employment density (or other land use variables) on VMT. Because they use cross-sectional data, collected in different places at one point in time, these studies show that differences in employment density are associated with differences in VMT, but they do not necessarily show that changes in employment density would produce changes in VMT.

Caveats

It is difficult to separate the impact of employment density from the effect of other variables. Often, employment density is included in a package of policies that aim to reduce VMT. Empirical results suggest that there is a greater impact of employment density on travel behavior if this strategy is coupled with other strategies. For instance, according to Ewing and Cervero (2010), some of the effects of employment density reported in the literature are not due to employment density itself but rather to better walking conditions, shorter distances to transit service, and parking fees usually (but not

always) associated with higher employment density. For example, several studies show that areas with higher employment density in proximity to railway stations have higher use of commuter rail (Frank and Pivo, 1994; Parsons Brinkerhoff, Quade and Douglas Inc., 1996; Badoe and Miller, 2000).

There is reason to believe that the impact of employment density on travel behavior is characterized by thresholds. For example, Frank and Pivo (1994) observed that the effects of an increase in employment density on mode shift from drive-alone to transit or walking vary significantly depending on the initial employment density. Increases in employment density had a significant effect on the split between travel modes in areas with initial densities of 20 to 75 employees per acre and in areas with more than 125 employees per acre; changes in employment density had little effect in areas where initial employment densities were between 75 and 125 employees per acre. These results suggest that the relationship between employment density and both VMT and mode share are not linear, but rather strongly influenced by thresholds and by the impact of other factors such as the types of transit services that are provided in each area.

GHG Emissions

No studies give direct evidence of the effect of employment density on GHG emissions. In general, reductions in VMT should translate into reductions in GHG emissions. However, higher employment densities may contribute to higher levels of traffic congestion, even with lower VMT overall, because it concentrates this VMT within a smaller area. If so, reductions in GHG emissions from reductions in VMT could be partly offset by reduced vehicle fuel efficiency and thus higher per-mile GHG emissions for the remaining VMT.

Co-benefits

Increases in employment density yield the most benefits if adopted as a part of a coordinated set of strategies rather than in isolation. Land use policies that encourage higher employment densities in conjunction with concentrations of shopping and service destinations and high-quality transit service together make alternatives to driving more attractive. A package of such strategies can produce many benefits beyond reductions in VMT. Shifts in travel mode from driving to transit, walking, or bicycling are likely to have positive impacts on health, through increases in physical activity and through improvements in local and regional air quality.

Examples

Many of the major cities in California, as well as some smaller ones, have adopted policies to increase employment densities, particularly in the urban core. San Francisco, for example, has been working for more than two decades to increase both residential and employment densities in the area south of Market Street. Strategies to achieve this objective include increases in height limits as well as investments in public facilities such as the Transbay Transit Center and public institutions such as the Museum of Modern Art and the new UCSF campus. Los Angeles, San Diego, San Jose, Oakland, Sacramento, Pasadena, and other cities have similarly adopted policies intended to increase employment densities in conjunction with increases in downtown population, increase in the mix of services, improved transit service, and enhanced public spaces.

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