Chapter 5B

Trends & Performance

Vehicle Miles Traveled (VMT) & Roadway Congestion

Building on the performance overview in Chapter 5A, this chapter describes the performance of the MTP/SCS transportation system in terms of two key roadway system indicators: vehicle miles traveled and roadway congestion.

Vehicle Miles Traveled (VMT)

This section discusses why SACOG measures and monitors VMT, defines the various types of VMT that are modeled and analyzed for the MTP/SCS, reports observed trends in VMT in the region, reports the VMT performance of the MTP/SCS, and explains the VMT performance of the MTP/SCS.

Why We Measure VMT

A vehicle mile traveled, or VMT, is literally one vehicle traveling on a roadway for one mile. Regardless of how many people are traveling in the vehicle, each vehicle traveling on a roadway within the Sacramento region generates one VMT for each mile it travels. For this section and most of SACOG's technical analysis, VMT is estimated and projected for a typical weekday, as defined in Chapter 5A.

VMT is and has been a primary indicator of travel for policymakers and transportation professionals for decades. The prevalence of this measure is due to several factors:

First, it is relatively easy to measure by counting traffic on roadways at different locations. It is one of the few measures of transportation performance that has been consistently and comprehensively monitored and documented over time in the region.

Second, VMT bears a direct relationship to vehicle emissions, although the relationship is complex moving into the future. State[1] and federal[2] policies pertaining to vehicle efficiency and formulation of vehicle fuels suggest that on a per VMT basis, emissions for most pollutants will decline relative to today. However, even with these per VMT improvements due to fuel and vehicle technology changes, lower VMT will mean lower emissions. Looked at another way, lowering VMT is a way to expand the reductions expected from fuel and vehicle technology improvements.

Third, VMT can be influenced by policy in a number of different ways. By providing more attractive alternatives to driving alone, VMT can be reduced by shifting from vehicle to non-vehicle modes (i.e., from a car trip to a bike or walk trip), or from low occupancy to higher occupancy vehicles (i.e., from a single-occupant vehicle trip to a carpool or transit trip). VMT can be influenced by land use patterns as well. A better mix of residential, employment, education, and service uses in an area can allow people to accomplish their daily activities with less driving, and consequently, less VMT.

Fourth, VMT correlates with congestion. The more miles people are driving their vehicles, the more vehicles there are on the roadways at any given time. Higher numbers of vehicles eventually result in congestion.

Finally, VMT correlates with frequency of traffic accidents. Although facility design and traveler behavior affect the frequency and severity of accidents, a major factor in determining the number of accidents that occur is the amount of travel. Safety analysts and researchers usually normalize the number of accidents with VMT in order to track and understand accident trends.

Definitions of VMT Reported

Although the basic definition of VMT is one vehicle traveling on a roadway for one mile, VMT is reported here in two different ways: total VMT and VMT attributed to source: household-generated, commercial vehicle, or external.

Total VMT is all VMT for all types of vehicles totaled together. In this report, total VMT is reported by the geography in which it occurs, based on the locations of the roadways being analyzed. So, for example, total VMT reported for Sacramento County includes all VMT on roadways within Sacramento County, even though some VMT that occurs on Sacramento County roadways is generated by travelers residing outside Sacramento County, and vice versa.

VMT attributed to source splits VMT into one of three categories: household-generated, commercial vehicle, and external.

- Household-generated VMT includes VMT generated by residents of the region, for their travel within the region. Household-generated VMT includes vehicle travel for normal commuting, going to school, shopping, and personal business. Household-generated VMT usually includes about three-quarters of total VMT.
- Commercial vehicle VMT includes VMT generated by commercial vehicles moving goods or services within the region. Commercial vehicle VMT is usually about one-sixth of total VMT.
- External VMT includes VMT generated by passenger vehicles traveling through the region. It also includes travel within the region from residents of areas outside the region. Through-trips by commercial vehicles are tallied with commercial vehicle VMT described above. External VMT usually includes slightly less than one-tenth of total VMT.

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1 AB 1493 (Pavley rule) vehicle efficiency standards, and low-carbon-fuel standards (Executive Order S-01–07), implemented as part of California's Global Warming Solutions Act (AB 32)

2 National Highway Transportation Safety Administration Corporate Average Fuel Efficiency (CAFE) vehicle efficiency standards http://www.nhtsa.gov/cars/rules/cafe/overview.htm

Observed Data and Recent Trends in VMT

Observed VMT is collected by Caltrans as part of the Highway Performance Monitoring System (HPMS). HPMS data are based on a sampling approach, in which a sample of roadways of different types (e.g., freeway, rural highway, principal arterial) are counted, and statistically expanded to estimate total VMT in different areas within the state. Table 5B.1 provides a county-by-county tabulation of VMT within the region for 2000 through 2008.

- During the period 2000 to 2005, total daily VMT in the region grew at about 2 percent per year. From 2005 to 2008, total daily VMT actually decreased slightly, reflecting the slowing of the region's economy, increasing unemployment, higher fuel prices, and other factors.
- During the period 2000 to 2005, population growth was 2.6 percent per year, slightly higher than the VMT growth rate. The population growth rate slowed to about 1 percent per year between 2005 and 2008.
- VMT per capita has declined on average since year 2000, from 26.3 miles to just under 25 miles per day by 2008.
- The longer term historic VMT growth rate, counting from 1995 to 2008, is 1.9 percent per year.

Table 5B.1

Vehicle Miles Traveled in the SACOG Region, 2000 to 2008

County	2000	2005	2008
Average Daily VMT on Roadways[1]			
El Dorado[2]	4,148	4,404	4,249
Placer[2]	7,361	8,581	8,502
Sacramento	29,244	32,145	32,530
Sutter	2,150	2,374	2,444
Yolo	5,132	5,683	5,489
Yuba	1,745	1,849	1,787
Region	49,780	55,034	55,002
Region Pop. (in thousands)[3]	1,896	2,153	2,215
VMT per Capita	26.3	25.6	24.8
Average Annual Growth Rates:	**'00 to '05**	**'05 to '08**	**'00 to '08**
El Dorado[2]	+1.2%	-1.2%	+0.3%
Placer[2]	+3.1%	-0.3%	+1.8%
Sacramento	+1.9%	+0.4%	+1.3%
Sutter	+2.0%	+1.0%	+1.6%
Yolo	+2.1%	-1.1%	+0.8%
Yuba	+1.2%	-1.1%	+0.3%
Region	+2.0%	-0.0%	+1.3%
Region Population[3]	+2.6%	+1.0%	+2.0%
VMT per Capita	-0.5%	-1.0%	-0.7%

1 From "California Public Road Data" reports, compiled from Highway Performance Monitoring System data

2 Adjusted by SACOG to exclude Tahoe Basin

3 California Department of Finance, adjusted by SACOG to exclude Tahoe Basin

Source: SACOG, September 2011.

Vehicle Miles Traveled and the MTP/SCS

Table 5B.2 and Figure 5B.1 provide tabulations and illustrations of historic and projected VMT growth for MTP/SCS.

Weekday VMT in the region is projected to grow from 57 million in 2008 to about 64 million by 2020 (an 11 percent increase) and 74 million by 2035 (a 30 percent increase). Population over the same periods increases by 14 percent and 39 percent, respectively. This compares to 85 million miles by 2035 for the 2008 MTP (see Table 5B.3), which is an increase of 48 percent from 2008, although in part, the extent of the increase in the 2008 MTP relates to higher population growth on which that plan was based.

The VMT growth rate through 2035 is projected to decrease from the historic growth rate of 1.9 percent per year to 1.0 percent per year. Moreover, the VMT growth rate is projected to be lower than the population growth rate of 1.2 percent. This compares to a VMT growth rate of 1.5 percent and 1.5 population growth rate to 2035 for the 2008 MTP.

Table 5B.2

Total Vehicle Miles Traveled in SACOG Region, 2008 and MTP/SCS

County	2008	2020 MTP/SCS	2035 MTP/SCS
Total Weekday VMT on Roadways[1]			
El Dorado[2]	4,421,000	4,726,800	5,328,200
Placer[2]	8,846,500	10,559,400	12,743,900
Sacramento	33,848,800	37,386,300	43,133,000
Sutter	2,543,500	2,785,700	3,269,300
Yolo	5,711,500	6,477,500	7,413,800
Yuba	1,859,500	2,104,100	2,420,100
SACOG Region	57,230,800	64,039,800	74,308,300
Total VMT per Capita	**25.8**	**25.4**	**24.1**
Annual Average Growth Rates, from 2008			
El Dorado[2]	n/a	+0.6%	+0.7%
Placer[2]	n/a	+1.5%	+1.4%
Sacramento	n/a	+0.8%	+0.9%
Sutter	n/a	+0.8%	+0.9%
Yolo	n/a	+1.1%	+1.0%
Yuba	n/a	+1.0%	+1.0%
SACOG Region	n/a	+0.9%	+1.0%
Total VMT per Capita	**n/a**	**-0.1%**	**-0.3%**
Population Growth Rate	n/a	+1.1%	+1.2%

1 Roadway VMT is tallied based on the location of the roadway on which the VMT is forecasted to occur. It is comparable to the VMT reported in "California Public Road Data" reports; however, the CPRD reports average daily VMT, while this table reports typical weekday VMT. Typical weekday traffic is on average 5 percent higher than average daily traffic.

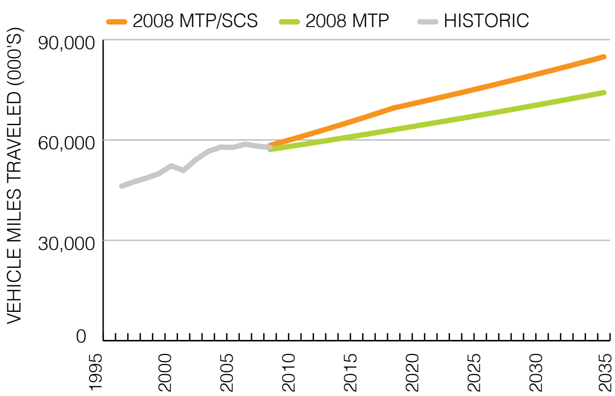
2 Tahoe Basin roadways are excluded from this tabulation

Source: SACOG, September 2011.

Although VMT increases in total through 2035 for the MTP/SCS, per capita VMT rates decline significantly over the same period. Total VMT per capita declines from 25.8 miles in 2008, to 25.4 by 2020, and 24.1 by 2035, as shown in Table 5B.2 above and in Figure 5B.2. Figure 5B.2 shows VMT per capita for the 2002 MTP, the 2008 MTP and the MTP/SCS. The 6.9 percent decline in VMT per capita for the MTP/SCS compares to a 5.2 percent decline for the 2008 MTP, and a 8 percent increase (compared to 2000) for the 2002 MTP.

Figure 5B.1

Total Vehicle Miles Traveled in the SACOG Region, Historic Trends and Projected MTP/SCS

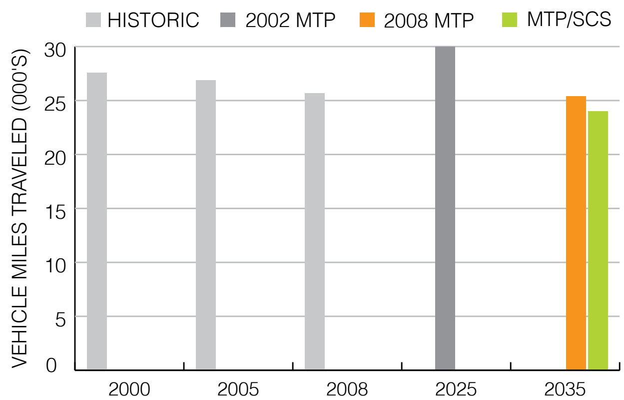


Historic based on CPRD reports. MTP/SCS based on SACOG forecasts. 2008 MTP from SACOG, A Creative New Vision for Transportation in the Sacramento Region, April 2008.

Source: SACOG, September 2011.

Figure 5B.2

Weekday Vehicle Miles Traveled per Capita in the SACOG Region, Historic Trends and Projected MTP/SCS



Historic based on CPRD reports. MTP/SCS based on SACOG forecasts. 2008 MTP from SACOG, *A Creative New Vision for Transportation in the Sacramento Region*, April 2008. 2002 MTP from SACOG, *A Bold First Step for Mobility in the Sacramento Region*, 2002, with adjustments to allow for comparison to more current VMT estimates.

Source: SACOG, September 2011.

VMT by Source

As mentioned above, three sources of VMT are considered: household-generated, commercial vehicle, and external. Household-generated—which includes all travel by residents of the region for work, school, shopping and other household purposes—accounts for almost three-quarters of all VMT in all scenarios. Table 5B.3 provides a tabulation of VMT by source in the region for 2008 and 2035. Household-generated VMT per capita is projected to decrease from 19.3 miles in 2008 to 17.6 miles by 2035 for MTP/SCS, a decrease of 8.8 percent. This compares to 18.3 miles per capita by 2035 for the 2008 MTP.

Commute VMT as a share of total household-generated VMT decreases from 46 percent in 2008 to 44 percent for the MTP/SCS (Table 5B.3), in part due to reductions in the number of workers as the population ages. Commute travel includes all travel by workers from home to work and back home, including any intermediate stops for other non-work activities (e.g., to drop off a child at school, to shop, or to attend to personal business).

Commercial vehicle and external VMT changes are less dramatic than those for household- generated travel. Commercial vehicles and external travel are influenced by factors outside of the SACOG region, such as national trends and markets for goods movement, growth and development in neighboring regions. Household-generated VMT is a measure that focuses more on factors that can be controlled within the SACOG region. Combined commercial vehicle and external travel is normalized by jobs, not population, for this comparison. In general, jobs drive these two VMT sources. By 2035, the MTP/SCS would result in virtually no change in these VMT sources. This compares to the 2008 MTP, which resulted in a small increase (2 percent).

Table 5B.3

Vehicle Miles Traveled by Source in SACOG Region, 2008 and 2035 MTP/SCS

Variable	2008	2035 MTP/SCS	2035—from 2008 MTP[5]
Weekday VMT by Source			
Household-Generated Commute VMT[1]	19,773,600	23,916,800	
Household-Generated Other VMT[1]	22,871,100	30,301,200	61,271,000[4]
Total Household-Generated VMT[1]	42,644,700	54,218,000	
Commute Share of Household-Generated VMT	46%	44%	
Commercial Vehicle VMT[2]	9,535,300	13,191,400	23,608,000[4]
Externally Generated VMT[3]	4,998,600	6,763,900	
Total VMT	**57,178,600**	**74,173,300**	**84,879,000**
Per Capita or Per Job Rates			
Population	2,215,000	3,086,200	3,348,000
Jobs	969,800	1,330,000	1,546,200
Household-Generated VMT per Capita	19.3	17.6	18.3
Commercial Vehicle + External VMT per Job	15.0	15.0	15.3
Total VMT per Capita	25.8	24.0	25.4
Percent Changes in VMT Per Capita or Per Job, compared to 2008			
Household-Generated VMT per Capita	n/a	-8.8%	-5.2%
Commercial Vehicle + External VMT per Job	n/a	--	+2.0%
Total VMT per Capita	**n/a**	**-6.9%**	**-1.8%**

1 Household-generated VMT is cumulative vehicle travel by residents of the region, for their travel within the region. Total household-generated VMT is split into commute (i.e., all VMT generated by workers going from home to work and back, with any stops along the way), and other (all non-commute).

2 Commercial vehicle VMT is cumulative vehicle travel for moving goods, services and freight within the region. It includes commercial travel in passenger vehicles, light trucks, and vans as well as in larger trucks.

3 Externally-generated VMT is cumulative vehicle travel from residents outside the region, but who travel to destinations within the region, or travel through the region.

4 Commercial and external travel was combined in the 2008 MTP document.

5 SACOG, 2008 MTP, *A Creative New Vision for Transportation in the Sacramento Region*, April 2008.

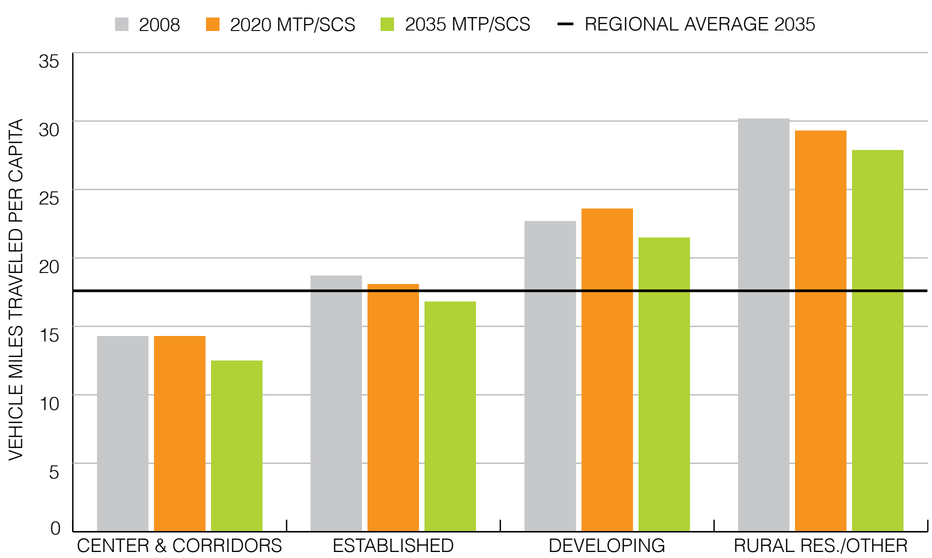
Source: SACOG, September 2011.

Figure 5B.3 provides an illustration of household-generated VMT per capita by the Community Type (defined fully in Chapter 3—Land Use Forecast) of the household's place of residence. This measure rolls up all VMT generated by a household, regardless of where the VMT actually occurs, to the place of residence of the traveler(s) in that household.

- Residents of Center and Corridor Communities have the lowest per capita VMT for the MTP/SCS of all Community Types: 14.3 miles in 2008, decreasing to 12.5 miles by 2035. Centers and Corridors have the most compact land uses, which support walking and biking for shorter trips, and have the greatest access to transit, which provides alternatives to driving for longer trips.
- Residents of Established Communities have the next lowest per capita VMT: 18.7 miles in 2008, decreasing to 16.8 by 2035. Although Established Communities are neither as compact nor as well served by transit as Centers and Corridors, because of the proximity of Established Communities to existing developed areas, especially employment centers, there are more options for making shorter vehicle trips.
- Residents of Developing Communities have the next lowest per capita VMT: 22.7 miles in 2008, decreasing to 21.5 by 2035. Both of these levels are above the regional average (19.3 miles for 2008, and 17.6 for 2035). There are a number of factors related to these VMT rates. First, by 2035 the Developing Communities in the SCS are only partially built-out. Because these areas are in general at the edges of the urbanized area where factors like regional accessibility are below average (see Table 5A-2), partial build-out limits the potential for land use and transportation factors to reduce VMT. Also, transit service in these areas, while present in the SCS, is limited. As Developing Communities develop more fully, and the full value of planned land uses in these areas emerge, the VMT rates for residents should drop significantly.
- Residents of Rural Residential Communities and Lands not Identified for Development in the MTP/SCS are similar in VMT per capita: about 30 miles in 2008, declining to about 28 miles in 2035. Because of the locations of these Community Types, options for shortening vehicle trips are few, and most of the areas have limited, if any, transit service.

Figure 5B.3

Weekday Household Vehicle Miles Traveled per Capita by Community Type in the SACOG Region[1]



[1] Household-generated VMT as defined in this report is rolled up to place of residence, and then totaled to the Community Type of the place of residence.

Source: SACOG, September 2011.

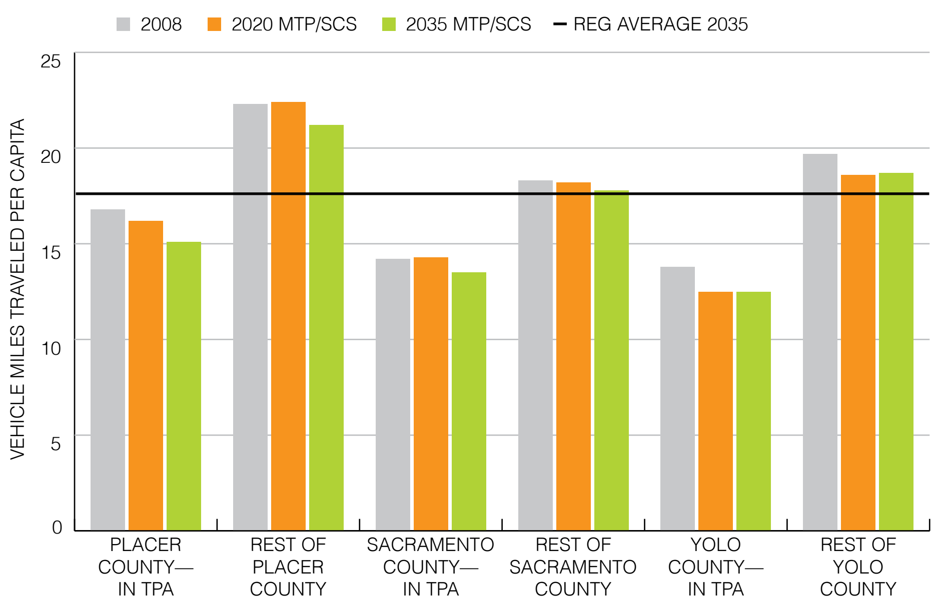
Figure 5B.4 provides an illustration of household-generated VMT per capita rates for residents of Transit Priority Areas (TPAs), compared to residents outside the TPAs in Placer, Sacramento and Yolo counties.

- Residents of TPAs overall have VMT per capita rates 20 to 30 percent lower than the rates for residents outside the TPAs within the same counties. For example in Sacramento County, TPA residents average 14.2 VMT per capita in 2008, declining to 13.5 VMT by 2035; for Sacramento County residents outside TPAs, VMT per capita rates are 18.3 VMT in 2008, declining to 17.8 by 2035.
- For all TPA areas, residents' VMT per capita rates are below the regional average for 2035 (17.6 VMT). Residents of TPAs in Placer County are 8 percent below the regional average in 2035, while residents of Sacramento and Yolo County TPAs are 25 and 30 percent below the regional average. The variation across counties relates in part to the extent of the TPAs in each county: the Placer County TPA is expected to include about 33,000 people by 2035, while the Sacramento and Yolo County TPAs include 750,000 and 150,000 people, respectively.

The overall lower VMT per capita for residents of TPAs is in part due to higher use of transit and non-motorized modes of travel (discussed in Chapter 5C), and in part due to better overall accessibility of TPA areas within the region.

Figure 5B.4

Weekday Vehicle Miles Traveled per Capita by Transit Priority Areas in the SACOG Region[1]



[1] Household-generated VMT as defined in this report is rolled up to place of residence, and then totaled to the TPA areas of the place of residence within counties.

Source: SACOG, September 2011.

VMT and Commute Travel

Commute travel accounts for 46 percent of all household-generated travel, a share which declines to 44 percent by 2035 for the MTP/SCS (see Table 5B.3). Table 5B.4 provides a tally of commute VMT by Community Type, normalized by the number of workers in those areas.

- Commute VMT per worker declines 8.8 percent, from 20.5 miles per worker in 2008 to 18.7 miles by 2035.
- Workers residing in Center and Corridor Communities have the lowest commute VMT per worker—about 30 percent below the regional average for all scenarios. Workers residing in Developing Communities have commute VMT per worker 17 to 21 percent above regional average; workers residing in Rural Residential and lands not identified for development in the MTP/SCS have commute VMT per worker nearly 60 percent above the regional average.
- All Community Types show declines in commute VMT per worker by 2035, ranging from 8 to 10 percent compared to 2008 levels.

Table 5B.4

Commute Vehicle Miles Traveled by Community Type in SACOG Region

Geography	2008	2020 MTP/SCS	2035 MTP/SCS
Center/Corridor Communities			
Household-Generated Commute VMT[1]	1,337,700	1,766,300	2,160,000
Resident Workers	95,700	125,400	170,900
Commute VMT per Worker	14.0	14.1	12.6
% Change from 2008 Per Worker Rate	n/a	+0.8%	-9.6%
Established Communities			
Household-Generated Commute VMT[1]	14,888,400	15,398,700	15,154,900
Resident Workers	743,600	809,700	836,300
Commute VMT per Worker	20.0	19.0	18.1
% Change from 2008 Per Worker Rate	n/a	-5.0%	-9.5%
Developing Communities			
Household-Generated Commute VMT[1]	787,000	2,360,500	4,186,800
Resident Workers	32,700	96,900	188,300
Commute VMT per Worker	24.1	24.4	22.2
% Change from 2008 Per Worker Rate	n/a	+1.2%	-7.6%
Rural Residential Communities			
Household-Generated Commute VMT[1]	2,431,600	2,391,600	2,415,100
Resident Workers	74,800	78,700	81,000
Commute VMT per Worker	32.5	30.4	29.8
% Change from 2008 Per Worker Rate	n/a	-6.5%	-8.3%
Region Total			
Household-Generated Commute VMT[1]	19,444,701	21,917,101	23,916,801
Resident Workers	946,800	1,110,700	1,276,500
Commute VMT per Worker	20.5	19.7	18.7
% Change from 2008 Per Worker Rate	n/a	-3.9%	-8.8%

[1] Commute tours combine all trips from home to work and back to home into one unit. Tours are roughly equivalent to commute round trips.

Source: SACOG, November 2011.

Key Factors Related To Declining VMT per Capita

It is impossible to attribute the full decline in VMT per capita (8.3 percent in household-generated VMT, and 6.6 percent in total VMT) to specific policies or factors. However, the list of factors that will contribute to the reduction includes:

- Improvements in Accessibility (i.e., the number of activities which can be reached within a given travel time)—In Chapter 5A, Table 5A-2 illustrates how this factor changes by 2035 for the MTP/SCS. Because the growth that occurs between 2008 and 2035 is more compact, the number of activities within a reasonable travel time increases by 31.3 percent. This change means that most residents will be able to find jobs, schools, shopping, and other activities closer to their place of residence, and their vehicle trips will be shorter.
- Improvements in Mix of Land Uses—Table 5A-2 also shows that most areas within the region improve to some degree in the balance of complementary land uses. This allows for a higher share of wants and needs to be met closer to a place of residence, which in turn allows for shortening of vehicle trips and creates more opportunities for non-motorized travel.
- Improvements in Transit Service and Walkability—Shifts in mode of travel from private vehicle (e.g., driving alone and carpooling) to non-auto modes (i.e., transit, bicycling and walking) are another key factor, which will be discussed in greater detail in Chapter 5C.

In addition to these land use/transportation factors, several external factors influence the decline in VMT per capita to some degree: projected increases in auto operating costs, driven by higher fuel prices expected in the future; and aging of the population, which is likely to result in less out-of-home activities, and in turn, less travel for a significant percentage of the population.

Roadway Congestion and Delay

This section: defines roadway congestion and discusses why SACOG measures it; reports observed trends in roadway congestion in the region; reports the roadway congestion performance of the MTP/SCS; explains the roadway congestion performance of the MTP/SCS; and then discusses the relationship between congestion and roadway efficiency.

What is Roadway Congestion and Why Do We Measure it?

Roadway congestion is an indicator with a much less specific and determined definition than VMT. In general, congestion occurs on roadways when the number of drivers who wish to use a particular route exceeds the capacity of that route. The typical signs of congestion are stop-and-go driving conditions on freeways, lines of drivers and vehicles waiting to get through a traffic light or from a ramp onto or off a freeway, and the accompanying frustration experienced by those drivers and passengers.

Delay, in general, refers to time wasted traveling on congested facilities. However, to quantify that delay requires some presumption of what time it should take to travel on a particular route, or a standard travel time which drivers and passengers should expect. Setting a standard by which delay can be quantified is a subjective exercise. For example, some might define a standard travel time as free-flow or totally uncongested conditions. The standard for freeways by this definition might be 60 MPH, and the standard travel time would be 1 minute for a one-mile stretch of freeway. If the actual travel speed, with congestion, was 40 MPH, the travel time would be 1.5 minutes, and the delay for each driver and passenger in that condition would be 30 seconds. Others may define the standard as a modest or tolerable level of congestion. For the same one-mile stretch of freeway, someone might define 35 MPH as the standard for measurement of delay—this is approximately the speed of travel for optimal throughput on a freeway lane. With the same actual travel speed of 40 MPH, no delay would be experienced, because the actual speed is higher than the standard.

SACOG has always focused more on the presence of congestion on roadways rather than an amount of delay. Specifically, SACOG estimates and tracks how much of the total VMT occurs on roadways that are at or above their reasonable capacities. SACOG defines a congested VMT (CVMT) as a VMT that occurs on roadways with volume-to-capacity ratios of 1.0 or greater. An example of CVMT is a vehicle and its driver and passenger(s) going westbound on I-80 during the busy morning commute period between Madison Avenue and the I-80/Capital City Freeway split, or on Hazel Avenue between Madison and Winding Way during commute hours.

Observed Data and Historic Trends in Roadway Congestion

While VMT has been consistently and comprehensively monitored in the region since the mid-1990s, monitoring of congestion and delay inform CMP activities. Two sources are presented here.

Delay data have been collected by Caltrans, primarily on freeway facilities, since 1998. Caltrans defines 35 MPH as a travel speed standard for freeways, with delay calculated as the difference between actual travel time and travel time at 35 MPH for the vehicles on the roadway segment in question. Caltrans collects field data for this measure annually (known as HICOMP data). Freeway delay by this measure is presented in Table 5B.5.

Delay estimates have been made for the Sacramento urbanized area (as well as most other urbanized areas in the U.S.) by the Texas Transportation Institute (TTI) annually since 1990 (see Table 5B.5)[3]. The standard for delay in the TTI reports is free-flow conditions, compared to 35 MPH for the Caltrans measure. TTI considers arterial and surface street conditions as well as freeways. Finally, TTI attempts to account for vehicle occupancy, and estimate passenger delay, rather than vehicle delay. For all of these reasons, the TTI measure is a much bigger number in scale than the Caltrans measure. Despite these differences, these two sources show similar trend lines in delay:

- Very high increases in delay during years 2000 to 2005 (+14.9 percent per year in HICOMP data, and +9.2 percent per year in the TTI data).
- High decreases during the years 2005 to 2008 (-19.1 percent per year in HICOMP, -10.0 percent per year in TTI). Although the factors which influence the amount of delay experienced by travelers is complicated, an over-arching factor affecting this extraordinary increase and then decrease in delay is the level of economic activity in the region. Since delay is strongly influenced by travel conditions during peak periods, the amount of work travel affects the amount of delay, all else being equal. Regional unemployment rate in 2000 was about 6 percent, and in 2005, it dropped below 5 percent; in 2008, it was nearly 12 percent.
- For the entire period between 2000 to 2008, both measures show delay modestly increasing (+0.8 percent per year in HICOMP, and +1.6 percent per year in TTI).

Chapter 9—Economic Vitality, discusses the TTI calculation of the total cost of congestion, estimated at $603 million in the region in 2010.

Included in Table 5B.5 are estimates of congested VMT. Compared to the delay estimates, the changes in congested VMT are somewhat muted. For example, congested VMT was estimated to have increased by 7.6 percent between 2000 and 2005, compared to 9.2 and 14.9 percent for the two delay measures. Similarly, the 2005 to 2008 declines in delay were much greater than the estimated decline in congested VMT. There are several factors which may explain this. First, the delay estimates take account of the severity of congestion, while congested VMT takes account of the presence of congestion. For example, a roadway segment which may be 20 percent over normal capacity may have more severe delay due to vehicles moving slowly through interchanges or on/off ramps and other detailed operational factors.

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[3] TTI recently revised its process for estimating delay, using to a much greater degree actual data on travel times collected by Inrix, Inc., and re-estimated its entire time series for each urbanized area. These revisions were published after the publication of the 2008 MTP. Differences in TTI data from that in the 2008 MTP *A Creative New Vision for Transportation in the Sacramento Region* are due to this change.

Table 5B.5

Historic Travel Delay in the SACOG Region

Congestion/Delay Measure	2000	2005	2008
Freeway Vehicle Hours of Delay (daily)[1]	10,896	21,832	11,576
All Road Traveler Hours (yearly, in thousands)[2]	24,506	38,076	27,781
Congested Vehicle Miles Traveled (weekday, in thousands)[3]	2,541	3,659	3,298
Annual Average Growth Rates	**‘00 to ‘05**	**‘05 to ‘08**	**‘00 to ‘08**
Freeway Vehicle Hours of Delay[1]	+14.9%	-19.1%	+0.8%
All Road Traveler Hours of Delay[2]	+9.2%	-10.0%	+1.6%
Congested Vehicle Miles Traveled[3]	+7.6%	-3.4%	+3.3%

1 Caltrans District 3 “Highway Congestion Monitoring Program Reports.” Caltrans defines delay as the difference between travel time at 35 MPH and actual travel time for state highways. All segments included in the monitoring reports for the SACOG region are freeways.

2 Texas Transportation Institute “Urban Mobility Report” for Sacramento urbanized area. TTI estimates delay as the difference between free flow travel time and actual travel time, including both surface streets and freeways.

3 SACOG estimates, made using SACSIM regional travel demand model. Congested VMT are VMT occurring on roadways at or near generalized hourly capacity.

Source: SACOG, September 2011.

Roadway Congestion and the MTP/SCS

Several principles guided the development of the roadway network for the three scenarios discussed at the MTP workshops held in October 2010 (and described in more detail in Chapter 2—The Planning Process). Based on the results of those public workshops and direction from the SACOG Board for development of the MTP/SCS, the following principles guided development of the MTP/SCS roadway system.

- For freeways, emphasizes new investments at major current bottleneck locations and congestion points. Examples of these investments are:
  - providing alternative modes of travel, which reduces demand in bottleneck locations and provides travel options for commuters and other travelers to avoid the worst congestion (e.g., dedicated transit lanes on the Watt/U.S. 50 interchange and express bus services along new high-occupancy vehicle (HOV) lanes in congested areas);
  - constructing the Green Line light rail extension in the I-5/Natomas corridor;
  - increasing frequency of commuter and express bus lines from Yolo, Yuba, Sutter, Placer and El Dorado counties into downtown Sacramento; and
  - providing new Class 1 bicycle paths (see section on non-motorized travel improvements in Chapter 5C for more detail).
- In some locations, adds auxiliary lanes and/or makes operational improvements to freeways to reduce delays and improve efficiency of the roadway system. Examples:
  - new auxiliary lanes on the Capital City Freeway-American River Bridge, (the worst single freeway bottleneck in the region);
  - operational improvements to I-80 through Roseville and on U.S. 50 through Rancho Cordova and Folsom;
  - improvements to the I-5/SR-113 interchange in Woodland; and
  - spot improvements in other locations.
- Adds freeway HOV lanes to provide carpooling options to avoid the worst peak period congestion, including:
  - I-80 HOV lanes between I-5 and Watt in Sacramento County;
  - U.S. 50 in El Dorado County and in Sacramento County from Watt Avenue to SR-99; and
  - I-5 into downtown Sacramento from the north and south.
- Provides new or expanded local street connections across rivers to serve shorter trips in congested corridors, such as:
  - new crossings of the Sacramento and American rivers into downtown Sacramento; and
  - widening crossings of the Feather River between Yuba City and Marysville.

- Provides modest new and expanded surface streets serving longer trips in areas where freeways and other restricted access facilities have not been developed, including:
  - improvements and widening of the Southeast Capital Connector corridor;
  - construction of the initial phases of the Placer Parkway and Lincoln Bypass in Placer County; and
  - completion of widenings and improvements on SR-70 in Yuba County and SR-99 in Sutter County.

Estimates of congested VMT in the future were made using SACOG's travel demand models, and are shown in Table 5B.6 and Figures 5B.5 and Figure 5B.6.

Congested VMT are estimated to increase from 3.3 million daily miles in 2008 to 4.3 million miles in 2035 under the MTP/SCS. This is a total increase of 30 percent from 2008, and an average annual increase of 1.0 percent over the same time period. This increase compares to a 112 percent increase in the 2008 MTP, or a 2.8 percent annual growth rate.

However, congested VMT per capita declines relative to 2008. Per capita congested VMT was estimated to be 1.49 miles in 2008, and 1.39 miles by 2035 for the MTP/SCS, a decline of 6.9 percent. This compares to per capita congested VMT in the 2008 MTP of 2.09. The improvement in roadway congestion per capita traces back to the 2002 MTP. In that Plan, SACOG projected a 58 percent increase from 2002 to 2025. The 2008 MTP, with a longer planning period from 2005 to 2035, projected a 22 percent increase in the same measure. With a 7 percent decrease from 2008 to 2035, the MTP/SCS projects further reduction in one of the most troublesome aspects of regional travel. This progression through the last two plans and the MTP/SCS is illustrated in Figure 5B.6.

Table 5B.6

Congested Travel in the SACOG Region, 2008 and MTP/SCS

Variable	2008	2035 MTP/SCS	2035 from 2008 MTP[2]
Total Congested VMT[1]	3,297,500	4,278,700	6,990,000
Population	2,215,000	3,086,200	3,348,000
Cong. VMT per Capita	1.49	1.39	2.09
% Change from Base Year of Plan	n/a	-6.9%	+22%[3]
% Change from '08 MTP	n/a	-33.6%	n/a

1 SACOG estimates made using SACSIM regional travel demand model. Congested VMT are VMT occurring on roadways at or near generalized hourly capacity.

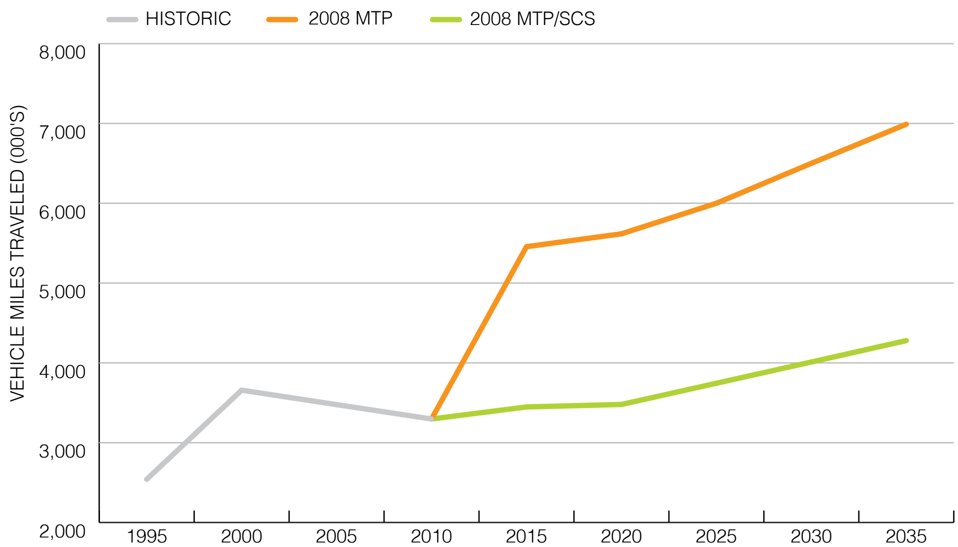
2 SACOG, 2008 MTP A Creative New Vision for Transportation in the Sacramento Region, April 2008.

3 The base year for the 2008 MTP was 2005, which had higher congestion levels than 2008 (approximately 1.7 miles per capita). Comparing the 2008 MTP end year to 2008, the change in per capita congested VMT would be 40 percent.

Source: SACOG, September 2011.

Figure 5B.5

Total Congested Travel in the SACOG Region, Historic Trends and Projected MTP/SCS

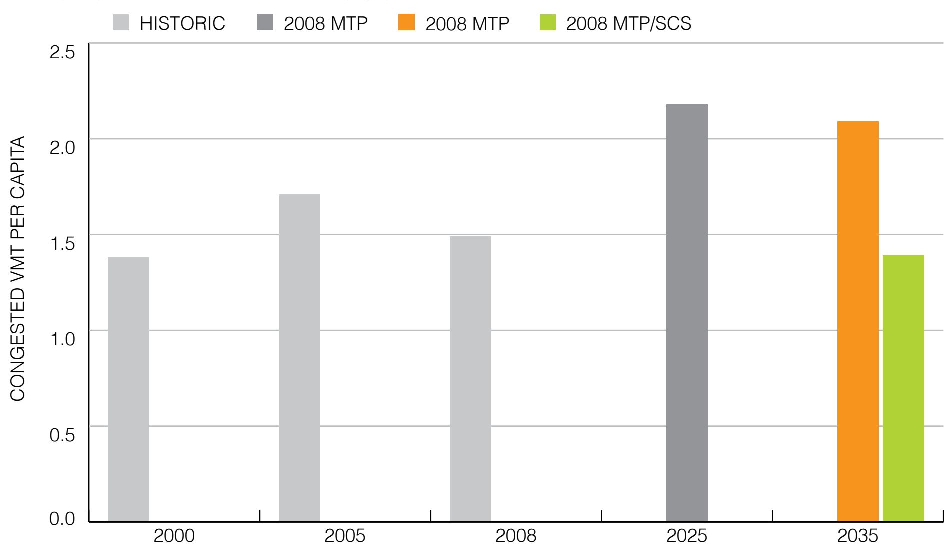


Historic and MTP/SCS based on SACOG forecasts/estimates. 2008 MTP from SACOG, *A Creative New Vision* for Transportation in the Sacramento Region, April 2008.

Source: SACOG, September 2011.

Figure 5B.6

Congested Vehicle Miles Traveled per Capita in the SACOG Region, Historic Trends and MTP/SCS



Historic and MTP/SCS based on SACOG forecasts/estimates. 2008 MTP from SACOG, *A Creative New Vision for Transportation in the Sacramento Region*, April 2008. 2002 MTP from SACOG, *A Bold First Step for Mobility in the Sacramento Region*, 2002, with adjustments to allow for comparison to more current congested VMT estimates.

Source: SACOG, September 2011.

Congested VMT by Source and Community Type

Table 5B.7 provides a tabulation of household-generated, commercial vehicle, and external congested VMT in the SACOG region for 2008 and 2035. Total congested VMT increases 6 percent by 2020, and 30 percent by 2035, for the MTP/SCS. Congested VMT generated by households increases the least, from 2.6 million to 3.3 million by 2035 for the MTP/SCS, an increase of 25 percent. Commercial vehicle and externally generated congested VMT increases more over the MTP/SCS planning period: commercial vehicle congested VMT increases by 40 percent, and externally generated travel by 75 percent from 2008. One reason for this apparent disparity is that more of the land use and transportation elements of the MTP/SCS are targeted at travel by residents of the region, which allow those residents to avoid the most congested routes. For example, the new Green Line light rail extension into Natomas allows residents of that corridor to avoid congestion on I-5; that option is not available to commercial vehicles and most residents of areas outside the region.

Table 5B.7 also provides congested VMT normalized by population (per capita) for household-generated travel, and by jobs for commercial vehicle and externally generated travel. Household-generated congested VMT per capita declines from 1.19 VMT per person in 2008 to 1.07 by 2035, a decline of 10.4 percent. Congested VMT experienced by commercial vehicles, normalized by the number of jobs in the region, increases from 0.69 VMT per job in 2008 to 0.75 in 2035, an increase of 8.7 percent. Total congested VMT from all sources declines on a per capita basis from 1.49 miles per capita in 2008, to 1.38 miles by 2020, and holding nearly steady from 2020 to 2035.

Table 5B.7

Congested Vehicle Miles Traveled by Source in the SACOG Region, 2008 and the 2035 MTP/SCS

Travel Source	2008	2020 MTP/SCS	2035 MTP/SCS
Region Total			
Household-Generated Commute CVMT[1]	1,711,500	1,757,100	2,128,300
Household-Generated Other CVMT[1]	921,100	988,200	1,159,500
Household-Generated CVMT[1]	2,632,600	2,745,300	3,287,800
Commute Share of Household-Generated CVMT	65%	64%	65%
Commercial Vehicle CVMT[2]	489,100	525,300	682,900
Externally Generated CVMT[3]	175,800	208,000	308,000
Total CVMT	3,297,500	3,478,600	4,278,700
Per Capita Rates			
Population	2,215,000	2,519,900	3,086,200
Jobs	969,800	1,072,200	1,330,000
Household-Generated CVMT per Capita	1.19	1.09	1.07
Commercial Vehicle + External CVMT per Job	0.69	0.68	0.75
Total CVMT per Capita	1.49	1.38	1.39
Percent Changes in Congested VMT Per Capita or Per Job, compared to 2008			
Household-Generated CVMT per Capita	n/a	-8.3%	-10.4%
Commercial Vehicle + External CVMT per Job	n/a	-0.2%	+8.7%
Total CVMT per Capita	n/a	-7.3%	-6.9%

1 Household-generated CVMT is cumulative vehicle travel by residents of the region on roadways which are at-or-above capacity, for their travel within the region. Household-generated CVMT is split into commute and other shares.

2 Commercial vehicle VMT is cumulative vehicle travel for moving goods, services and freight within the region. It includes commercial travel in passenger vehicles, light trucks, and vans as well as in larger trucks.

3 Externally generated VMT is cumulative vehicle travel from residents outside the region, but who travel to destinations within the region, or travel through the region.

Source: SACOG, November 2011.

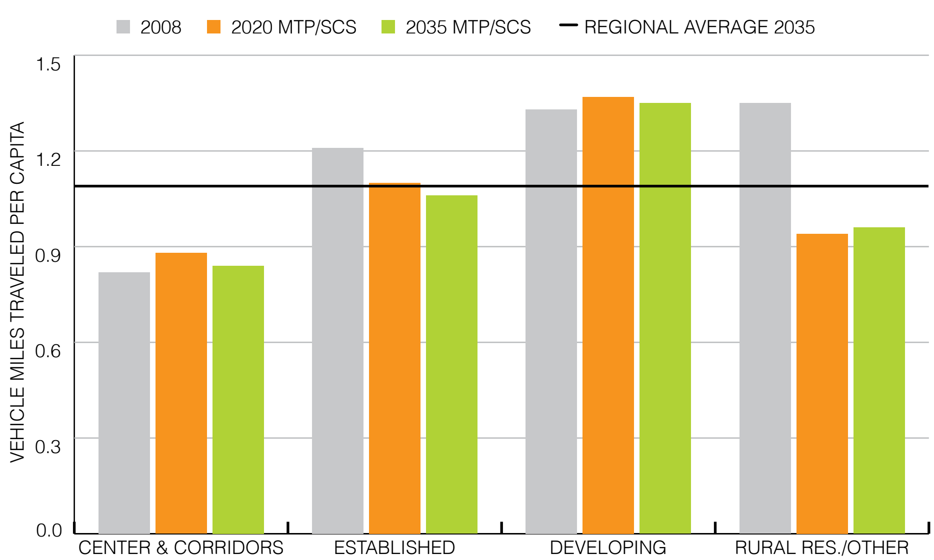
Figure 5B.7 provides an illustration of congested VMT per capita for household-generated travel only, tallied back to the Community Type of the residence of the travelers. The amount of congested VMT which residents of the different Community Types would experience varies widely:

- For residents of Center and Corridor Communities, the average amount of congested travel a resident would experience increases very slightly, from 0.82 miles per capita in 2008 to 0.84 miles in 2035. Although increasing, the 2035 congested VMT per capita for Center and Corridor Community residents is still nearly 20 percent below the 2035 regional average. In part, this is due to much lower commute VMT per capita (see Table 5B.4), and in part due to the availability of transit options during peak periods, when congestion is worst.
- For residents of Established Communities, the average amount of congested travel is, not surprisingly, near the average. About two-thirds of all residents of the region by 2035 would reside in Established Communities, so their travel strongly affects the regional average. Per capita congested VMT declines by 12.4 percent over the MTP/SCS planning period.
- Residents of Developing Communities would experience increased congested travel over the MTP/SCS planning period from 1.33 to 1.35 miles per person per day. Residents of these areas would also experience congested travel about 27 percent higher than the regional average of 1.07 miles per weekday. The increase in congested travel for residents of these communities is due to several factors. First, as mentioned above, these communities are expected to be partially, not fully, developed. Because of the location of these communities closer to the edges of the urbanized area, and further from job centers, commutes for workers residing in these areas will tend to be longer than for workers in other communities (see Table 5B.7), which also exposes these workers to more congestion.
- Residents of Rural Residential Communities would experience the biggest reduction in congested travel. The average resident in an area of this type would experience a 30.3 percent reduction in congested travel by 2020, and 28.9 percent by 2035. Additionally, the swing in congestion relative to the regional average is the greatest for residents of these areas: in 2008, residents experienced congested travel nearly 14 percent above the regional average; by 2035, they will be nearly 10 percent below the regional average. A significant driver of this improvement is travel conditions on roadways serving El Dorado County residents which have significant congestion relief in the MTP/SCS.

Figure 5B.7

Congested Vehicle Miles Traveled by Community Type in SACOG Region[1]

[1] Household-generated congested VMT as defined in this report is rolled up to place of residence, and then totaled to the Community Type of the place of residence.



Source: SACOG, September 2011.

Congested VMT and Commute Travel

Commuting and congestion go together, for some obvious and less-obvious reasons. The most obvious reason is that the majority of commute travel occurs during peak periods, when travel demands frequently exceed available capacity, resulting in congestion. Peak periods are defined by when commute travel occurs. For example, in the SACOG region, during the period between 7:00 and 10:00 a.m., approximately 70 percent of all workers and students arrive at their workplace or school (see Figure 5B.8), with 30 percent arriving during a one-hour period. Conversely, for all other non-work travel (e.g., shopping, personal business), only about 17 percent of all arrivals at the activity location occur during the same three-hour period, with 8 percent occurring during the highest hour. The daily pattern of activities for work and school is bi-modal—that is, it has two extreme peaks, one in the morning and one in the afternoon. The daily pattern for all other activities is much flatter and more distributed over the entire day.

Commuters and students often have very little discretion over when they travel—their times of travel are dictated by their work or school hours. Although the amount of flexibility workers have on when to arrive at work may vary by employer, workers have far less freedom to choose when to travel than a non-working adult making a choice about when to go shopping. This difference makes commuters more willing to endure worse congestion than other travelers would—they endure it because they have little choice.

This relationship between commute travel and congestion is in evidence in the statistics presented earlier in Table 5B.7). Although commute travel accounts for only 41 to 44 percent of household-generated VMT, it accounts for about 65 percent of congested VMT.

Figure 5B.8

Peaks in Time of Travel for Work, School, and Other Trips

Based on 2000 Household Travel Survey.

Source: SACOG, September 2011.

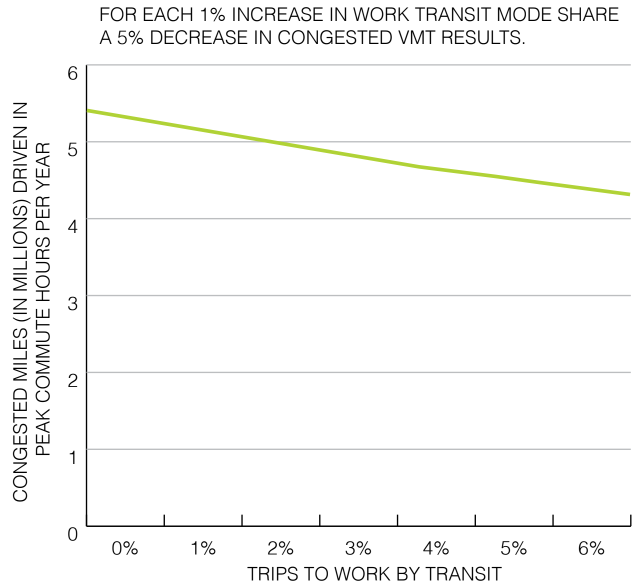
Key Factors Influencing Reduction in Congested Travel in the MTP/SCS

The reduction in congested travel is driven by two basic factors in the MTP/SCS:

- Roadway capacity investments include a significant number of projects that resolve or improve major existing bottlenecks, including several new projects for bottleneck locations not addressed in prior plans.
- On several major congested travel corridors, new transit options are provided in the MTP/SCS. Overall transit mode share increases, and commute transit share increases dramatically—the MTP/SCS forecasts show transit mode share increasing by 5 percentage points, from about 3 percent in 2008 to over 8 percent in 2035 (see Chapter 5C where this issue is discussed in greater detail). There is a strong relationship between the work travel mode share, and the level of congested VMT experienced during the peak period, illustrated in Figure 5B.9. For each incremental percentage point in work travel transit share, congested VMT decreases by 5 percent.[4]

Figure 5B.9

Transit Mode Share and Congested Travel in the SACOG Region



Source: SACOG, September 2011.

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[4] Based on modeling by SACOG staff. Note that an increment in work transit mode share from, e.g., 3 percent to 4 percent, which is a 1 percent share increment, represents a 33 percent increase in the number of actual transit trips.

Roadway Utilization and Efficiency

Increasing the productivity of the region's existing transportation infrastructure through more optimal use of the region's roadway system is an important goal for the MTP/SCS. The concept of optimal levels of use of roadways is a new one in transportation planning. Historically, the quality of service has been measured on a simple A-through-F scale, with the implication that level of service A is always better than level of service B, level of service B is better than C and so on. Optimal use takes a slightly different perspective, based not solely on the level of service to individual travelers in motorized vehicles only (which is the focus of level of service measurement), but on some level of system efficiency and on balance of benefit across travel modes[5].

The concept of optimal use applied to roadways starts with a few basic assumptions. First, travel demand is always subject to peaks and valleys, when demand is higher or lower than average. Second, achieving better levels of service during peak demand periods requires progressively greater infrastructure investments, and those investments may only really be used for one or two hours during the day—the rest of the time, those investments essentially sit idle. Finally, optimal use also recognizes that in addition to the infrastructure costs of providing higher levels of service during peak demand periods, those investments impose other costs, too, such as the costs associated with building wider roads, increased physical distances between uses, and making travel by transit, bicycle and walking more costly.

In order to analyze the utilization level of roadways according to this concept, an operational definition was developed based on the methods of evaluating roadway demand and supply in SACOG's SACSIM regional travel demand model. For roadway investments, overall efficiency is measured as the percent of total travel which occurs at optimal levels of use. Optimal use presumes that because of peaks and valleys in demand, and because of the extremely high cost of providing sufficient roadway infrastructure to provide a high level of service during peak demand times, some level of congestion is expected and, in a way, desired, at peak times. If free flow conditions prevail during peak demand times, this is an indication that roadways were over designed, and a high percentage of roadway capacity is un-utilized during non-peak periods. So, the key to defining optimal use is to define optimal utilization levels around moderate or tolerable levels of congestion.

[5] Milam, Ron, "Transportation Impact Analysis Gets A Failing Grade When It Comes to Climate Change and Smart Growth", published at the California Office of Planning and Research Level of Service Forum website, October 2008, http://opr.ca.gov/sch/pdfs/Ron_Milam_Fehr_and_Peers.pdf

The definition is based on roadway segment volume-to-capacity (V/C) ratios. In concept, segment V/C ratios are similar to intersection V/C ratios which are commonly reported as part of traffic impact studies. For computational efficiency, segment, rather than intersection, V/C ratios are used for regional travel demand models. Segment capacities are set to represent the number of vehicles which can pass through a segment based on normal operating conditions. Freeways, for example, are set at 2,000 vehicles per lane per hour. For surface streets, segment capacities depend heavily on intersection operations, and actual segment capacities can vary widely based on different ways of handling intersection operations (e.g., signalization, presence/absence of turning lanes). A working definition of optimal use needs to take account of some of these characteristics of segment capacities by different functional classes of roadways.

The following V/C ratio ranges were defined as optimal for this analysis:

- For general purpose freeways, V/C ratios between 0.95 and 1.05 (i.e., from 5 percent below to 5 percent above the normal capacity) were defined as optimal. Below the lower threshold, freeways may be considered to be over-capacity; above the upper threshold, congestion is likely to become unmanageable.
- For HOV lanes, it is presumed that a travel time advantage is desired compared to adjacent general purpose freeway lanes, so the optimal utilization level was set at 0.50 to 0.85. At these levels, near free flow speeds would be maintained in the HOV lanes.
- For arterial and expressway roadways, where actual capacities may vary due to intersection operations, a wider range of optimal utilization was specified than for freeways: 0.85 to 1.15.
- Local and collector streets are the streets with the most varied use patterns. For example, local streets are those onto which the majority of houses front, and these streets are not expected to be operating at capacity at any time of the day. In fact the streets may be used for everything from setting out a garbage or recycling container to playing catch with a child. For this reason, the optimal use level was set at a maximum V/C ratio of 0.75, or 75 percent of normal capacity.

The MTP/SCS is projected to increase the percentage of VMT which occurs at optimal utilization level from 28.5 percent in 2008 to 30.4 percent in 2035. Table 5B.8 provides a tabulation of VMT by roadway class by utilization level. The improvement in utilization comes roughly equally from the under-utilized and over-utilized categories; however, overall the share of VMT on over-utilized roadways declines from 4.3 percent to 3.6 percent by 2035.

Table 5B.8
Roadway Utilization in the SACOG Region, 2008 and MTP/SCS

	UTILIZATION LEVEL[1,2]			
Roadway Type / Year	**Under-Utilized**	**Optimally Utilized**	**Over-Utilized**	**Total**
2008 Weekday VMT by Road Class				
General Purpose Freeways	21,251,400	1,369,700	878,500	23,499,600
HOV Lanes	413,800	700,300	26,600	1,140,700
Auxiliary Lanes/Ramps	744,300	502,700	269,500	1,516,500
Arterials/Expressways	16,013,500	2,835,300	412,400	19,261,200
Collectors/Local Streets	0	10,904,100	866,600	11,770,700
Total	**38,423,000**	**16,312,100**	**2,453,600**	**57,188,700**
2008 Share of VMT:	**67.2%**	**28.5%**	**4.3%**	**100.0%**
2035 MTP/SCS Weekday VMT by Road Class				
General Purpose Freeways	24,350,600	2,134,600	767,300	27,252,500
HOV Lanes	908,100	2,356,600	134,800	3,399,500
Auxiliary Lanes/Ramps	1,000,000	823,300	370,000	2,193,300
Arterials/Expressways	22,920,900	4,677,700	581,400	28,180,000
Collectors/Local Streets	0	12,614,400	790,100	13,404,500
Total	**49,179,600**	**22,606,600**	**2,643,600**	**74,429,800**
2035 MTP/SCS Share of VMT :	**66.1%**	**30.4%**	**3.6%**	**100.0%**

[1] V/C ratio ranges are based on segment (not intersection) calculations.

[2] Under-Utilized: <0.95 for GP Freeway; <0.50 for HOV and Aux/Ramp; <0.85 for Arterial/Expressway; no minimum for Collectors/Local Streets.
Over-Utilized: >1.05 for GP Freeway; >0.85 for HOV and Aux/Ramp; >1.15 for Arterial/Expressway; >0.75 for Collectors/Local Streets.

Source: SACOG, September 2011.

Key Factors in Increasing VMT in the Optimal Use Range

Discussed above in the sections on VMT and Roadway Congestion are several of the key factors that will lead to better utilization of the region's roadways:

- Targeted investments in projects which ameliorate some of the worst bottlenecks on the region's freeways and major roadways—Reducing the level of congestion at major existing bottleneck locations through targeted auxiliary lanes and operational improvements moves some of those bottlenecks from severe to manageable levels of congestion.
- Right-sizing roadway widening projects—Mentioned above are many locations where roadway widening projects in the MTP/SCS were down-sized from the projects in the 2008 MTP. The reduced-scale projects were often reconfigured as complete streets projects with multi-modal focus. Through the diligent efforts of local agencies in general plan circulation element updates, many of these downsized roadway projects result in more optimal use of roadways than the larger capacity projects they replaced.
- Roadways tied to growth—By tying the construction of new roadway facilities to the land use development and growth assumed in the MTP/SCS, new roadway facilities are better utilized in the MTP/SCS.

Chapter 10—Financial Stewardship provides additional discussion of strategies in the MTP/SCS that increase efficient and productive use of the region's transportation infrastructure.