TECHNICAL EVALUATION OF THE GREENHOUSE GAS EMISSIONS REDUCTION QUANTIFICATION FOR THE KERN COUNCIL OF GOVERNMENTS' SB 375 SUSTAINABLE COMMUNITIES STRATEGY

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California Environmental Protection Agency

Air Resources Board

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Executive Summary

The Sustainable Communities and Climate Protection Act of 2008 (Senate Bill 375) is intended to support the State's broader climate goals by encouraging integrated regional transportation and land use planning that reduces greenhouse gas (GHG) emissions from passenger vehicle use. Now in its seventh year of implementation, SB 375 has resulted in Sustainable Communities Strategies (SCS) which are developed as part of a region's Regional Transportation Plan (RTP). These SCSs demonstrate whether, if implemented, the metropolitan planning organizations (MPO) of California can achieve the per capita passenger vehicle GHG emissions targets (targets) for 2020 and 2035 set by the California Air Resources Board (ARB or Board) in 2010.

For the Kern Council of Governments (KernCOG), the MPO for the County of Kern, the Board set targets of five percent reduction in 2020 and 10 percent reduction in 2035 from a base year of 2005. The KernCOG board of directors adopted its first SCS on June 19, 2014 and made a determination that, if implemented, the SCS would achieve the targets established by the Board. KernCOG submitted its adopted SCS and GHG determination to ARB for review on June 4, 2015. The ARB staff evaluation presented in this report affirms that KernCOG's 2014 SCS would, if implemented, meet the Board-adopted targets.

Kern County (County) is in the San Joaquin Valley (Valley), a significant agricultural region of the State with unique socioeconomic characteristics and environmental challenges. It is the southernmost of the eight Valley counties, directly north of Los Angeles and Ventura Counties and east of San Louis Obispo County. It is the largest in size of the Valley counties, and the second most populous. The County is currently home to over 800,000 people and is projected to grow to almost 1.5 million people by 2040.

The largest population center in the County is Metropolitan Bakersfield with over 500,000 people, or about 60 percent of the County's total population. Delano, Ridgecrest, and Wasco are the next largest cities, all with populations under 55,000. About 30 percent of the population lives in unincorporated rural communities.
About five percent of the County's land area is encompassed within the boundaries of the region's 11 cities. Approximately 70 percent of the land in the County is dedicated to non-urban uses such as agriculture and natural resource extraction (e.g., oil and boron) or preserved as State and federal public lands. Whereas the urban population is concentrated in Bakersfield, the County's resource-focused economy contributes to a dispersed employment base, with most of the region's job centers located in rural areas with access to these resources.

The urban development pattern in the County over the last 30 years has been characterized by low density housing and suburban style commercial development with dispersed job centers. Recognizing the need to minimize land consumption, preserve natural resources and increase travel choices, KernCOG adopted the *Kern County Regional Blueprint* (Blueprint) in 2008. The Blueprint established the policy foundation for subsequent development of the 2014 RTP/SCS with the identification of regional goals that included targeting growth in existing urban areas and emphasizing mixed-use commercial and high density residential development in the Metropolitan Bakersfield area.

Implementation of the 2014 RTP/SCS would change the region's historical land use pattern and transportation investments through 2040. The plan calls for new growth to be focused within existing urban boundaries as compact, infill development. Over 60 percent of the region's population growth is forecast to occur within the Metropolitan Bakersfield area. Additional SCS strategies include increasing the number of households and jobs with access to transit and increasing the proportion of multi-family and small-lot single-family homes. The plan also dedicates a greater amount of funding for active transportation infrastructure and public transit, compared to the prior RTP. Planned transit improvements include increasing the number of natural gas buses in transit fleets, and adding additional buses for fixed routes and express service throughout the region. The plan would establish additional transit transfer stations and add a new bus rapid transit system in Metropolitan Bakersfield. With this emphasis on more compact, transit-oriented development, approximately 62 percent of total housing and 75 percent of total jobs would be located within one-half mile of a transit station by 2040.

Access to rural employment centers would also be improved, with plans to double the number of vanpool riders and construct the region's first high-occupancy vehicle lanes to accommodate an increasing number of carpoolers.

SB 375 directs the Board to accept or reject the determination of each MPO that its SCS would, if implemented, achieve the region's targets for 2020 and 2035. This report represents ARB staff's technical analysis of KernCOG's GHG determination, and describes the methods used to evaluate the MPO's GHG quantification. ARB staff's technical analysis was enhanced by being able to run KernCOG's travel model which was provided by the MPO.

ARB staff based its conclusion that the region would be able to achieve its targets on multiple factors. These include the use of appropriate modeling tools and model assumptions, the sensitivity of the travel model to SCS strategies, the types of projects and strategies reflected in the SCS, and supporting evidence from SCS performance indicators. Model sensitivity tests, conducted by KernCOG staff with assistance from ARB, showed that the model does respond, although subtly in some instances, to changes in key inputs.

Staff's evaluation of the SCS strategies that encourage more sustainable development and several SCS performance indicators provide additional evidence of appropriate per capita GHG reductions. Taken together, all of the above factors support the conclusion that the SCS, if implemented, would achieve the region's targets of five and 10 percent in 2020 and 2035, respectively.

Because the effect of auto operating cost assumptions on KernCOG's quantification was of particular interest, ARB staff thoroughly analyzed this issue and performed a model sensitivity test by independently running the region's travel model. Initial efforts by KernCOG to quantify the effect of individual strategies and assumptions (for example, auto operating cost, land use strategies, transit improvements) on GHG emissions in 2040 did not consider the synergistic effects of the other strategies and assumptions embedded in the 2040 scenario. The method that KernCOG used resulted in an estimate of about eight percent per capita reduction in GHG emissions due to an increase in auto operating cost alone. To better understand the impact of auto operating cost on VMT (and by extension, GHG emissions), KernCOG staff collaborated with ARB staff to conduct additional model sensitivity tests that more appropriately considered these synergistic effects. These tests found that a one percent change in auto operating cost leads to less than a 0.13 percent change in VMT. This is consistent with the findings in published studies. Based on KernCOG's forecasted price of fuel, auto operating cost would increase 23 percent by 2035, and the corresponding reduction in VMT would be approximately three percent by 2035. ARB staff concludes that this change in VMT is reasonable and consistent with the results from other MPOs' models.

To improve forecasting of GHG emissions in future planning cycles, staff has identified several areas in which the MPO could improve the quality of its data inputs and assumptions. Throughout this report are several recommendations for modeling improvements that should be considered by KernCOG in its 2016 update of the travel model. If implemented, these recommended improvements should enable the model to better capture the GHG benefits of the land use and transportation strategies in KernCOG's next SCS

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I. Kern Council of Governments

The Kern Council of Governments (KernCOG) serves as both the Regional Transportation Planning Agency (RTPA) and the federally designated Metropolitan Planning Organization (MPO) for Kern County. KernCOG is one of eight single-county MPOs in the San Joaquin Valley (Valley) and includes the 11 incorporated cities of Arvin, Bakersfield, California City, Delano, Maricopa, McFarland, Ridgecrest, Shafter, Taft, Tehachapi, and Wasco. KernCOG is responsible for long range transportation planning for the County of Kern (County).

> *Kern County is the third largest county in the State.*

The KernCOG Board of Directors is comprised of one elected official from each of the 11 incorporated cities in the County, two County Supervisors and four ex-officio members representing Caltrans, the Golden Empire Transit District, and two military bases. The 2014 Regional Transportation Plan/Sustainable Communities Strategy (2014 RTP/SCS) was developed by KernCOG through collaboration with member jurisdictions, technical advisory committees, citizens, stakeholder groups and other government agencies. The RTP[1] is a long range plan which is updated every four years in accordance with federal requirements. KernCOG's 2014 RTP/SCS, adopted on June 19, 2014, is the first to include a Sustainable Communities Strategy (SCS)[2] as required by SB 375.

A. Planning Area

The following section discusses the planning context within which KernCOG developed the SCS.

San Joaquin Valley Context

The Valley is characterized by agricultural communities and urban areas predominantly located near the State Route (SR) 99 corridor, which runs north-south in the center of the region. There is heavy truck travel along the Interstate 5 (I-5) corridor, which runs along the western edge of the Valley and serves as a primary corridor for freight movement throughout the State.

The eight Valley counties (Fresno, Kern, Kings, Madera, Merced, San Joaquin, Stanislaus, and Tulare) account for about 11 percent of the population of California and collectively are more populous than 24 of the 50 states nationwide. By 2050, the Valley

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[1] An RTP is a federally required plan to finance and program regional transportation infrastructure projects, and associated operation and maintenance for the next 20 years.

[2] The SCS sets forth a forecasted development pattern for the region which, when integrated with the transportation network and other transportation measures and policies, will reduce the greenhouse gas emissions from automobiles and light trucks. It shall include identification of the location of uses, residential densities and building densities, information regarding resource areas and farmland.

is expected to account for about 15 percent of California's population. Table 1 identifies the eight Valley counties and their major cities.

Table 1: 2013 Populations of Valley Counties and Their Largest Cities

Valley County	County Population	Largest City	
		City	Population
Fresno	953,179	Fresno	508,994
Kern	861,164	Bakersfield	360,633
San Joaquin	701,745	Stockton	297,757
Stanislaus	523,038	Modesto	205,562
Tulare	456,037	Visalia	128,525
Merced	262,390	Merced	80,572
Madera	152,525	Madera	62,960
Kings	151,127	Hanford	55,122

Source: California Department of Finance's estimates for January 1, 2013 at: http://www.dof.ca.gov/research/demographic/reports/estimates/e-1/view.php

The residents of the Valley face challenges of poor air quality, high unemployment, and low average incomes. Most of the jobs across the eight-county Valley are in agriculture (12.0 percent), education, health and social services (21.5 percent), and retail trade (11.3 percent). The overall unemployment rate across the Valley counties is 15 percent, which is higher than the 11 percent State average. Educational levels for Valley residents lag behind California with only 24 percent of persons 25 years of age and older having a college degree, compared to 39 percent statewide. Related to these unemployment and education factors, the Valley's median annual household income of $45,000 is far below the State average of $58,000.

Kern County

Kern County is located at the southern end of the San Joaquin Valley and is the largest in size and second largest in population of the eight counties that make up the Valley (see Figure 1). It is also the third largest County in terms of size in the State of California but the 11th most populous. In addition to the 11 incorporated cities, Kern County has 41 unincorporated communities. The greatest concentration of the population is in Bakersfield, with many smaller communities in the western part of the County, especially near I-5 and SR 99. Vast distances separate small rural communities in the central and eastern portions of the County.

Figure 1: Kern County Context Map

There are over 900,000 acres of farmland in Kern County (outside city limits and city spheres of influence) which produced approximately $5 billion in revenue in 2011. In addition, Kern County is the number one oil producer in the State, accounting for 76 percent of the State's total oil[3]. It also boasts the world's largest borax mining operation and one of the first wind farms in California. There are two military bases – Edwards Air Force Base and Naval Air Weapons Center

According to the US Dept. of Agriculture Economic Research Service, Kern County was the top oil-producing county in the 48 contiguous states in 2011.

[3] 2014 RTP/SCS, page 4-18

China Lake – and eight correctional facilities, each with an inmate population of over 2,000. The fastest growing industries include transportation and logistics, in part due to the County's central location and year-round highway and rail access through the Sierra Nevada Mountain Range. Education and income levels trail behind California averages and for the last five years the unemployment rate has been over 10 percent, reaching almost 16 percent in 2010[4].

B. Current Land Use

Land use patterns in the Kern region are a result of the economic base, geography, and historical settlement patterns. Kern County's 8,161 square miles of land can generally be divided into three distinct areas based on topography, climate, and other environmental factors. These areas include the following:

- Valley Region of the County is within the southern San Joaquin Valley with an elevation below 1,000 feet mean sea level. Most urbanized areas are located in the Valley Region, including the City of Bakersfield.
- Mountain Region corresponds to the western-most and central portion of the County. It includes the Tehachapi Mountains, Greenhorn Mountains, Piute Mountains and the Cities of Tehachapi and Ridgecrest.
- Desert Region includes the eastern portion of Kern County including California City and the Edwards Air Force Base.

The County is primarily rural and sparsely populated outside the Metropolitan Bakersfield area. According to the 2010 Census, almost two-thirds of the County's 839,600 residents live in Metropolitan Bakersfield, which is located in central Kern County. Metropolitan Bakersfield is defined as the joint Kern County/Bakersfield General Plan Boundary and is approximately 1,600 square miles, or about five percent of the County's land area. The City of Bakersfield is the ninth largest city in the State of California and the only urban area[5] in Kern County. The next largest city, Delano, has a population of 53,041 and the remaining cities range in population from 1,000 to 28,000 residents. A little over one-third of the population lives in unincorporated County areas. Almost all cities (except Maricopa and Ridgecrest) experienced growth between 1990 and 2010. Figure 2 shows the distribution of the County's population in 2010.

[4] State of California, Employment Development Department not-adjusted annual unemployment rate 2010-2014.

[5] The U.S. Census defined urban areas as 50,000 or more people https://www.census.gov/geo/reference/ua/urban-rural-2010.html

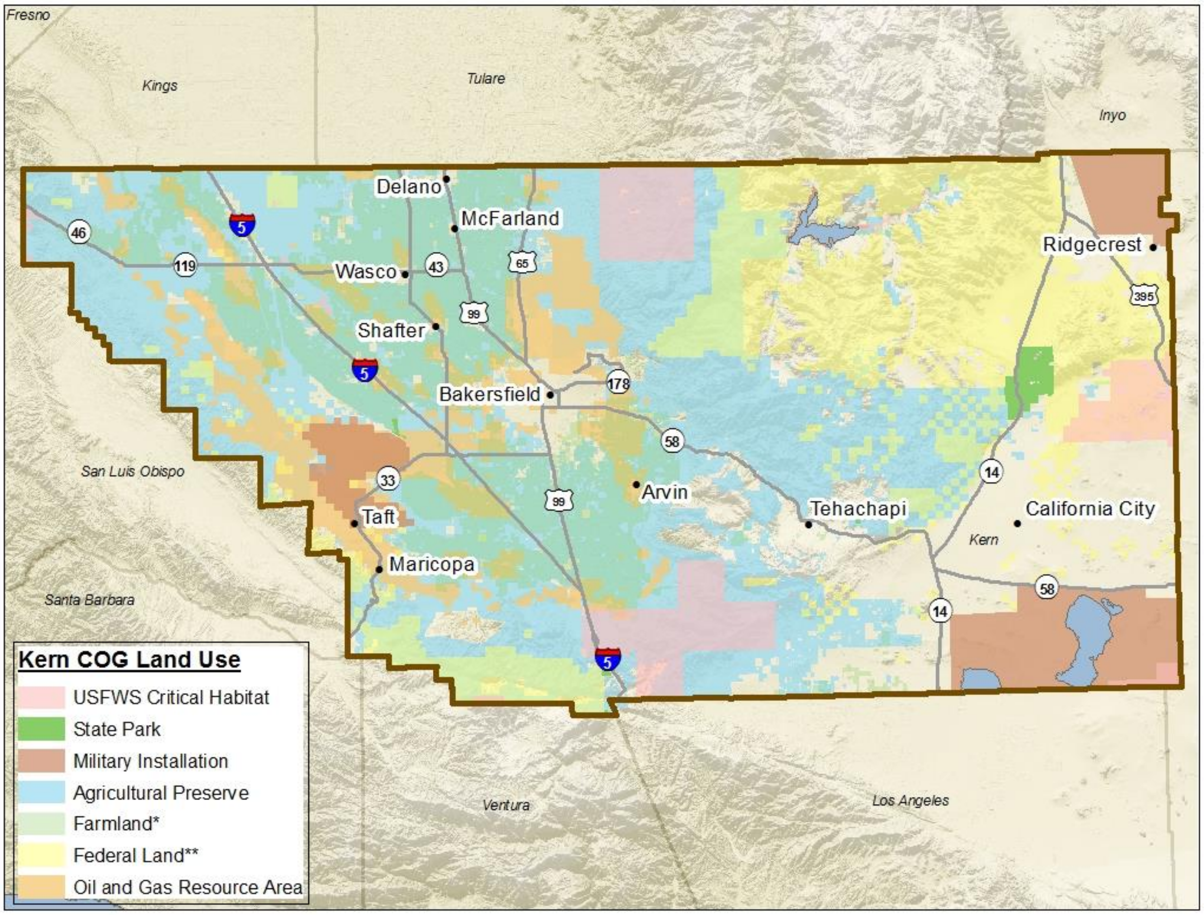
Figure 2: Kern County Population 2010

Before World War II, cities and towns in Kern County were more focused on walkability and streetcar accessibility; many of the communities today still have an urban core based on these concepts. Rapid suburban growth since WWII has led to a low-density development pattern with less focus on the urban core. Over the last two decades, almost all incorporated areas have experienced population growth, especially the cities of Tehachapi, California City, and Delano, which have more than doubled in size. Growth has also occurred in the unincorporated communities around Tehachapi and near the Los Angeles County/Kern County border in Rosamond and Frazier Park. In addition, recent commercial development has occurred at the Tejon Ranch Commerce Center near the Los Angeles/Kern County border.

Approximately 50 percent of the land in the County is used for agricultural and other natural resources, approximately 20 percent is under Federal or State ownership, and only about 30 percent of the land area is available for urban uses (see Figure 3). Public lands include the Naval Air Weapons Center China Lake, which is the U.S. Navy's largest single land holding[6], and several State and National Parks.

[6] Kern County Bike Plan, page 15

Figure 3: KernCOG Federal, State, and Resource Areas



*Farmland includes Prime, Statewide Importance, Unique, and Local Importance
**Federal Land includes National Forest, Bureau of Land Management, and Wilderness Act Areas

Kern's primary industries include agriculture, warehousing, oil production, wind farms, power plants, and correctional facilities. These employment centers generally take up large areas of land that are typically situated distant from residential development. Table 2 below describes the top ten employment industries for Kern County; almost 23 percent of the total employees work in agriculture or natural resource extraction[7]. This contributes to a dispersed employment base, with most of the County's job centers located in rural areas where these resources are located.

[7] Mining, Quarrying, and Oil/Gas extraction is ranked number 11 and includes 4% of the job share

Table 2: Kern County Employment: Top 10 Industries in 2013

Jobs by NAICS Industry Sector	Job Share
Agriculture, Forestry, Fishing and Hunting	19%
Health Care and Social Assistance	11%
Educational Services	9%
Retail Trade	8%
Accommodation and Food Services	7%
Construction	6%
Public Administration	6%
Manufacturing	5%
Professional, Scientific, and Technical Services	5%
Administrative, Support and Waste Management Services	5%

Source: U.S. Census Bureau. 2013 Average Quarterly Workforce Indicators Data. Longitudinal-Employer Household Dynamics Program.

C. Existing Transportation System

Kern's transportation system serves as a major corridor through the Valley and the State. The transportation network consists of freeways, highways, local roadways, transit, and bicycle/pedestrian facilities.

Roads

Kern County has approximately 14,500 miles of freeway and general purpose lanes. I-5 is the major north-south freeway that starts at the Mexican border and ends at the Canadian Border. SR 99 is another north-south connector that begins in Kern County at the City of Bakersfield, and travels north through Fresno and on to Sacramento. East-west traffic is served via State Routes 58 and 46.

The roadway system is critical to Kern's economic base providing transportation for the agricultural, oil and gas, and mineral extracting industries throughout the region. According to Kern County's General Plan, truck travel makes up approximately 20 to 30 percent of all vehicle miles traveled; this is much higher than the State average of 10 percent.

Transit

Public transportation in Kern County is provided by Amtrak, Greyhound, and local public agencies. Two operators, Golden Empire Transit (GET) and Consolidated Transportation Service Agency (CSTA), operate services specifically in the Metropolitan Bakersfield area. Kern residents are also afforded public transportation services to areas outside the County by other operators in the Valley, such as Tulare County Transit, Inyo-Mono Transit, Metrolink, Antelope Valley Transit Authority, and Santa Clarita Transit. In addition, Union Pacific and Burlington Santa Fe provide commercial rail service supporting freight movement throughout the region and beyond.

Public transit served almost 8 million passengers between 2009 and 2010.

Kern County is unique in that local jurisdictions are not required to contribute to the cost of providing intercity transit services. Currently, no local dedicated funding source is available for public transit. A one-half cent countywide sales tax ballot issue for highway and transit improvements failed in November 2006.

Amtrak

Amtrak provides passenger rail and bus service in the Kern region with stations located in the Cities of Bakersfield and Wasco. Bakersfield is the end of the line for Amtrak trains and also a transfer point for individuals traveling to Southern California and Nevada. There are six round-trip trains daily. In fiscal year 2010/2011, the Bakersfield station served almost 500,000 passengers. Bakersfield is the second busiest Amtrak station on the San Joaquin route, with Sacramento being the first.

Kern Regional Transit

Kern Regional Transit is a division of the Kern County Roads Department and has provided service since 1981. Kern Regional Transit operates 17 fixed transit routes and Dial-A-Ride services. It provides service between and in the rural communities throughout Kern County serving both incorporated[8] and unincorporated[9] areas. Connections to Metrolink rail service in Lancaster (Los Angeles County) are also available from several cities.

In 2002, Kern Regional Transit joined with the Eastern Sierra Transit Authority to offer CREST (Carson Ridgecrest Eastern Sierra Transit) which provides service from Ridgecrest to areas along US 395 and SR 14, including Lone Pine, Independence, Bishop, and Mammoth. CREST provides linkage to existing public and commercial transportation services serving Kern, Los Angeles, Inyo, and Mono counties mentioned above. Demand-response services are also offered for several smaller cities as well as connections to transit agencies outside Kern County. Intercity service to Bakersfield with connections to Greyhound and Amtrak are also available.

CalVans

According to a recent transit study[10] conducted for the Valley, vanpools were found to be a practical and cost effective way to address transit needs in rural areas. CalVans is a public vanpool service that serves areas throughout Central California. CalVans became a participating member of the KernCOG Board in July 2012 and KernCOG is a member agency of the CalVans Board. CalVans operates 65 vanpools throughout Kern County resulting in a reduction of 1.7 million vehicle miles traveled for the year 2013[11].

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[8]Deland/McFarland/Wasco/Shafter/Bakersfield; Lamont/Bakersfield, Lake Isabella/Bakersfield; Frazier Park/Bakersfield; California City/Mojave/Rosamond/Lancaster/Palmdale; Los Hills/Bakersfield; and Taft/Bakersfield.

[9]Buttonwillow, Lamont, Kern River Valley, Fraizer Park, Rosamond, and Mojave

[10]San Joaquin Valley Express Transit Study, 2009

[11] KernCOG 2014 RTP/SCS, page 5-119

Golden Empire Transit District

Golden Empire Transit (GET) has provided public transit service for the Metropolitan Bakersfield area for over 40 years. GET operates 16 fixed routes with a fleet of 88 buses[12]. The GET service area covers 160 square miles and serves almost 500,000 residents. GET had ridership of slightly over seven million passengers for fiscal year 2011/2012. It also provides complimentary paratransit service within Metropolitan Bakersfield under the program "GET-A-Lift" for individuals not physically able to use fixed-route service.

The GET Long Range Transportation Plan aims to create a more straightforward and understandable route system with faster cross-town trips throughout Metropolitan Bakersfield. In the short-term, this plan calls for a reconfiguration of the GET's fixed-route network adding two rapid routes with buses running every 15 minutes as well as two crosstown routes with 30 minute headways. New express routes and wider spacing of stops are also proposed. This will provide the foundation for the Rapid Bus network through the core area of Bakersfield. Mid-term goals for GET include expansion of the rapid bus network and implementation of a Bus Rapid Transit (BRT) System. The long-term goals include expanding the transit system further and decreasing headways throughout the system. Portions of this system may also become the foundation for the future light rail system in Metropolitan Bakersfield.

The Long Range Transportation Plan was being implemented before the 2014 RTP/SCS was adopted and several of the short-term goals have already been realized. The transportation system has been reorganized to include the rapid routes and crosstown routes mentioned earlier providing Metropolitan Bakersfield with high-quality transit areas[13].

Consolidated Transportation Service Agency (CSTA)

The North of the River Recreation and Park District (a Special District under section 5780 of the California State Code) was designated a Consolidated Transportation Service Agency in 1999. This agency uses State and Federal funds to purchase, maintain, and operate vans and buses for elderly and disabled community members.

CSTA ridership has increased by almost 70 percent in the last four years.

The Consolidated Transportation Service Agency provides door-to-door service within Metropolitan Bakersfield. Transportation services are available weekdays on a demand-response basis for essential trips such as medical appointments, grocery shopping, and senior activities. A small fee is charged for each one-way trip. The agency underwent a series of service improvements, such as wheelchair accessibility, in 2004 to improve ridership. Over the past four years ridership has increased almost 70 percent and experiences a 15 percent farebox return (a minimum of 10 percent is required for State funding).

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[12] http://www.getbus.org/about/

[13] A high-quality transit area is defined as the area within one-half mile of fixed route transit service with 15-minute headways or less during peak hours.

City Operators
Currently, nine cities (not including Bakersfield and Maricopa) operate dial-a-ride services and two of those, Delano and Taft, also operate fixed-route transit service. Delano Transportation, operated by the City's Transportation Services Department, operates and manages the Delano Area Rapid Transit (DART) fixed route and dial-a-ride services for travel within the City and surrounding unincorporated areas. DART has four fixed-routes with total annual boardings of approximately 150,000[14]. Taft Area Transit[15], operated by the City of Taft, offers two fixed routes within the City and one fixed route between Taft and Maricopa.

Active Transportation
Active transportation includes bicycle and pedestrian facilities and infrastructure. Travel by bicycle is possible almost year-round in Kern County due to the moderate climate and relatively flat topography in urbanized areas. GET and Kern Regional Transit operate buses equipped with front loading bicycle racks. As of 2008, the Kern region had 288 miles of bicycle lanes and pedestrian trails. The County is responsible for bike facilities planning and development for the unincorporated areas of Kern County. Cities are responsible for bike facilities planning within their respective incorporated areas.

> *The Kern River Parkway, at approximately 32 miles, is the longest bike and pedestrian pathway in the County.*

Bicycle facilities are divided into three categories, Class I, Class II, and Class III. Class I bicycle facilities are paved rights-of-way for exclusive use by non-motorized modes of travel. Class I designed facilities are found in the cities of Bakersfield, Ridgecrest, Tehachapi, Wasco and portions of unincorporated Kern County. Class II bike lanes are defined by pavement striping and signage that designates a portion of a roadway for bicycle travel. The majority of the bike lanes in the Kern region are designed as Class II. Class III bike facilities do not have pavement markings but bicycle routes are clearly marked or signed. Kern County has a variation of Class III for rural areas that includes a four-foot delineated shoulder that is signed for bicycle use.

D. SCS Foundational Policies

Development of the 2014 RTP/SCS began in 2011, building on the region's earlier efforts to establish more sustainable planning policies through the Kern and Valley Blueprints, described below. The planning and development process involved taking account of the current land use and regulatory environment of the County, gathering public and stakeholder input on a vision for the future, and creating alternative growth scenarios to illustrate options for the future of the Kern region through 2040.

[14] http://www.cityofdelano.org/index.aspx?NID=184
[15] http://www.cityoftaft.org/docview.aspx?docid=11963

This section describes the planning context within which the 2014 RTP/SCS was developed and the process through which a final plan was formulated and adopted.

Kern Regional Blueprint

In 2008, KernCOG established a vision, guiding principles, and an alternative growth scenario for the region known as the Kern Regional Blueprint. The Kern Blueprint was informed by a public input process that included over 34 public meetings, several roundtables, and two quality of life phone surveys administered by Price Research (2007 survey) and Godbe Research (2008 survey). The phone surveys gathered information on public attitudes and perceptions regarding the quality of life in their city or town.

The Kern Regional Blueprint Guiding Principles include:

- Enhance Economic Vitality
- Conserve Energy and Natural Resources
- Provide Adequate and Equitable Services
- Provide a Variety of Transportation Choices
- Provide a Variety of Housing Choices
- Use/Improve Existing Community Assets and Infrastructure
- Use Compact, Efficient Development and/or Mixed Land Uses (where appropriate)
- Conserve Undeveloped Land
- Increase Civic and Pubic Engagement

The Blueprint was adopted in November 2008 and is based on the public input process, county and cities' local general plans, and the centers concept (described below) identified in the 1990's. It contains a conceptual map that depicts a more compact urban form for the region, including village centers, town centers, community centers, and a metro center, as well as employment centers. Additional surveys were conducted after adoption of the Blueprint plan to inform the 2014 RTP/SCS process.

San Joaquin Valley Regional Blueprint

The San Joaquin Valley Regional Blueprint (Valley Blueprint) combines the Kern Blueprint with the seven other county blueprint efforts in the Valley. The Valley Blueprint was adopted in 2009 by the San Joaquin Valley Regional Policy Council and identified 12 voluntary growth principles. These growth principles are consistent with those found in the Kern Blueprint. The Valley Blueprint growth principles are as follows:

- Create a range of housing opportunities and choices
- Create walkable neighborhoods
- Encourage community and stakeholder collaboration
- Foster distinctive, attractive communities with a strong sense of place
- Make development decisions predictable, fair, and cost-effective
- Mix land uses
- Reserve open space, farmland, natural beauty, and critical environmental areas

- Provide a variety of transportation choices
- Strengthen and direct development toward existing communities
- Take advantage of compact building design
- Enhance the economic vitality of the region
- Support actions that encourage environmental resource management

KernCOG SB 375 Framework
KernCOG's Regional Planning Advisory Committee (RPAC) developed a framework for the 2014 RTP/SCS that builds upon the Valley and Kern Regional Blueprints and the centers concept (see below). The framework included four core values and several action items that later became the foundation for the 2014 RTP/SCS. The four core values include:

- The Sustainable Communities Strategy relies on the existing and planned circulation networks and land use designations for Kern County and its incorporated cities.
- The Sustainable Communities Strategy shall not hinder the local land use authority of Kern County and its incorporated cities.
- The Sustainable Communities Strategy shall allow Kern County and its incorporated cities to continue the pursuit and promotion of a diversified economic base.
- Kern County shall continue to discuss cooperation and coordination with the seven other counties located in the Central San Joaquin Valley, while recognizing the Kern region's unique qualities and developing appropriate strategies for Kern County.

Metropolitan Bakersfield General Plan Centers Concept
In 1992, the Metropolitan Bakersfield General Plan Centers Concept was adopted and became the guiding principle for existing and future development in the Metropolitan Bakersfield area. The centers concept is defined as a "land use pattern consisting of several concentrated mixed-use commercial and high density residential centers surrounded by medium density residential uses" (2002 Bakersfield GP, II-2). Single-family residential uses are located between the centers encouraging residents to live and work in the same area. In 2008, this concept was incorporated into the Kern Regional Blueprint Conceptual View maps. This centers concept provided a foundation for the land use and transportation strategies discussed in the Kern Regional Blueprint and the 2014 RTP/SCS.

Local General Plans and Sustainability Plans
Several cities have adopted plans and policies that are consistent with the sustainable communities principles of the SCS. The cities of Bakersfield and Tehachapi have established a development impact fee system that rewards infill development in designated core areas with density bonuses and discourages sprawl development through higher fees.

Many of the smaller cities in the County such as Maricopa, Delano, Ridgecrest, Taft, and Tehachapi have also incorporated sustainable community principles into their general plans by encouraging infill and mixed-use development, and discouraging urban sprawl. The City of Maricopa is planning for more compact development and the City of Delano added a new "Health and Sustainability Element" to its general plan. The City of Taft incorporated emission reduction policies in its general plan and the City of Delano has adopted a Climate Action Plan.

In addition, both the County and City of Bakersfield have adopted active transportation plans that are complementary. In 2012, Kern County adopted a Bicycle Master Plan and Complete Streets Recommendations and in 2013 the City of Bakersfield adopted a Bicycle Transportation Plan. All 11 cities in Kern County have completed bike plans or are in the process of developing one.

Farmland Preservation

Agricultural resources are an integral part of Kern County's economy and some of the most productive farmland in the State is located here. In addition to statewide efforts to conserve farmland, such as the Williamson Act of 1965[16] and Farmland Security Zones[17], KernCOG supports the use of easements and private land use agreements to protect agricultural lands. As of 2012, almost 1.7 million acres of land was protected under Williamson Act contracts or designated as a Farmland Security Zone[18]. In addition, KernCOG currently has eleven land trusts in operation which preserves thousands of acres of land.

Habitat Conservation Plans

Habitat conservation plans establish protection for sensitive wildlife habitat and endangered species by identifying potential impacts and proposing minimization and/or mitigation strategies. Land set aside for conservation through such plans is not available for urban development.

There are three habitat conservation plans in the County. The Metropolitan Bakersfield Habitat Conservation Plan was first developed in 1992 and an update is currently under development which will result in a combined Valley Floor Habitat Conservation Plan and

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[16] The California Land Conservation Act of 1965--commonly referred to as the Williamson Act--enables local governments to enter into contracts with private landowners for the purpose of restricting specific parcels of land to agricultural or related open space use. In return, landowners receive property tax assessments which are much lower than normal because they are based upon farming and open space uses as opposed to full market value (http://www.conservation.ca.gov/dlrp/lca/Pages/Index.aspx).

[17] A Farmland Security Zone is an area within an agricultural preserve with a contract between a private landowner and a county that enforceably restricts land to agricultural or open space uses. The minimum initial term is 20 years. It offers greater tax reduction than that of the Williamson Act. http://www.conservation.ca.gov/dlrp/lca/farmland_security_zones/Pages/index.aspx#what is a farmland security zone

[18] The California Land Conservation Act 2014 Status Report: http://www.conservation.ca.gov/dlrp/lca/stats_reports/Documents/2014%20LCA%20Status%20Report_March_2015.pdf

a new Metropolitan Bakersfield Habitat Conservation Plan. In addition, the U.S. Fish and Wildlife Service's habitat conservation plan for Chevron's North American Exploration and Production Unit in the Lokern area and the California Department of Fish and Game's habitat conservation plan for the Elk Hills Oil and Gas Field protect habitat within mineral exploration areas.

Regional Housing Needs Assessment
A Regional Housing Needs Assessment (RHNA) is a county-level housing accommodation target set by the California Department of Housing and Community Development (HCD) to ensure that local governments adequately plan to meet current and future housing needs of the population according to income groups. KernCOG received its RHNA allocations for the 2013-2023 housing element cycle and was engaged in this process concurrently while developing the RTP/SCS. The different projection period cycles of RHNA and the SCS (11 years and 27 years, respectively) prevent direct comparisons, as does the difference in the way that RHNA distributes housing by political jurisdiction whereas the SCS distributes housing by geographic area. In June 2014, the KernCOG Board of Directors adopted the final 2013-2023 Regional Housing Needs Plan, accommodating the number of housing units required by HCD, and detailing the total number of housing units for which each city and the county must plan.

E. Public Outreach Process

KernCOG's public participation process was branded "Directions to 2050" and included an interactive website and two public outreach cycles. Cycle 1 included two stakeholder roundtable meetings and 16 community workshops between March and July of 2012. Cycle 1 was designed to solicit input from stakeholders and community members on priorities for the region's future. In the roundtable meetings, stakeholders provided input related to energy efficiency, energy use reduction, and implementing various regional and local plans. The community workshops provided an opportunity for community members to review and prioritize the Blueprint Principles for Growth.

KernCOG's Public Participation Plan was recognized as a national best practice by the Federal Highway Administration.

Cycle 2 was conducted from August 2012 to October 2013 and attracted over 4,000 participants. This series of meetings and events provided an opportunity for community members to identify their transportation project priorities for the future and obtain general information about the 2014 RTP/SCS process. Cycle 2 included four festivals, three stakeholder meetings, 11 community meetings, and 21 presentations to City council and County representatives. The community meetings focused on the relationship between the Blueprint Principles for Growth and the 2014 RTP/SCS. During these meetings, Cycle 2 participants identified several priorities for the Kern Region with the top two being (1) maintain local streets and roads, and (2) increase bicycle lanes, pedestrian paths, and sidewalks.

The Directions to 2050 website was an interactive webpage and served as a community and educational tool for the public outreach process. The website included the following content and features: resources page, contact page, media page, interactive online activity, and survey. The website allowed the public to participate in an online survey regarding quality of life for the region and an online game "How Would You Improve Your Community?" to help participants understand how different transportation spending scenarios impact the regional transportation budget.

KernCOG spent almost two years conducting public outreach for the 2014 RTP/SCS beginning with community phone surveys in January of 2012 and concluding with a final outreach presentation in October 2013. KernCOG's Public Participation Plan reached over 5,000 participants and was recognized as a national best practice by the Federal Highway Administration.

F. 2014 RTP/SCS Development

The 2014 RTP/SCS is an update of the previous RTP adopted in 2011 (prior plan). This is KernCOG's first RTP to include an SCS. Seven goals were identified for this plan through a public process: mobility, accessibility, reliability, efficiency, livability, sustainability, and equity. While all goals are important, KernCOG considers mobility its highest priority. The following section describes the 2014 RTP/SCS development process.

1. Regional Growth Forecast

Demographic and socioeconomic growth forecasts help KernCOG plan for the number of people living, working, and traveling in the Kern region within the plan's 26-year timeframe. These forecasts are fundamental to the development of the transportation and land use scenarios. For KernCOG, the regional growth forecast is updated every three to five years. Total population numbers (i.e., growth controls) are approved by the KernCOG Board of Directors and growth distribution is approved by the Transportation Modeling Committee.

In October of 2009, KernCOG adopted the Regional Growth Forecast to be used for the 2014 RTP/SCS planning process. This forecast used the most recent Department of Finance Projections (2007) and estimates (2008). After adoption in 2009, the regional growth forecast was compared to the Planning Center's 2012 forecast for the eight Valley COGs as well as the Department of Finance's 2011 Interim Report, and was found to be reasonable. In addition, after release of the 2010 Census, KernCOG performed a checkpoint analysis and compared the regional growth forecast with the 2010 Census information; the difference was less than half a percentage point.

2. Performance Measures

KernCOG used 11 performance measures to evaluate whether the 2014 plan met the seven goals for the region. The performance measures provide information on how well the transportation system is performing compared to the plan's 2008 base year, countywide averages, or a no project baseline. They also identify opportunities for system improvements and assessment of system-wide impacts of future improvements using the Kern Regional Transportation Model. Table 3 lists the 11 performance measures and corresponding goals.

Table 3: 2014 RTP/SCS Performance Measures

Performance Measure	RTP Goal
Average Travel Time	Mobility
Average Travel Time to Job Centers	Accessibility
Average Level of Congestion	Reliability (congestion)
Annualized Accident Statistics	Reliability (safety)
Daily Investment per Passenger Mile Traveled	Efficiency
Average Trip Delay Time	Livability
Percentage Change NOx/PM	*Environment/Health**
Percentage Change in Households within ¼ mile of Roadways with Volumes Greater than 100,000 per day	*Environment/Health**
Percentage Change in Maintenance Dollars Per Lane Mile	Sustainability
Percentage of Expenditures versus Passenger Miles Traveled in 2035 (highways and transit)	Equity
Percentage of Farmland outside City Spheres of Influence	*Land Consumption**
*This is a general performance measure category and is not specifically associated with one of the seven 2014 RTP/SCS goals.	

KernCOG used the Caltrans' Smart Mobility Framework[19] and the KernCOG Environmental Justice Analysis[20] as the foundation for the 2014 RTP/SCS performance measures. The Environmental Justice measures have been in place since 2001 and have been adapted for use with the 2010 Smart Mobility Framework performance measure categories.

3. Transportation Project Selection

Whereas the above performance measures look at system-wide performance, the following describes how individual projects were evaluated for inclusion in the 2014 RTP/SCS. In preparation for development of the 2014 plan, KernCOG updated its project selection process to better reflect concepts from the Kern Regional Blueprint and the KernCOG SB 375 framework. The RTP list of projects includes transportation

[19] Consistent with the Caltrans *Smart Mobility 2010: A Call to Action for the New Decade* planning guide
[20] Consistent with Federal Title VI of the 1964 Civil Rights Act and Executive Order 12898

projects from five funding programs[21] administered by KernCOG. In 2012, KernCOG modified two of the five funding programs' evaluation criteria to give greater priority to projects that reduce vehicle miles traveled (VMT) and/or promote livable communities and transit oriented development. KernCOG also updated the evaluation criteria to better leverage additional and new funding sources that will allow larger scale projects to better compete for State and federal discretionary funds. The remaining three funding programs were not modified because they were already consistent with KernCOG's sustainability and RTP goals.

KernCOG revised its project evaluation criteria to promote livable communities and transit oriented development.

The Transportation Technical Advisory Committee (TTAC) developed a preliminary project list for the 2014 Draft RTP/SCS that was based on the 2011 RTP. In addition, the 11 KernCOG member agencies submitted transportation projects to the TTAC that are expected to be completed within the RTP timeframe. The TTAC then evaluated and ranked each of the projects using the funding program criteria mentioned above. The evaluation included expected performance and impacts in the following areas:

- VMT Reduction
- Emissions Reduction
- Livability
- Congestion Relief
- Cost-Effectiveness
- Safety
- Sustainability/State of Good Repair
- Economic Well-Being

This ranked project list was then compared to possible revenue scenarios which demonstrated that it was possible to financially constrain all projects submitted for inclusion in the 2014 RTP/SCS. The draft plan was then released for public comment, and based on stakeholder input, the TTAC revised the project list to include projects in the Golden Empire Transit Plan and recently approved bicycle plans for Kern County and the City of Bakersfield. This revised project list was used to generate modeling results for the scenarios during the public input process that occurred throughout 2012-2013. The final project list was adopted by the KernCOG Board in June 2014, as part of the adoption of the 2014 RTP/SCS.

4. Alternative SCS Scenarios

In developing the 2014 RTP/SCS, KernCOG used an iterative process to analyze and compare numerous potential scenarios over the course of two years involving multiple

[21] The Five Funding Programs are: (1) Regional Transportation Improvement Program (RTIP), (2) Regional Surface Transportation Program (RSTP), (3) Congestion Mitigation and Air Quality (CMAQ), (4) Transportation Enhancements (TE), and (5) Transportation Development Act (TDA)

rounds of public engagement and stakeholder input. A preferred plan scenario was not selected until final adoption of the 2014 RTP/SCS. The first three scenarios listed below were pared down from a larger set of 12 scenarios developed by the RPAC in 2012. An additional two scenarios representing intensification of housing development in the Metropolitan Bakersfield area were added in the summer of 2013. KernCOG analyzed and publicly presented over 25 variations of these five scenarios at workshops and hearings.

Scenario 1 (Old Plan): Scenario 1 is also considered the Baseline Alternative. This Scenario is based on transportation planning assumptions from the 2011 RTP's list of financially constrained projects. These projects incorporate modest improvements to transit and active transportation infrastructure. Growth is expected to continue at a rate consistent with the last several decades. The growth pattern is concentrated primarily on the periphery of Metropolitan Bakersfield and has the largest development footprint of all five scenarios. This scenario assumes approximately 21 percent of new housing growth will be in the form of multi-family, townhomes, and small-lot housing for Metropolitan Bakersfield.

Scenario 2 (Preliminary Plan): This scenario includes assumptions from the 2011 RTP list of financially constrained projects but also includes new investments for highway maintenance, transit, and active transportation infrastructure. Transit investments are based on recommendations of the Golden Empire Long Range Transit Plan and the Kern Commuter Rail Study. This scenario also accelerated investments in highway maintenance, transit, and active transportation infrastructure as compared to Scenario 1. The growth pattern reflects adopted plans and policies that were developed and/or adopted after the 2011 RTP. This scenario assumes approximately 56 percent of new housing growth will be in the form of multi-family, townhomes, and small-lot housing for Metropolitan Bakersfield.

Scenario 3 (Intensified Transportation): This scenario uses the transportation planning assumptions and a preliminary plan list of financially constrained projects but intensifies investment in transit and active transportation infrastructure and concentrates development in the County's urban area. Transit, bike, and pedestrian projects planned for 2035 would be implemented by 2020 and projects expected to be completed in 2040 would be implemented by 2035. This scenario assumes approximately 73 percent of new housing growth will be in the form of multi-family, townhomes, and small-lot housing for Metropolitan Bakersfield.

Scenario 4 (33 Percent Housing Mix): This scenario further changes the mix of new housing in Metropolitan Bakersfield and assumes 33 percent of new housing as high density, 33 percent as medium density, and 33 percent as low density. This scenario assumes approximately 67 percent of new housing growth will be in the form of multi-family, townhomes, and small-lot housing for Metropolitan Bakersfield. The transportation network would be the same as in Scenario 3.

Scenario 5 (100 Percent Infill): This scenario assumes all new growth would be accommodated as infill development with 98 percent of housing as multi-family, townhomes, and small-lot housing for Metropolitan Bakersfield. Countywide, the housing mix would average about two-thirds medium or high density. The transportation network would be the same as in Scenario 3.

Scenario 1 was not selected because it did not meet the Clean Air Act requirements. Scenario 3 was not selected because it requires additional bonding or other funding mechanisms, such as a mileage based user fee, that are not expected to be in place during the planning period. Scenarios 4 and Scenario 5 were not selected because these scenarios would have greater impacts on existing infrastructure for local communities, especially the City of Bakersfield, that are unnecessary in order to achieve the greenhouse gas emission reduction targets. In addition, Scenarios 3, 4, and 5 assumed housing preferences that were not supported by the local communities according to the survey data. These scenarios could become more viable options in the future if funding and housing market assumptions change.

5. Adopted Plan Scenario

Based on public outreach and modeling results, KernCOG selected Scenario 2 “Preliminary Plan” as the 2014 RTP/SCS Plan Scenario. This scenario reflects the housing allocation shown in Table 4. In selecting this as the preferred scenario, KernCOG made one modification to the project list by postponing the South Beltway, a major highway project, until after 2040.

Table 4: Plan Scenario New Growth Housing Allocation

	Infill	Multi-Family	Small Lot/Townhome	Large Lot
Metropolitan Bakersfield	21%	23.3%	32.3%	44.4%
Countywide	N/A	17.8%	24.3%	57.9%
Source: EIR Table 5.0-1				

In Metropolitan Bakersfield, over half (56 percent) of the new housing growth is assumed to be multi-family or small lot/townhome development. Infill development would be concentrated in transit oriented development and infill sites identified in the Golden Empire Transit District Long Range Transit Plan. Compared to 2005, the Plan Scenario shows a 16.6 percent decrease in per capita greenhouse gas emissions by 2035.

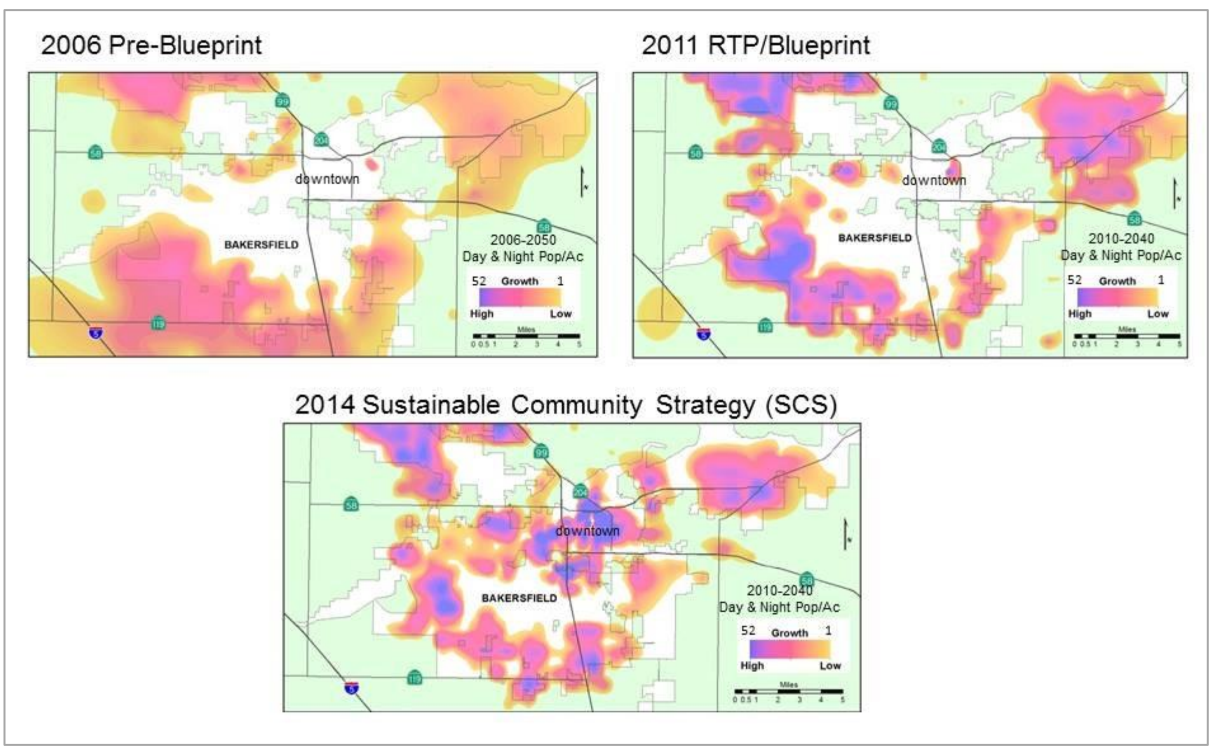
G. 2014 RTP/SCS Strategies

Consistent with the requirements of SB 375, KernCOG’s SCS intends to provide a foundation for the integration of land use policies with transportation system planning while minimizing negative impacts on natural resources and developed open space. These strategies will promote more compact infill development in existing urban areas and accelerated investments in transit and active transportation. These strategies would lead to a smaller development footprint than business as usual, and increased connectivity throughout the region. The following sections describe the land use and transportation strategies that underlie KernCOG's 2014 RTP/SCS.

1. **Land Use Strategies**

The RTP/SCS encourages population growth in existing urban areas and along transportation corridors in the form of transit oriented development. Approximately 65 percent of the population growth by 2035 is anticipated in Metropolitan Bakersfield, 20 percent would occur in the other 11 cities and 18 percent in unincorporated areas. The RTP/SCS would increase population density near transit, employment centers, and shopping areas and shift new housing development from single family homes on large lots to small-lot and multifamily housing by 2040. By 2040, the Metropolitan Bakersfield area would become substantially more dense. Figure 4 displays the forecasted development pattern for new growth in the Metropolitan Bakersfield area between 2006 and 2014 illustrating the shift to a more compact urban form.

Figure 4: Metropolitan Bakersfield Forecasted Development Pattern



Note: Population per acre figures are by analysis zone for growth only and exclude existing development

The RTP/SCS anticipates that approximately 33,000 households (about 20 percent of new development) will be added to infill areas in Metropolitan Bakersfield by 2040. Two-thirds of new development in the Metropolitan Bakersfield area will be in the form of multi-family and small-lot homes. This will increase the overall percentage of medium and high density housing in Metropolitan Bakersfield from 24 percent in 2008 to 39 percent by 2040. On a regional basis, this percentage will increase from 17 to 29 percent.

The RTP/SCS would increase the number of households and employment with close proximity to transit. In 2008, KernCOG had only 5,000 households and 5,600 jobs located within one-half mile of a high-frequency transit station or stop (defined as transit with 15 minute headways or less). The RTP/SCS anticipates an increase of over 250,000 households and 200,000 jobs with access to high-frequency transit by 2040. In addition, the number of households within one-half mile of any transit station will increase from 41,000 to approximately 282,000 and employment will increase from 40,000 to approximately 378,000. This means the region will experience approximately 62 percent of total housing and 75 percent of total jobs within one-half mile of a transit station by 2040.

The RTP/SCS includes local land use policies that would reduce pressure to convert agricultural land to urban uses. Over the plan's 26-year planning period, KernCOG forecasts a conversion of 19,961 acres of farmland. Of this amount only 914 acres (approximately 5 percent) would be converted to urban uses by 2040; the remainder will no longer be used for farming due to lack of water availability and/or habitat conservation. This is significantly less than the approximately 150,000 acres that were converted over the 22-year period between 1988 and 2010. Table 5 shows the forecasted agricultural land consumption in 2020, 2035, and 2040 as a result of urbanization.

About 700 acres of farmland would be converted to urban uses by 2035.

Table 5: Farmland Consumption for New Development (2010 to 2040)

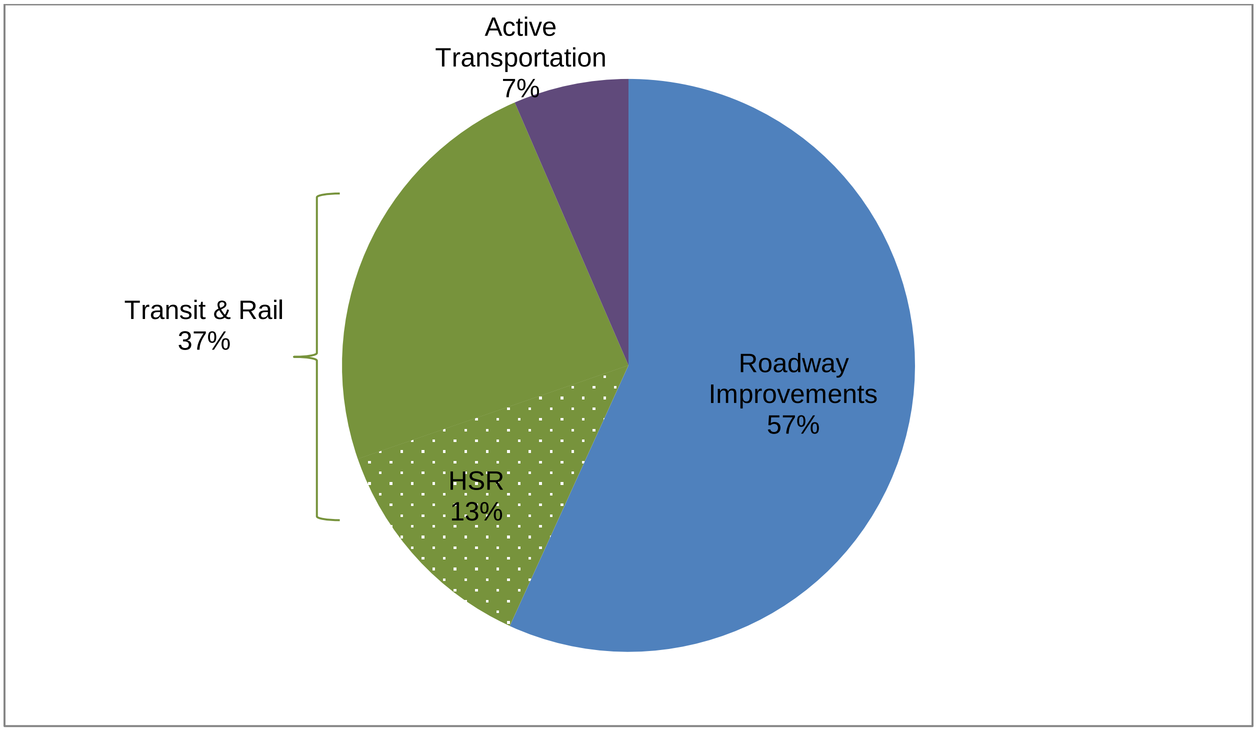
	2008	2020	2035	2040
Total Acres within the County	5,227,647			
Total Farmland Acres	803,533	784,325	783,763	783,572
Farmland Converted to Urban Uses (Acres)	N/A	289	723	914
Source: KernCOG Data Table				

2. Transportation Strategies

The Kern region experiences a "reverse commute" with workers generally traveling from population centers, namely Metropolitan Bakersfield, to employment centers in rural areas. This reverse commute indicates that residents located on the urban fringe may actually have a shorter commute but require more driving to reach services and amenities such as shopping. KernCOG is attempting to address this issue in the plan through transportation strategies focused on rural areas and overall connectivity.

The plan's financially constrained project list is based on an overall budget of $7.4 billion through 2040. The transportation strategies are focused on increasing access to and availability of transit and active transportation throughout the region, which is reflected in the significant increase in funding for transit and active transportation and a decrease in funding for roadway improvements, compared to the prior plan (see Figure 5). KernCOG has allocated funding for California High-Speed Rail (HSR), described below in the transit section. In addition, funding is provided for transportation demand measures such as the first high-occupancy vehicle (HOV) lanes and HOV ramp meters in the region to facilitate carpooling.

Figure 5: Distribution of RTP Expenditures by Project Category



Streets and Roads

The 2014 RTP responds to the public's priority to maintain existing roads by investing approximately 57 percent of the budget for roadway improvements. This includes maintenance and operational improvements, such as new interchanges and grade separations, for highways, local streets and roads. The 2014 RTP/SCS delays construction of a major highway project that was intended to increase capacity and improve east-west circulation in the Metropolitan Bakersfield area.

Many of the region's residents currently travel by carpool (vehicles that have two or more passengers), constituting slightly over 50 percent of all passenger vehicle trips. The operational improvement project list consists of high-occupancy vehicle (HOV) ramp metering and the addition of an HOV lane on two State routes to accommodate increased carpooling. These two HOV lanes will be the first for the Kern region. HOV ramps and meters are also proposed for several interchanges to help facilitate highway entry. Ramp metering will also be implemented, where appropriate, as part of KernCOG's transportation system management to maximize the efficiency of existing and future transportation facilities. This also includes the Kern 511 travel information system and improving traffic signalization and synchronization to reduce travel times and promote free-flow travel speeds.

Transportation Demand Measures

KernCOG incorporated transportation demand management strategies in the plan to reduce the need for single-occupancy vehicle travel. KernCOG will continue to promote carpooling, vanpooling, telecommuting, and teleconferencing through use of the existing online tool "Commute Kern". It provides customer service upon request from the general public, employers, colleges, vanpool operators, and other agencies and the media regarding ridesharing opportunities. KernCOG will continue to improve and promote the online tool to help expand the carpooling network.

In addition, the plan proposes to build and maintain a fleet of 500 vans for vanpooling through coordination with CalVans and local jurisdictions. In 2008, vanpool ridership was approximately 1,200 riders per weekday, and this is anticipated to almost double by 2040. There are also seven existing park-and-ride lots for commuters to meet carpools, vanpools, or use transit. KernCOG will add 1,500 permanent park-and-ride spaces among existing lots and one new lot for a total of eight park-and-ride lots throughout the region. KernCOG will also continue to support the Valley Air District's Employer Based Trip Reduction Rule (9410) that requires employers of a certain size to encourage employees to reduce SOV trips.

> *Over 50 percent of all passenger trips are carpools.*

Transit

The plan focuses on updating the transit fleet and expanding the transit network. The project list includes improvements to the bus fleet by increasing the number of natural gas buses, adding additional buses for fixed routes and express service, and increasing the number of transfer stations. The budget also allocates funding for the expansion of the existing Metrolink system in Palmdale (Los Angeles County) to the community of Rosamond (Kern County) and includes 24 new buses for the Bus Rapid Transit (BRT) system. The GET Long Range Plan proposes a BRT system by 2035 to connect various points throughout the City including the Bakersfield College Transit Center, the California State University at Bakersfield Transit Center, and a future high-speed rail station. The BRT system would replace and expand the existing rapid bus route and may eventually become a future light rail system in Metropolitan Bakersfield.

California High Speed Rail (HSR)

California is expected to have the first high-speed rail system in the nation. HSR will connect San Diego to Sacramento totaling 800 miles with up to 24 stations. The project will be completed in two main phases: Phase 1 will connect San Francisco to Los Angeles by 2029 and Phase 2 will extend the system to Sacramento and San Diego. Travel times for Phase 1, from San Francisco to Los Angeles, will be under three hours at speeds capable of over 200 miles per hour. Construction is underway on the initial segment from Merced to Bakersfield with stations planned for the cities of Merced, Fresno, and Bakersfield.

KernCOG has anticipated high-speed rail and highlighted this project in both the 2011 RTP and the 2014 RTP/SCS. The existing Amtrak stations in Bakersfield and Wasco, and additional planned stations, may eventually become a feeder rail for HSR. The City of Bakersfield Economic and Community Development Department is planning to intensify land uses around the proposed station in downtown Bakersfield. KernCOG is also exploring opportunities to consolidate the various transportation hubs in order to accommodate the future high-speed rail station and facilitate travel throughout the County and region.

Active Transportation

Seven percent of the total budget is allocated for bike and pedestrian projects, as well as complete streets and pedestrian enhancements. This is a significant increase from 2011, which allocated less than one percent of the total budget. The complete streets improvements constitute over half of the active transportation budget with the remaining allocated for bike lanes and pedestrian enhancements. Complete street improvements such as bicycle lane striping and accessible transportation stops, will help promote safety and connectivity. Pedestrian improvements such as sidewalks, high visibility crosswalks, improved street lighting, and pedestrian signals are also included in the list of projects. These improvements will increase the existing active transportation system by over 700 bicycle and pedestrian trail miles by the year 2040.

H. Environmental Justice Analysis

As a recipient of federal transportation funding, KernCOG is required to prepare an environmental justice (EJ) analysis as part of the RTP (federal Executive Order 12898). The U.S. Department of Transportation (DOT), the Federal Highway Administration (FHWA), and California Department of Transportation (Caltrans) set the policy and criteria for EJ analysis. The purpose of KernCOG's analysis is to "ensure that all people, regardless of race, color, national origin or income, are protected from disproportionate negative or adverse impacts caused by the 2014 Regional Transportation Plan (RTP) Program of Projects" (RTP, Appendix page D-1).

The California Transportation Commission (CTC) recognized KernCOG's EJ Analysis as an RTP best practice.

Since 2002, KernCOG has had a 22-member Environmental Justice Task Force consisting of government and community-based organizations to develop a methodology to assess potential disproportionate negative or adverse impacts from the regional transportation plan program of projects. In 2010, this Task Force was renamed the Environment and Social Equity Roundtable (Roundtable) to assist in the development of the 2014 RTP/SCS. The Roundtable recommended using a new methodology developed by the University of California at Davis entitled the Cumulative

Environmental Vulnerability Assessment (CEVA) to map EJ areas. The CEVA methodology uses a Cumulative Environmental Hazard Index and a Social Vulnerability Index along with a Health Index for reference. The CEVA methodology produces a spatial analysis that identifies places with the highest concentrations of cumulative environmental hazards and the fewest social, economic, and political resources known as CEVA analysis areas (Land of Risk/Land of Opportunity, November 2011).

Federal law defines low-income and minority populations as EJ populations (Title VI of the Civil Rights Act of 1964). The Roundtable expanded upon that definition to include the elderly and transit-disabled[22] individuals as part of the EJ population. Neighborhoods with higher than average concentrations of the identified target populations along with the CEVA spatial analysis were mapped at the Census Block Group level. Performance measures were then used to evaluate whether the identified EJ areas performed better, or worse, than the Kern regional averages. Based on the results of the analysis in Table 6, KernCOG concluded that the EJ areas would not experience disproportionate negative or adverse impacts resulting from adoption of the 2014 RTP/SCS.

Table 6: Environmental Justice Performance Measures and Results

Performance Measure	Result
Mobility: Average trip time by mode	EJ communities experiences shorter average travel times than the County as a whole.
Accessibility/Economic Well-Being: Average trip time to job centers	EJ communities fare better than other areas for commute to major job centers.
Reliability/Congestion: Average level of congestion (LOS)	EJ areas in Metropolitan Bakersfield spend less time in congestion than non EJ areas. Additionally, hours spent in congestion countywide for EJ areas will be 27% less than the County as a whole.
Reliability/Safety: Property damage, injury, and accident statistics	Accidents are forecasted to rise at a slightly lower rate than countywide averages.
Efficiency/Cost-Effectiveness: Daily investment per passenger mile traveled (PMT)	Overall, daily investment per PMT for roads uses more funds per PMT in EJ areas than the County as a whole. Transit also performs better in EJ areas.
Livability/Consumer Satisfaction: Average trip delay	EJ areas within Metropolitan Bakersfield increase 46% less than the area as a whole. In rural areas, travel delay grows faster than in the County as a whole.
Environment/Health: Percentage change in NOx/PM and percentage change in households within ¼ mile of a high volume roadway	EJ areas are affected at a slower rate than all areas countywide.
Sustainability/Preservation: Percentage change in maintenance dollars	The RTP assumes an increase of 11% over previous RTPs.

[22] Transit-disabled is defined as “those who declared themselves unable to go outside the home alone to shop or attend appointments because of a disability (2014 RTP/SCS Appendix, page D-1).

Equity: Passenger miles traveled compared to percentage of investment	EJ areas will make up approximately 48% of transit PMT, these same areas will receive 60% of transit funding attributable to the metropolitan area.
Land Consumption: Percentage of farmland outside city sphere of influence	Farmland consumption may be reduced as much as 33% compared to the No Project Baseline (2011 RTP).

KernCOG's EJ process ensures information is widely available in a variety of forms, and with multiple opportunities for public input, especially for EJ areas. KernCOG's environmental justice outreach was recognized by the California Transportation Commission as a best practice in its 2010 RTP Guidelines.

KernCOG determined that the constrained list of projects does not have a discriminatory effect or disparate impact on any segment of the population, especially those identified as EJ populations.

I. Plan Implementation

There are a number of implementation actions that are already being taken to further the policies of the 2014 plan. KernCOG provides technical and financial assistance to local governments through the Community Progress Tracking and Assistance Program, created in 2014. As part of this program, KernCOG uses the transportation model to provide feedback to sub-regions regarding performance measures. This information will assist local jurisdictions in tracking progress toward regional sustainability goals and VMT reduction. KernCOG also distributes State and federal transportation funds to member agencies for transportation planning in support of the 2014 RTP/SCS. For example, KernCOG provided $50,000 for development of the City of Delano's Long Range Transit Plan. The program has distributed over $400,000 in planning funds for sustainable development projects.

Several efforts are also underway to improve the active transportation infrastructure in the Kern region. In 2014, KernCOG received approximately $8 million in Caltrans Active Transportation grants, more than any other MPO in the Valley. These funds will be used for both local and regional active transportation projects including pedestrian improvements such as improved lighting, construction of walking paths, and sidewalk improvements. The City of Bakersfield has dedicated annual maintenance funds to pave and re-stripe bike lanes in accordance with the 2013 Bicycle Transportation Plan. KernCOG anticipates the active transportation projects in the plan will be completed significantly earlier than 2040 due to unanticipated State funding.

To help implement urban transit projects throughout the region, KernCOG has been awarded approximately $300,000 in cap-and-trade funding from the State's Low Carbon Transit Operation Program. This funding will be used for eight to 11 projects including enhanced bus shelters, solar lighting, GPS vehicle locating systems, and transit security cameras, as well as covering costs of transit operation and purchase of bus passes for low income riders. KernCOG has also been awarded $2.6 million from the Strategic Growth Council's (SGC) Affordable Housing and Sustainable Communities Program for an apartment project in downtown Bakersfield and $3 million for a vanpool expansion project. The vanpool project will target farmworkers in rural areas for Kern and several other counties.

KernCOG is currently working with Golden Empire Transit, Kern Transit, and the City of Bakersfield to consolidate transit services for a more efficient system. Currently they are identifying potential locations for transit centers in Metropolitan Bakersfield to consolidate Amtrak, Greyhound, and public transit services. These local agencies will coordinate with the State and attempt to co-locate the transit center with a potential future high-speed rail station.

To help address transit needs in rural areas, Caltrans recently awarded a Transportation Planning Grant to the eight Valley MPOs and the University of California at Davis, Institute of Transportation Studies for a shared access pilot program. This program will look at car, bike, and ridesharing options as well as other alternatives that may meet the transit needs of smaller communities in the Valley.

II. ARB Staff Technical Analysis

Senate Bill 375 calls for ARB to accept or reject an MPO's determination that its SCS would, if implemented, achieve the greenhouse gas emission reduction targets in 2020 and 2035. KernCOG's quantification of GHG emissions reductions in the SCS is central to its determination that the SCS would meet the targets established by ARB in September 2010. Those targets for KernCOG are 5 percent per capita reduction in 2020 and 10 percent per capita reduction in 2035. The remainder of this report describes the method ARB staff used to review KernCOG's determination that its SCS would meet its targets, and reports the results of staff's technical evaluation of KernCOG's quantification of passenger vehicle GHG emissions reductions.

Government Code section 65080(b)(2)(J)(i) requires the MPO to submit a description to ARB of the technical methodology it intends to use to estimate GHG emissions from its SCS. KernCOG's February 2014 technical methodology identifies its transportation modeling system, which includes the regional travel demand model, model inputs and assumptions, land use projections, growth forecast, performance indicators, and sensitivity analyses, as the technical foundation for its quantification.

KernCOG's analysis estimates that the SCS, if implemented, would achieve a 14.1 percent per capita reduction in GHG emissions from passenger vehicles by 2020, and a 16.6 percent per capita reduction by 2035. ARB staff's evaluation of KernCOG's SCS and its technical documentation indicates that if implemented, the SCS would meet the GHG emissions reduction targets set by the Board.

A. Application of ARB Staff Review Methodology

ARB's review of KernCOG's quantification focused on the technical aspects of regional modeling that underlie the quantification of GHG emissions reductions. The review is structured to examine KernCOG's modeling tools, model inputs, application of the model, and modeling results. The general method of review is outlined in ARB's July 2011 document entitled "Description of Methodology for ARB Staff Review of Greenhouse Gas Reductions from Sustainable Communities Strategies Pursuant to SB 375." To address the unique characteristics of each MPO region and modeling system, ARB's methodology is tailored for the evaluation of each MPO. KernCOG provided a copy of its travel demand model to ARB staff which enabled a first-hand assessment of the model's structure and performance.

ARB staff evaluated how KernCOG's model operates and performs when estimating travel demand, land use impacts, and future growth, and how well it is able to quantify GHG emissions reductions associated with the SCS. In evaluating whether or not KernCOG's model is reasonably sensitive for this purpose, ARB staff examined issues such as:

- How does the growth forecast reflect the recent economic recession?
- What is the basis for allocation of land use changes?
- How well does KernCOG's travel demand model replicate observed results?

- Are cost assumptions, including fuel price and auto operating cost, used in the model reasonable?
- How sensitive is KernCOG's travel model to changes in key land use and transportation variables as compared with the empirical literature?
- How well is inter-regional travel addressed in KernCOG's RTP/SCS?

To help answer these and other questions, ARB staff used publicly available information in KernCOG's RTP/SCS and accompanying documentation, including the RTP technical appendices and the model description and validation report. In addition, KernCOG provided clarifying information, sensitivity analyses, and a data table, shown in Appendix A.

Four central components of KernCOG's GHG quantification methodology and supporting analyses were reviewed for technical soundness and general accuracy:

- Data inputs and assumptions for modeling tools
- Modeling tools
- Model sensitivity analyses
- Performance indicators

Data Inputs and Assumptions for Modeling Tools

KernCOG's key model inputs and assumptions were evaluated to assess whether they represent current and reliable data, and were appropriately used in their model. Specifically, a subset of the most relevant model inputs were reviewed, including: 1) regional socioeconomic characteristics, 2) the region's transportation network inputs and assumptions, and 3) cost assumptions. In evaluating these three input types, model inputs were compared with underlying data sources. The assumptions KernCOG used to forecast growth and VMT were also reviewed. This involved using publicly available, well documented sources of information, such as national and statewide survey data on socioeconomic and travel factors. ARB staff also evaluated documentation of regional forecasting processes and approaches.

Modeling Tools

ARB staff assessed how well the travel model replicates observed results based on both the latest inputs (socioeconomic, land use, and travel data) and assumptions used to model the SCS. The documentation of KernCOG's application of the UPlan scenario planning tool and results were reviewed to assess whether an appropriate methodology was used to quantify the expected reduction in GHG emissions from its SCS. KernCOG's modeling practices were also compared against California Transportation Commission (CTC) "2010 California Regional Transportation Plan Guidelines," the Federal Highway Administration's (FHWA) "Model Validation and Reasonableness Checking Manual," and other key modeling guidance and documents.

Model Sensitivity Analysis

Sensitivity testing is often used to assess whether a model is reasonably responsive to changes in key inputs, including changes to land use and transportation factors. These tests often involve systematically changing model input variables and measuring variations in output variables. They can also be performed by examining variations in independent and dependent variables across a dataset, and evaluating the correlations between the variables. KernCOG conducted sensitivity tests of the travel model to support its GHG emissions quantification analyses. The results of KernCOG's sensitivity tests were compared to those found in the available empirical literature.[23] As part of the sensitivity analysis review, responsiveness of the travel model to changes for the KernCOG region in the following input variables was examined:

- Auto operating costs
- Household income distribution
- Transit frequency
- Proximity to transit
- Residential density

Regional Performance Indicators

Performance indicators help explain changes in VMT and related GHG emissions that are expected to occur, whether through changes in travel modes, vehicle trip distances, or through some other means. ARB developed several performance indicators to evaluate the effect of implementation of the 2014 RTP/SCS on changes in VMT and GHG emissions. These performance indicators include residential density, mix of housing types, jobs/housing balance, jobs and housing near transit, passenger VMT, passenger mode share, active transportation, and transportation investments. ARB staff performed a qualitative evaluation to determine if increases or decreases in a subset of these individual indicators are directionally consistent with KernCOG's modeled GHG emissions reductions.

B. Data Inputs and Assumptions for Modeling Tools

KernCOG's key model inputs and assumptions were evaluated to confirm that model inputs represent current and reliable data, and were used appropriately. Specifically, a subset of the most relevant model inputs were reviewed, including: 1) regional socioeconomic characteristics, 2) the region's transportation network inputs and assumptions, and 3) cost assumptions. In evaluating these three input types, ARB staff reviewed the assumptions KernCOG used to forecast growth and VMT, and compared model inputs with underlying data sources. This involved using publicly available, authoritative sources of information, such as national and statewide survey data on socioeconomic and travel factors, as well as region-specific forecasting documentation.

1. Demographics and the Regional Growth Forecast

Demographic data and forecasts describe a number of key characteristics used in travel demand models. The regional forecast describes how many people will live in the region, how many jobs the region will have, and the anticipated number of households.

[23] Empirical literature elasticities were taken from a series of empirical literature reviews commissioned by ARB. These reviews can be accessed on ARB's website at: http://arb.ca.gov/cc/sb375/policies/policies.htm.

The demographic forecasts for Kern County were conducted by the Kern Regional Transportation Modeling Committee, which is a subcommittee of the KernCOG Transportation Technical Advisory Committee. The Kern Regional Transportation Modeling Committee consists of technical staff from KernCOG member agencies and is responsible for updating the countywide forecasts for households, employment, and other socio-economic data. After final approval of the forecast by the KernCOG Board of Directors, the Modeling Committee is then responsible for sub-area distribution.

KernCOG compared its regional growth forecast with the forecasts prepared by The Planning Center in 2012 for the eight counties in the San Joaquin Valley. The Planning Center's report cites data sources including the California Department of Finance (DOF), U.S. Census Bureau, and the California Employment Development Department, and describes the application of the least-squares method to determine a line of best fit for the trend data for the primary forecasts. The main population, housing and employment forecasts used the projections of several trends including: household trend, total housing unit trend, housing construction trend, employment trend, cohort-component model, population trend, average household size trend, and household income trend. KernCOG compared the regional growth forecast to the Planning Center's forecast and it was found to be reasonable.

KernCOG's population forecasts were confirmed to be valid in January 2010 when the U.S. Census released projections for Kern County that differed by less than one-half percent for each relevant year. Table 7 shows the population, housing units, and total employment for the Kern region between 2005 and 2040.

Table 7: Kern County Population, Housing, and Employment (2005 to 2040)

Year	Population	Housing Units	Employment
2005	762,000	260,700	286,432
2008	816,000	258,400	297,016
2020	1,010,800	319,200	365,700
2035	1,321,000	417,200	460,674
2040	1,444,100	456,100	501,710
Source: KernCOG Data Table			

Population

For the last 50 years the average annual growth rate has been 2.1 percent for the Kern region. The County is projected to grow at a rate of 1.8 percent annually, resulting in an increase of over one-half million residents by 2040. Between 2005 and 2020 the population is expected to increase by 33 percent and between 2005 and 2035 the population is expected to increase by almost 75 percent. This is less than the 2.5 percent growth rate observed between 1970 and 1990, and the 2.2 percent annual growth rate between 1990 and 2010.

Employment
The employment forecast is based on information from the State of California Employment Development Department, Info USA data, and the U.S. Census Longitudinal Employer-Household Dynamics data. Employment in Kern County is forecast to increase by about 164,000 jobs between 2008 and 2035, yielding an annual employment growth rate of approximately 1.6 percent. The rate of employment growth is proportional to the rate of population growth.

Households
Household sizes are projected to decrease slightly from 3.12 persons per household in 2008 to 3.03 persons per household in 2035. The number of households is projected to increase in the same period by more than 167,000, yielding an annual growth rate in households of about 1.9 percent. The number of households is growing at a slightly higher rate than the population, but this seems reasonable as the number of persons per household decreases slightly and more homes will be needed to accommodate the smaller household size.

2. Transportation Network Inputs and Assumptions

The transportation network is a map-based representation of the transportation system serving the KernCOG region. One part of the transportation network is the roadway network, which consists of an inventory of the existing road system, and highway travel times and distances. The other part of the transportation network is the transit network, which contains data such as route name, stop locations, transit fares, headway, and type of transit service. The model includes roadway and transit networks for the model base year of 2008 and for future years (i.e. 2020, 2035). ARB staff reviewed the KernCOG regional roadway network, transit network, and network assumptions such as link capacity and free-flow speeds. The methodologies KernCOG used to develop the transportation network and model input assumptions is consistent with guidelines provided in the National Cooperative Highway Research Program (NCHRP) Report 365.

Roadway Network
KernCOG's roadway network is a representation of the automobile roadway system, which includes freeways, highways, expressways, arterials, collectors, local roads, and freeway ramps in the region. Roadways in the model were also grouped by adjacent development (i.e. central business district, fringe, urban, suburban, or rural) and terrain (i.e. flat, rolling, or mountains). Figure 6 shows the current condition of the roadway and transit network in the KernCOG region. The roadway network provides the basis for estimating zone-to-zone travel times and costs (in terms of travel distance and travel time) for the trip distribution and mode choice steps of the modeling process, and for trip routing in vehicle assignments.

Figure 6: Existing Roadways and Transit Service in KernCOG

The KernCOG model uses facility type classifications consistent with the Federal Highway Administration (FHWA) approved functional system. Table 8 summarizes the reported roadway lane miles in the KernCOG region in 2008 by facility type. In the roadway network, link attributes (e.g. route/street name, distance, capacity, speed) are coded for each roadway segment.

Table 8: Lane Miles in 2008 by Facility Type

Facility Type	Lane miles in 2008
Freeway	14,500
Highway	1,250
Expressway	193
Arterial	5,109
Collector	712
Local	7,149

Link Capacity
Link capacity is defined as the number of vehicles that can pass a point of roadway at free-flow speed in an hour. One important reason for using link capacity as an input to the KernCOG model is for congestion impact, which can be estimated as the additional vehicle-hours of delay based on the 2000 Highway Capacity Manual (2000 HCM). Table 9 summarizes the reported link capacity assumptions used in the model. The capacity of each road segment in the network is based on the terrain, facility type, and area type, and is determined using the methodology suggested in the 2000 HCM.

Table 9: Default Link Capacity (Vehicles Per Hour Per Lane)

Facility Type	Terrain		
	Flat	Rolling	Mountain
Freeway	1,750 to 2,100	1,580 to 1,800	1,310 to 1,500
Highway	1,300 to 1,680	1,060 to 1,300	570 to 700
Expressway	800 to 1,155	650 to 1,300	350 to 700
Arterial	750 to 945	610 to 1,300	330 to 700
Collector	700 to 735	570 to 1,300	310 to 700
Local	600	550 to 1,000	330 to 600
Ramps	1,250 to 1,900	1,250 to 1,800	1,250 to 1,500

Free-Flow Speed
Free-flow speed is used to estimate the shortest travel time between origin and destination zone in the highway network. Factors such as prevailing traffic volume on the link, posted speed limits, adjacent land use activity, functional classification of the street, type of intersection control, and spacing of intersection controls can affect link speed. KernCOG estimated the free-flow speed of each link segment (Table 10) using the Bureau of Public Roads formulas suggested in the 2000 HCM.

Table 10: Free-Flow Speed Assumptions (Miles Per Hour)

Facility Type	Terrain		
	Flat	Rolling	Mountain
Freeway	55 to 70	65 to 70	65
Highway	40 to 45	40 to 45	40 to 45
Expressway	40 to 55	50 to 65	40 to 55
Arterial	25 to 45	30 to 45	30 to 45
Collector	35 to 50	50	25 to 40
Local	25 to 40	50	25 to 40
Ramps	45 to 50	45 to 50	35 to 50

The methodology used in estimating highway free-flow speeds in the KernCOG region was reviewed. KernCOG's estimation of free-flow speed, based on the posted speed, is consistent with the recommended practice indicated in the NCHRP Report 365.

Transit Network
Besides the roadway network, the transportation network of the KernCOG model also includes a transit network. KernCOG built the transit network using the completed roadway network to which transit routes and stops information was added. Figure 6 shows the existing transit service in the KernCOG region. The purposes of developing a transit network are: verification of access links and transfer points, performance of system level checks on frequency and proximity between home and transit station or stop, and relating transit speed to highway speeds.

Elements coded in the transit network include walk/bike access to transit, drive access to transit, park-and-ride lots, highway based (i.e. bus) and non-highway based (i.e. rail) transit in the study area. Some attributes coded in the transit network include transit fare, travel time, park-and-ride locations, and maximum distance for walk and ride to transit stops. KernCOG estimated transit bus travel times from the highway network, with a delay factor to account for stops and slow operating speeds. The model assumes a walking speed of three miles per hour for walk access in estimating transit travel time. KernCOG also reported operation miles for bus transit and passenger rail (Table 11).

Table 11: Existing and Future Transit Operation Miles

Transit Service	2008	2035
Bus	10,800	13,730
Passenger rail	348	380

The methodology KernCOG used in developing its transit network was reviewed and found consistent with the procedures discussed in the NCHRP Report 365 and USDOT-FHWA Manual.

3. Cost Inputs and Assumptions

Travel cost is one of the major factors determining the mode of transportation for any given trip. ARB staff reviewed basic travel cost components, such as auto operating cost and value of time, that were used as inputs in the Kern model. To examine the responsiveness of the model to changes in the cost variable or other model inputs, model sensitivity tests performed by KernCOG, such as auto operating cost and transit frequency were evaluated. The results of the sensitivity tests are presented in the model sensitivity analysis section of this report.

Auto Operating Cost
Auto operating cost is a key parameter used in the mode choice step of the KernCOG model. KernCOG staff defined auto operating costs as the cost of fuel alone. Fuel cost is an important factor that influences per capita VMT. The price of fuel is the amount consumers pay at the pump for regular grade gasoline (in dollars/gallon). When gasoline prices go up, drivers are expected to decrease their frequency of driving, reduce their travel distance, increase their use of public transit, and/or switch to more

fuel efficient cars. Lower gas prices would be expected to have the opposite effect on VMT.

KernCOG followed a similar method as other Valley MPOs to estimate auto operating cost as documented in the 2009 Regional Transportation Plan Analysis performed by the Metropolitan Transportation Commission (MTC) to forecast fuel price in the region. The fuel price in 2020 and in 2035 was forecasted using the historical trend from 1998 to 2008 in the KernCOG region. The corresponding auto operating costs were then derived by dividing the fuel price in each year by fuel efficiency assumptions. Based on this method, KernCOG estimated fuel cost as $6.06/gallon (2000 dollar) in 2035 which is higher than the cost estimated by other MPOs; and assumed a fuel economy of 32 miles per gallon which is also higher than that estimated by other MPOs. However, these higher estimates cancel each other out and result in an auto operating cost similar to other MPOs. Table 12 summarizes the reported year 2008 and future years' auto operating cost in the KernCOG region.

Table 12: Auto Operating Cost (in 2000 Dollars)

	2008	2020	2035
Auto Operating Cost	0.15	0.18	0.19

The SCS claims about eight percent reduction in the per capita CO_2 emissions by 2040 due to the increase in auto operating cost. During KernCOG's public input process, several stakeholders expressed concerns regarding the auto operating cost and its effect on the greenhouse gas emissions quantification. As a result, KernCOG staff collaborated with ARB staff to further examine the impact of auto operating cost on VMT. ARB performed a sensitivity test using auto operating cost and the Kern model and found that a one percent change in auto operating cost leads to less than a 0.13 percent change in VMT. This is consistent with the findings in published studies. Based on the annual forecast of fuel price, auto operating cost would increase 23 percent by 2035, and the corresponding reduction in VMT would be approximately three percent by 2035. Further discussion can be found in the model sensitivity analysis section of this report.

Although fuel cost is the major component of travel cost for auto mode, other minor costs such as the cost of vehicle maintenance and tire replacement are considered in some California MPO regional travel demand models. ARB staff recommends KernCOG include these minor costs such as tire and maintenance costs in estimating auto operating cost in its future model update.

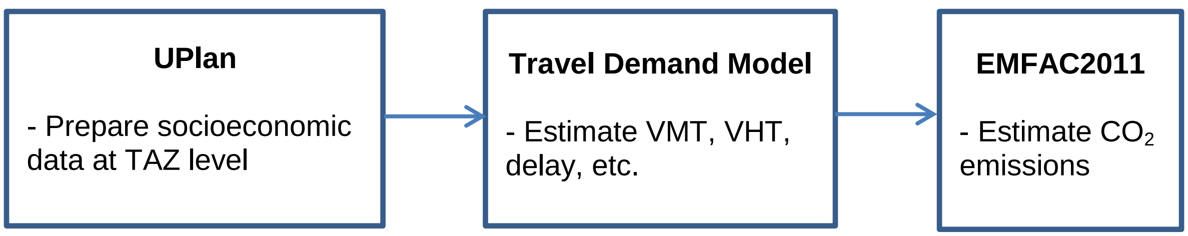
Cost of Time

A value-of-time assumption is used, in the trip distribution step, to estimate the travel cost of alternative routes. KernCOG staff converted travel cost to cost-of-time using a value of time. The average perceived value of time that KernCOG used, similar to that used by other MPOs in the Valley, was six dollars per hour per person. The value of time was also further adjusted according to vehicle ownership status.

C. Modeling Tools

Similar to other MPOs in the Valley (e.g. Fresno Council of Governments and Stanislaus Council of Governments), KernCOG used a land use scenario planning tool, a trip-based travel demand model, and the ARB vehicle emission model (EMFAC2011) to quantify the GHG emissions for its 2014 RTP/SCS. The analysis years for the GHG emissions were 2005, 2020, and 2035. Figure 7 shows the flow chart of the modeling process. The UPlan land use tool takes demographic data (e.g. population and housing units) and future socioeconomic changes as inputs, and then allocates growth in housing, employment, and population at the Transportation Analysis Zone (TAZ) level. The outputs of the land use tool were fed as inputs to the travel demand model to estimate the amount of travel in the KernCOG region. Results from the travel model, such as VMT by time of day and vehicle hours of travel (VHT), were input to EMFAC2011 to estimate GHG emissions associated with the 2014 RTP/SCS.

Figure 7: KernCOG's Modeling Tools



1. Land Use Tool

KernCOG used the UPlan model as a land use allocation tool to prepare population, household, employment, and land use datasets to run the travel model for forecast year scenarios (i.e. 2020, 2035). UPlan converts the population growth into land use demand in acres using county-level employment and household forecasts prepared by KernCOG. UPlan then designates areas for future development and excludes the areas that are not suitable for development, e.g., waterways, State and federal land. UPlan does not change existing land use or shift of land use from one type to another unless it is in areas designated for future development. The main outputs from the UPlan model are households and employment distributed by TAZ, which are then used as inputs to the travel demand model.

Land use allocation is based on the value of attractiveness of TAZs. The land use categories used in the general plans of local governments are binned into seven generalized categories modeled in UPlan: industry, high-density commercial, low-density commercial, and four residential categories: high-density residential, medium-density residential, low-density residential, and very low-density residential.

For validation purposes, KernCOG developed a base year land use database to provide inputs to UPlan for the 2008 model base year. The 2008 population and household inputs were initially developed based on 2000 U.S. Census information by census block.

The increment between the 2000 Census and the 2008 model base year was based on building permits.

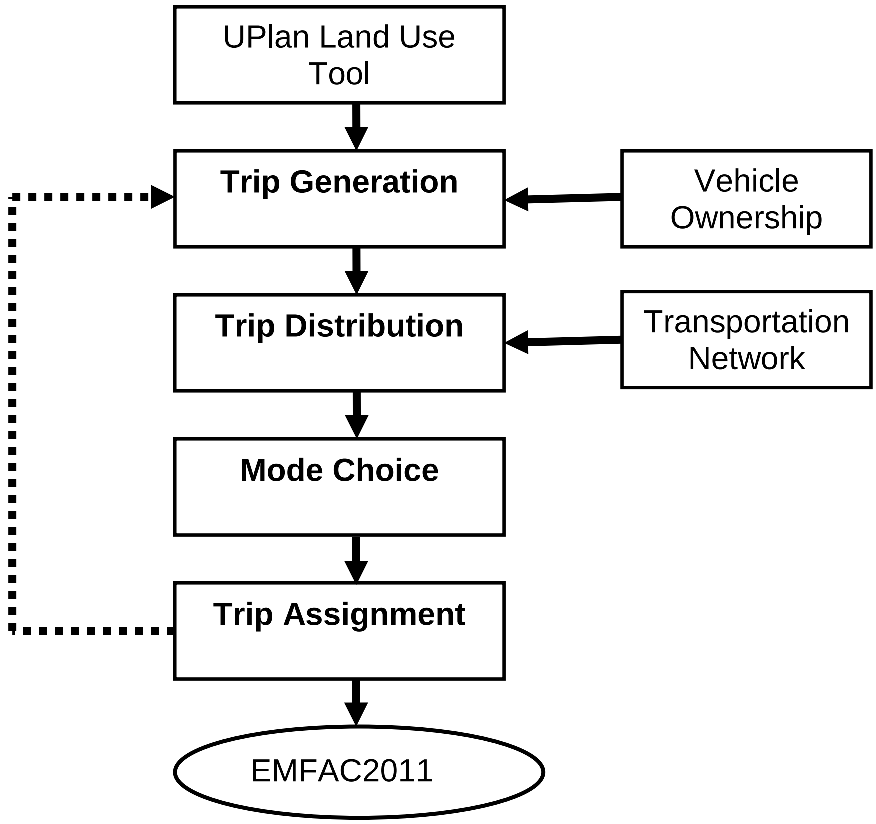
2. Travel Demand Model

In 2010, the eight MPOs in the Valley began a collaborative process to improve their travel demand modeling capabilities. This process, known as the San Joaquin Valley Model Improvement Plan (MIP), was funded by the Strategic Growth Council (SGC) and was completed in 2012. The MIP effort substantially upgraded and standardized travel demand models of the Valley MPOs and improved their ability to evaluate land use and transportation strategies central to meeting SB 375 requirements.

Additionally, in 2012, KernCOG had a consultant, DKS Associates, examine and revise the MIP model to improve its base year validation on the gateway zones and update several factors that were used in the trip distribution step. The resulting model is known as the KernCOG MIP travel demand model (or KernCOG model). The 2014 RTP/SCS is the first RTP to be developed by KernCOG using the new model. Similar to most regional travel demand models, the KernCOG model is a four-step model that includes trip generation, trip distribution, mode choice, and trip assignment (Figure 8). The model uses land use, socioeconomic, and roadway network data to estimate travel patterns, roadway traffic volumes and transit volumes. The model contains approximately 1,726 TAZs representing origins and destinations of travel in the model area. Travel to/from and through the model area is represented by 34 gateway zones at major road crossings of the county line in order to estimate interregional travel.

UPlan zonal level land use outputs are included as inputs to the Kern model. This is comprised of population-related inputs such as total population, number of households by structure type, household income, age of population in households, and housing density. It also includes employment related inputs such as employees by detailed sector, employment density, and student enrollment.

Figure 8: The KernCOG MIP Travel Demand Model



Vehicle Ownership
Modeling of vehicle ownership is a new component of the KernCOG model. Previously KernCOG used a fixed rate of vehicle ownership. The new model calculates the number of motor vehicles in the KernCOG region based on demographic characteristics, auto operating cost, and accessibility, which helps to capture the economic characteristics of each household. The output of this component is a critical input to the trip generation step, accounting for travelers' long term decisions for mode of transportation.

ARB staff evaluated the structure and variables used in the vehicle ownership model, as well as whether the model followed the state of the practice.[24] The model captures the relationship between household characteristics and vehicle ownership, and shows that the number of vehicles available per household increases as the average household income rises. This is consistent with the recommended practice in the Federal Highway Administration's "Model Validation and Reasonableness Checking Manual" (FHWA 2010). For future model improvements, KernCOG should consider including the sensitivity to land use and transit accessibility in modeling auto ownership, as well as validating the vehicle ownership model results against the Department of Motor Vehicles' (DMV) data.

[24] The state of the practice indicates the methods used by most MPOs in developing their travel demand models.

Trip Generation
Trip generation, the first step of travel demand modeling, quantifies the amount of travel in terms of person-trips in a model area. KernCOG estimates person-trips by trip purpose using cross-classification, which is similar to a look-up table of residential data, employment information, and school enrollment based on the 2000/2001 California Household Travel Survey (CHTS) and is supplemented by information from previous models developed by KernCOG. There are eight trip purposes contained in this step of the model: home-based work (HBW), home-based shopping (HBShop), home-based K12 (HBK12), home-based college (HBCollege), home-based other (HBO), work-based other (WBO), other-based other (OBO), and highway commercial.

Consistent with a conventional trip-based travel demand model, the KernCOG model has two trip ends, trip production[25] and trip attraction.[26] The trip production rates for HBW trips by housing type and by auto ownership, and for WBO by employment type were derived from survey results from the 2000/2001 CHTS. The model also used survey results from all eight counties in the Valley to ensure larger sample sizes. HBW trip attraction rates were also derived from the 2000/2001 CHTS because the survey has records of surveyed households and their employment information. Table 13 summarizes the trip production and attraction rates by trip purpose. The differences between estimated trip productions and attractions were within 10 percent, consistent with the guidance in the 2010 FHWA's Travel Model Validation and Reasonable Checking Manual.

Table 13: Trip Productions and Attractions

Trip Purpose	Productions	Attractions	Percent Difference	FHWA Criterion
HBW	427,102	420,521	-2%	±10%
HBSchool*	256,003	250,623	-2%	±10%
HBO	992,569	967,560	-3%	±10%
NHB	738,889	711,535	-4%	±10%
Total	2,414,563	2,350,239	-3%	±10%

**HBSchool is an aggregation of HBK12 and HBCollege.*
Source: DKS Associates (2013). Revisions to Kern COG MIP Travel Demand Model.

The OBO trip production and attraction rates for each employment type were estimated by comparing the trip generation derived from the 2000/2001 CHTS to standard vehicle trips in the Institute of Transportation Engineers (ITE) Trip Generation manual. The modeled person trip rates were then converted to vehicle trips using average auto occupancies for the County for each trip purpose (i.e. drive alone, shared ride 2, shared ride 3+)[27].

[25] Trip production is defined as the home end of any home-based trip, regardless of whether the trip is directed to or from home. If neither end of the trip is a home, it is defined as the origin end.
[26] Trip attraction is defined as the non-home end of a home-based trip. If neither end of the trip is a home, the trip attraction is defined as the destination end.
[27] Shared ride 3+ includes vehicles with 3 or more riders including driver in the vehicle, calculated as 3.5 persons per vehicle.

As part of the evaluation of the trip generation step, ARB staff reviewed the parameters used in the trip production and attraction models, their association to trip rates, and the responsiveness of trip rates to key parameters in the model. Analysis of the trip generation component of the KernCOG model indicates that trip rates tend to increase as household income and household size increases. Overall, the trip generation model followed the process for estimating trip generation outlined in NCHRP Report 365.

As part of future model improvement, KernCOG should consider including some sensitivity to land-use mix, particularly in areas with high transit use to capture the transit-oriented development travel behavior. ARB staff recommends KernCOG use the latest available independent data sources such as the National Household Travel Survey (NHTS), Census Transportation Planning Package (CTPP), and the American Community Survey (ACS) to validate the travel model.

Trip Distribution

The trip distribution step is the second step of the Kern model, which utilizes a gravity model[28] to estimate how many trips travel from one zone to any other zone. The inputs to the gravity model include the person-trip productions and attractions for each zone, zone-to-zone travel cost, and friction factors[29] that define the effect of travel time. The travel time (or skim) between a pair of zones is based on the shortest path connecting the two zones. The results of the zone-to-zone travel times serve as input to the trip distribution process. Intrazonal travel times were assumed to be 100 percent of the average travel time to the nearest adjacent urban TAZ and one-third the average travel time to the nearest adjacent rural TAZ.

Because time is an important factor in trip distribution, the model added terminal times to reflect the average time to access one's vehicle at the each end of the trip. The model estimated terminal time by taking the difference between the model estimate of roadway network travel time and the reported travel times for trips in Kern County from the 2000/2001 CHTS. KernCOG decided to use a terminal time of one minute for all TAZs in the model area, which is similar to some other MPOs in the Valley.

In evaluating the trip distribution step of the Kern model, the average travel time by trip purpose was reviewed. Table 14 shows the average travel time by trip purpose from the model. KernCOG explained that the differences between the modeled travel time and the observed travel time (CHTS) are due to the limited samples from the 2000/2001 CHTS for the region, the time gap between model base year (i.e., 2008) and survey year, and also the survey data collected from other locations in California which could vary from the region's demographic make-up. In addition, ARB staff also reviewed the interregional travel pattern in KernCOG. The details are discussed in the Interregional Travel section later in this report.

[28] A gravity model assumes that urban places will attract travel in direct proportion to their size in terms of population and employment, and in inverse proportion to travel distance.

[29] Friction factors represent the effect that travel time exerts on the propensity for making a trip to a given zone.

Table 14: Average Travel Time by Trip Purpose (Minutes)

Trip Purpose	Model	CHTS
HBW	16.7	20.2
HBO	14.8	15.1
NHB	11.5	15.5

To better estimate the GHG reductions associated with SCS strategies in the future, ARB staff recommends that KernCOG consider developing a destination choice model or other method, which can improve the sensitivity of changes to land use and socioeconomic factors on trip distribution by better reflecting the attributes that influence a person's decision to travel. KernCOG should also provide goodness-of-fit statistics, the frequency distribution of trip lengths, and coincident ratios for different trip types in future model documentation.

Mode Choice

The mode choice step of the KernCOG model uses demographics, travel cost and time from trip distribution outputs, and average ratios of persons to vehicle from travel surveys to assign person-trips by mode of transportation. The model uses a multinomial logit model[30] to assign the person-trips to these modes: drive-alone, shared ride 2 people, shared ride 3+ people, transit, walk, or bike. For the transit mode, the model further distinguishes between walk- and drive-access. The mode choice model estimates for the 2008 base year were calibrated using the 2000/2001 CHTS survey data. Table 15 shows the calibrated percent mode share in the model base year for the KernCOG region. Mode share estimates were compared against the observed data from CHTS. The modeled mode share results are similar to the observed data. The small differences between model estimates and observed data were expected due to the time gap between the model base year and the time of the survey.

Table 15: Person-trips by Mode in 2008

Mode	Model	CHTS
Drive alone	42%	44%
Shared ride 2	25%	28%
Shared ride 3+	25%	22%
Transit	1%	1%
Walk	7%	4%
Bike	1%	0%
Total	100%	100%

The KernCOG model estimated transit ridership for each of the transit services for the 2008 base year. The model estimate for fixed-route bus ridership in 2008 is 26,734,

[30] A multinomial logit model assigns the probability of using a particular mode based on an attractiveness measure or utility for an alternative mode in relation to the sum of the attractiveness measures for all modes.

while the observed ridership from survey data shows 23,131. The model estimate is about 16 percent higher than reported transit data, which falls within KernCOG's suggested evaluation criterion of 20 percent difference. However, FHWA does not suggest a reasonable range for transit ridership validation.

In evaluating the mode choice component of the KernCOG model, ARB staff reviewed the model structure, the input data, and data sources that KernCOG used to develop and calibrate the model, model parameters, and auto-occupancy rates[31] by purpose. Estimated mode share by trip purpose was also compared against the observed data, including transit ridership.

The method KernCOG used to develop their mode choice model is consistent with the approaches used nationwide as cited in NCHRP Report 365. However, the coefficients and constants used in the mode choice model are based on other regional models. In future model updates, KernCOG should consider developing a nested logit based mode choice model since they have more than two mode choices. The mode choice model should consider including demographic and socioeconomic characteristics in allocating the trips between modes. Model documentation should consider including more details on the model estimation process, estimated parameters, and statistical significance of the estimates. KernCOG should also consider auto occupancy rates by trip purpose in the mode choice step, and use the latest household travel survey data.

Trip Assignment

In the trip assignment step, vehicle trips from one zone to another are assigned to specific travel routes between the zones in the transportation network. Congested travel information serves as feedback to the beginning of the process until convergence is reached. This process utilizes a user equilibrium assignment concept to assign vehicles to roadways in the network. The iteration runs until no driver can shift to an alternative route with a faster travel time. The convergence criterion used in the KernCOG model is a 0.001 relative gap,[32] or a maximum internal iteration of 20 iterations for peak and off-peak period traffic assignments and 50 iterations for peak hour traffic assignments. The model used the Bureau of Public Roads (BRP) formula to estimate congested travel time, which is a common practice among transportation planning agencies.

For transit trip assignment, the model chooses the best path based on in-vehicle time plus weighted out-of-vehicle times. Transit trips were assigned in four groups: peak period, walk access; peak period, drive access; off-peak, walk access; and off-peak, drive access.

After the initial trip distribution and assignment using free-flow speed on the roadway network, the congested travel time from the most recent A.M. peak three-hour period is used as input to the home-based work (HBW) trip distribution, and the congested travel times from the most recent off-peak traffic assignment are used for the other trip

[31] Auto-occupancy indicates the number of people, including the driver, in a vehicle at a given time.
[32] Relative gap measures the relative difference of traffic flow between current iteration and the previous iterations.

purposes. However, the Kern model was not calibrated with a feedback mechanism for each step. ARB staff recommends KernCOG include the feedback mechanism in the next model update.

In evaluating the trip assignment step, ARB staff reviewed the assignment function used in the model, and the estimated and observed volume counts by facility type (Table 16). ARB staff also compared these estimated volume counts by facility type with observed data in the region. The travel model uses an assignment function as required by CTC's 2010 California RTP Guidelines to estimate the link volumes and speeds. The coefficients used in the assignment function were consistent with FHWA guidelines. Comparison of estimated and observed traffic counts at the screenline[33] locations by facility type in Table 16 shows that the differences were within the recommended range of FHWA guidelines. The differences between modeled and observed values are commonly attributed to the lack of data points from certain facility types (e.g. freeway and collector). Between now and the next model update, KernCOG should continue to gather the most recent traffic count data at different facility types to ensure there are sufficient sample sizes.

Table 16: Estimated and Observed Traffic Counts for KernCOG Region

Facility Type	Model Estimate	Traffic Count	Percent Difference	FHWA Guidelines
Freeway	1,215,813	1,170,147	4%	±7%
Expressway	119,463	129,526	-8%	±15%
Arterial	4,355,519	4,797,242	-9%	±15%
Collector	291,216	350,347	-17%	±25%

The estimated total VMT for the region from the KernCOG model and the observed data from the Caltrans Highway Performance Monitoring System (HPMS)[34] were compared at the county level (Table 17), and the difference was less than three percent, which is within the five percent evaluation criterion used by KernCOG.

Table 17: Model Validation - VMT for KernCOG Region

	Model	HPMS	Percent Difference
VMT	21,612,502	22,217,235	-2.7%

Interregional Travel

In travel demand modeling, trips are categorized as Internal trips (II), which begin and end in the model area; Internal to External (IX) trips, which begin in the model area and end outside the model area; External to Internal (XI) trips, which begin outside the model area and end within the model area; and External-External trips (XX), also known

[33] The screenline is an imaginary line used to split the study area into different parts. Along these lines, traffic counts are collected to compare against the model estimates.
[34] Highway Performance Monitoring System is a federally mandated program to collect roadway usage statistics for essentially all public roads in the US.

as through-trips, which start and end outside the model area. An example of an IX trip is a trip that begins in Kern County and ends in Los Angeles. A trip that begins outside the region and ends in Kern County is an example of an XI trip. A trip from Los Angeles to Stockton would be a XX trip for Kern County. It is important to note that through-trips (XX) are not subject to the SB 375 targets, as there is little that an individual MPO can do to influence them. These IX, XI, and XX trips are collectively defined as interregional travel.

Kern County experiences interregional travel mainly due to the presence of major north-south transportation corridors such as I-5 and SR-99 which carry significant amounts of traffic that pass through the Valley. The County also has a substantial amount of commute travel to neighboring counties, particularly to Los Angeles and Tulare counties. Based on the five-year average (2006 to 2010) ACS, there are about 5,390 workers from Tulare County and 7,897 workers from Los Angeles County that commute to Kern County daily. There are about 3,054 workers from Kern County that commute to Tulare County and about 10,443 that commute to Los Angeles County daily.

The methodology that KernCOG used for quantifying interregional travel was similar to the methodology used by many MPOs, including the four largest MPOs in the State. They included 100 percent of VMT from internal trips, 100 percent of VMT from interregional trips, and excluded all of the VMT from through-trips. Appropriately accounting for each type of interregional travel is important for GHG quantification. The KernCOG model has 34 gateway locations for monitoring the traffic into, out of, and through the region. Model inputs for estimating traffic volumes at the gateways include production person-trips by trip purpose, attraction person-trip-ends by trip purpose, and through vehicle-trips by trip purpose. To estimate the amount of productions and attractions at the gateways, KernCOG gathered model base year traffic count data of gateway roads from Caltrans , and the estimated traffic volumes from Tulare County Association of Governments, San Luis Obispo County, the Southern California Association of Governments, and Edwards Air Force Base. KernCOG's consultant based its future-year traffic volumes at the gateways on the future gateway volume estimates of neighboring MPOs, and applied the estimates and the annual growth rate from the 2009 California Statewide Travel Demand Model (CSTDM) for each gateway. KernCOG also estimated truck traffic volume at the gateways, and gathered truck traffic volume on State highways from Caltrans.

KernCOG used the 2009 version of the CSTDM (CSTDM09) to update traffic volumes and travel patterns at the gateways. This model better reflects the latest socioeconomic, network and land use characteristics than the previous version developed in 2003. The CSTDM09 is a tour-based model developed by ULTRANS of the Institute of Transportation Studies at the University of California, Davis, and HBA Specto in Calgary, Alberta. The CSTDM09 forecasts all personal travel made by every California resident, plus all commercial vehicle travel, made on a typical weekday. The CSTDM09 includes a Short Distance Commercial Vehicle Model (SDCVM), a Long Distance Personal Travel Model (LDPTM), and Long Distance Commercial Vehicle Model

(LDCVM) that strive to capture activity and travel patterns of interregional travel between counties.

KernCOG reported its estimates of the base year traffic volume at major corridors based on traffic counts collected from Caltrans and neighboring counties or MPOs. For example, in 2008, there were 23,850 northbound and 58,500 southbound trips (all vehicles) on I-5, and 47,960 trips (all vehicles) on SR-99. KernCOG used these traffic counts as the targets for the preparation of the gateway trip generation[35] (IX and XI trips), and through trips (XX).

The proportion of IX, XI and XX trips from the 2009 CSTDM were used to split the gateway traffic volumes. Based on the estimated proportions, gateway person-trip production (XI) and attraction (IX) trip matrices were developed, similar to the trip patterns for the 2008 base year from the 2009 CSTDM for each trip purpose (HBW, HBShop, HBK12, HBCollege, HBO, WBO, OBO) as shown in Table 18. However, for XX trips, a through-trips matrix by purpose was developed instead of trip production and attraction since these trip origins or destinations are not known. The total trips at each gateway by purpose are dynamic and adjust to the traffic count targets. These gateway trips were then distributed to TAZs along with the in-county (II) trips.

Table 18: Trip Productions and Attractions at Gateways in 2008

Trip Purpose	Productions (XI)	Attractions (IX)
HBW	49,660	30,960
HBShop	5,110	4,460
HBK12	2100	1050
HBCollege	1320	3680
HBO	20,760	14,330
WBO	8,360	6,790
OBO	3,630	3,900
Source: DKS (2014) and Fehr & Peers (2014).		

ARB staff reviewed KernCOG's methodology for estimating interregional travel, and the associated inputs and assumptions and the estimates for base year and future year. The methodology KernCOG used in estimating base year and future year interregional travel is consistent with common practice that other California MPOs follow. As part of the model update in the future, ARB recommends KernCOG continue to incorporate the latest traffic volumes at gateways when they become available.

[35] Trip generation predicts number of trips produced and attracted to each individual TAZ. Trip production and attraction should not be confused with origin and destination which uses a different method of accounting for trips. For example, in any home-based trips, the production is always at the home end of the trip, whether home is the starting point or the ending point.

Model Validation
Model validation, usually the last step in the development of any regional travel demand model, reflects how well the model estimates match observed data. The CTC's 2010 California RTP Guidelines suggests validation for a travel model should include both static and dynamic tests. The static validation tests compare the model's base year traffic volume estimates to traffic counts using the statistical measures and the threshold criteria. Testing the predictive capabilities of the model is called dynamic validation and it is tested by changing the input data for future year forecasts. During the model development process, KernCOG performed dynamic tests to study the responsiveness of the model to changes in land use, traffic assignment, travel cost, and induced demand. In addition, KernCOG conducted model sensitivity tests as part of their model dynamic testing during ARB's evaluation process of the 2014 RTP/SCS, which is summarized and discussed later in this report.

KernCOG's model validation was based on a traffic count database, the Caltrans Performance Measurement System (PeMS), and HPMS. Based on the results presented in Table 19, the KernCOG model estimate for the region has a correlation coefficient of 0.95 between the modeled and the observed volumes. The root mean square error (RMSE) for daily traffic assignment in the model is 9 percent, which is within the suggested criterion of 40 percent. However, only 66 percent of the links with volume-to-count ratios from the model for the KernCOG region are within the Caltrans deviation allowance. The reason for the model estimates not meeting the criteria is probably due to aggregation of traffic count data from 2001 to 2012. In addition, the variation in methods used to collect data and the geographical locations where data was collected may have contributed to this difference.

Table 19: Static Validation According to CTC's 2010 RTP Guidelines

Validation Item	Criteria for Acceptance	KernCOG Model
Correlation coefficient	at least 0.88	0.95
Percent RMSE	below 40%	9%
Percent of links with volume-to-count ratios within Caltrans deviation allowance	at least 75%	66%

Planned Model Improvements
For the next RTP update anticipated in 2018, KernCOG plans to continue to refine its travel demand model to better estimate trips and VMT in the region. Immediate model improvements seek to increase model sensitivity to land use and transportation policies. The immediate and ongoing model improvement efforts include using the latest regional or local demographic data and using the 2010 Census, 2012 ACS, and the 2012 CHTS travel data for model recalibration and revalidation. These model improvements will increase the accuracy of estimates and forecasts of external trips, trip modes, distribution for internal and interregional travel, and vehicle speeds (which is critical for air quality analysis).

Additional improvements to the KernCOG model will be realized through a series of Valley-wide model improvements, known as the Valley Model Improvement Program 2 (VMIP2). In VMIP2, the Valley MPOs are planning to review and refine their models' TAZ structure, using 2010 Census geography to update TAZ boundaries and the GIS layers. KernCOG's consultant suggests performing statistically significant tests when the model is updated with the 2012 CHTS travel data.

In this staff report, throughout the above sections on data inputs and assumptions, and modeling tools, ARB staff offers recommendations and suggestions for KernCOG to improve the model's forecasting ability. These recommendations should be incorporated into the VMIP2 model improvement program that KernCOG is currently developing.

EMFAC Model

ARB's Emission Factor model (EMFAC2011) is a California-specific computer model which calculates weekday emissions of air pollutants from all on-road motor vehicles including passenger cars, trucks, and buses for calendar years 1990 to 2035. The model estimates exhaust and evaporative hydrocarbons, carbon monoxide, oxides of nitrogen, particulate matter, oxides of sulfur, methane, and CO_2 emissions from light duty vehicles. It uses vehicle activity provided by regional transportation planning agencies, and emission rates developed from testing of in-use vehicles. The model estimates emissions at the statewide, county, air district, and air basin levels. The EMFAC2011 modeling package contains three components:

- EMFAC2011-LDV for light-duty vehicles
- EMFAC2011-HD for heavy-duty vehicles
- EMFAC2011-SG for future growth scenarios.

EMFAC2011-SG uses the inventory from EMFAC2011-LDV and EMFAC2011-HD modules, and scales the emissions based on changes in total VMT, VMT distribution by vehicle class, and speed distribution. To estimate per capita CO_2 emissions, KernCOG estimated passenger vehicle VMT and speed profiles for the region using the travel demand model, and applied them to the EMFAC2011-SG model. KernCOG then divided the estimated CO_2 emissions for passenger vehicles by the year 2005, 2020, and 2035 residential populations to obtain CO_2 emissions per capita.

D. Model Sensitivity Analysis

Model sensitivity tests are used to study the responsiveness of the travel demand model to changes in selected input variables. The responsiveness, or sensitivity, of the model to changes in key inputs indicates whether the model can reasonably estimate the anticipated change in VMT and associated GHG emissions resulting from the policies in the SCS. A sensitivity test usually assumes one input variable change at a time and examines the range of output change. Sensitivity analyses are not intended to quantify model inputs or outputs or provide analyses of actual modeled data.

ARB requested that KernCOG conduct a series of sensitivity analyses for its model using the following variables:

- Auto operating cost
- Household income distribution
- Transit frequency
- Proximity to transit
- Residential density

In addition, ARB staff assisted KernCOG in conducting the sensitivity tests by preparing input files for the income distribution test and providing general procedures on how to perform different test runs.

Following the methodology in ARB's "Description of Methodology for ARB Staff Review of Greenhouse Gas Reductions from Sustainable Communities Strategies (SCS) Pursuant to SB 375" (2011), ARB staff reviewed results from model sensitivity test runs on land use and transportation-related variables. Model sensitivity test results were compared to findings in the empirical literature as discussed in ARB policy briefs and corresponding technical background documents[36] to evaluate the model's ability, given the data inputs and assumptions, to produce reasonable estimates. In those cases where the findings were corroborated by the empirical literature, the findings were referred to as either sensitive directionally, meaning that the direction of change was consistent with findings in the empirical literature, or sensitive in magnitude, meaning that the amount of change predicted was consistent with the literature. In those cases where sensitivity test results could not be specifically corroborated by the empirical literature, ARB staff has indicated whether the model was at least sensitive directionally, meaning that changes in model inputs resulted in expected changes to model outputs.

1. Auto Operating Cost Sensitivity Test

Initial efforts by KernCOG to quantify the effect of auto operating cost on GHG emissions in 2040 did not consider the synergistic effects of the other strategies and assumptions embedded in the 2040 scenario. The method that KernCOG used resulted in an estimate of about eight percent per capita reduction in GHG emissions due to an increase in auto operating cost alone. To better understand the sensitivity of the KernCOG model to auto operating cost, KernCOG staff consulted and collaborated with ARB staff to further examine how changes in auto operating cost affect mode share and VMT in the region by conducting additional model sensitivity tests.

In these additional tests, KernCOG used three scenarios to examine the responsiveness of the model to changes in auto operating cost. These three scenarios included a 25 percent decrease, 50 percent increase, and 100 percent increase from base case. Auto operating cost is an important factor influencing travelers' auto use. KernCOG's definition of auto operating cost for the region includes fuel price only. When the auto operating cost increases, the number of drive-alone trips would be

[36] These policy briefs and technical background documents, which seek to identify the impacts of key transportation and land use policies on vehicle use and greenhouse gas emissions, based on the scientific literature, can be found at http://arb.ca.gov/cc/sb375/policies/policies.htm

expected to shift to shared-ride-2 (SR2), shared-ride-3-plus (SR3+), transit, bicycling, and/or walking. With respect to VMT, it is expected that as auto operating cost increases, travelers are expected to drive less. Conversely, when auto operating cost decreases, travelers are expected to drive more.

Figure 9 summarizes the change in mode share for the three modeled scenarios. As expected, as auto operating cost increases, the percentage of drive alone trips decreases while the percentages of other modes such as HOV, transit and non-motorized trips increase, although the percentage increases in these modes are small. KernCOG staff explained the subtle changes in mode share are due to the limited transit service coverage within the region and also due to commuting outside population centers, especially Metropolitan Bakersfield, to job centers in rural areas. Even when auto operating cost increases or decreases, residents in the KernCOG region must still rely on the auto mode to reach their destinations.

Figure 9: Mode Share Split and Auto Operating Cost

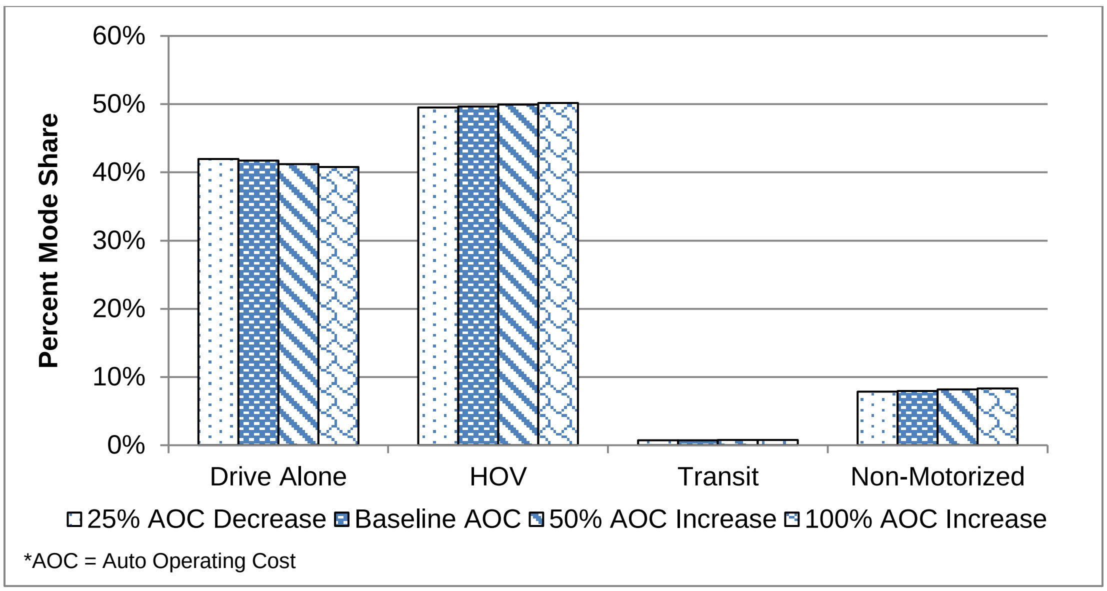


Table 20 summarizes the VMT changes related to changes in auto operating cost. As auto operating cost increases, the model shows a decrease in VMT, which is expected. ARB staff compared these modeled VMTs to what would be expected based on the elasticity[37] of VMT with respect to the change in auto operating cost from the empirical literature. Studies[38] report short-run elasticities (less than five years) of VMT with respect to auto operating cost to be -0.026 (Small and Van Dender, 2010), -0.195 (Burt and Hoover, 2006), and -0.091 to -0.093 (Boilard, 2010). Reported long-run elasticities (greater than five years) were -0.131 (Small and Van Dender, 2010), and -0.29 to -0.31

[37] Elasticity is defined as the percent change in one variable divided by the percent change in another variable.
[38] These studies are cited in the ARB-funded policy brief on the Impact of Gas Price on Passenger Vehicle Use and Greenhouse Gas Emissions, which can be found at http://www.arb.ca.gov/cc/sb375/policies/gasprice/gasprice_brief.pdf

(Goodwin et al., 2004). The modeled VMT from each of KernCOG's sensitivity tests changed in the expected direction and fell within the expected range except in two cases where the modeled VMTs are slightly higher than the upper bound of the expected range of long-run elasticities.

Table 20: Auto Operating Costs – Sensitivity Results

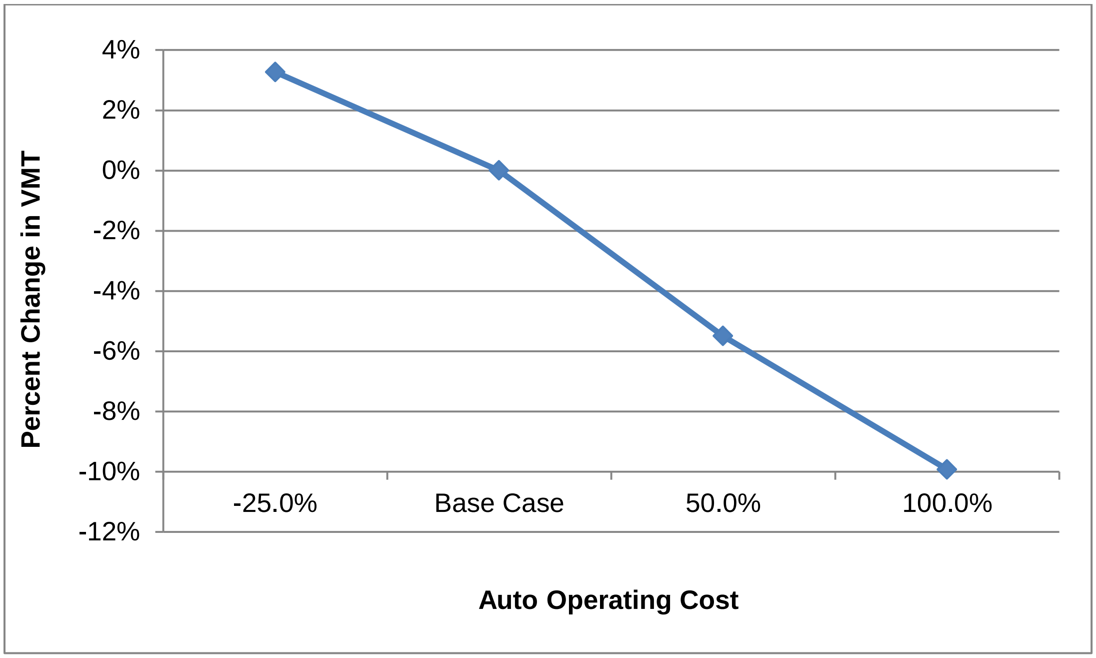
Test	Modeled VMT	Expected VMT (Short-Run)	Expected VMT (Long-Run)
25% Decrease from Base Case	22,294,972	21,696,760 - 22,830,173	22,182,508 - 23,423,865
Base Case (2008)	**21,588,816**	--	--
50% Increase from Base Case	20,402,073	19,106,102 - 21,372,928	17,918,717 - 20,401,431
100% Increase from Base Case	19,445,921	16,623,388 - 21,157,039	14,248,618 - 19,214,046
Source: -0.026 (Small and Van Dender, 2010), -0.195 (Burt and Hoover, 2006), and -0.091 to -0.093 (Boilard, 2010) for short-run; -0.131 (Small and Van Dender, 2010), and -0.29 to -0.31 (Goodwin et al., 2004) for long-run.			

Figure 10 shows the VMT changes with respect to changes in auto operating cost under the three scenarios as compared to the base case. As auto operating cost increases, the model shows a decrease in VMT. The percentage of VMT change from the base case in each test scenario ranged from -9.9 percent to 3.3 percent.

Based on the modeled VMT and the change in auto operating cost from the three scenarios that KernCOG tested, ARB staff estimated the elasticity of VMT to auto operating cost ranged from -0.10 to -0.13. This means that for a one percent increase in auto operating cost, VMT will decrease by 0.10 to 0.13 percent. This result is consistent with findings in existing studies. Assuming the impact of auto operating cost on CO_2 emissions is similar to the impact on VMT[39], given KernCOG's forecasts that auto operating cost will increase by 23% by 2035, ARB staff found this would contribute to an approximately three percent reduction in CO_2 emissions and not eight percent as stated in KernCOG's 2014 RTP/SCS. ARB staff concludes that this change in VMT is reasonable and consistent with the results from other MPOs' models.

[39] It is common practice to assume 1 percent reduction in VMT can be translated in to 1 percent CO_2 emissions for approximation.

Figure 10: VMT Change and Auto Operating Cost

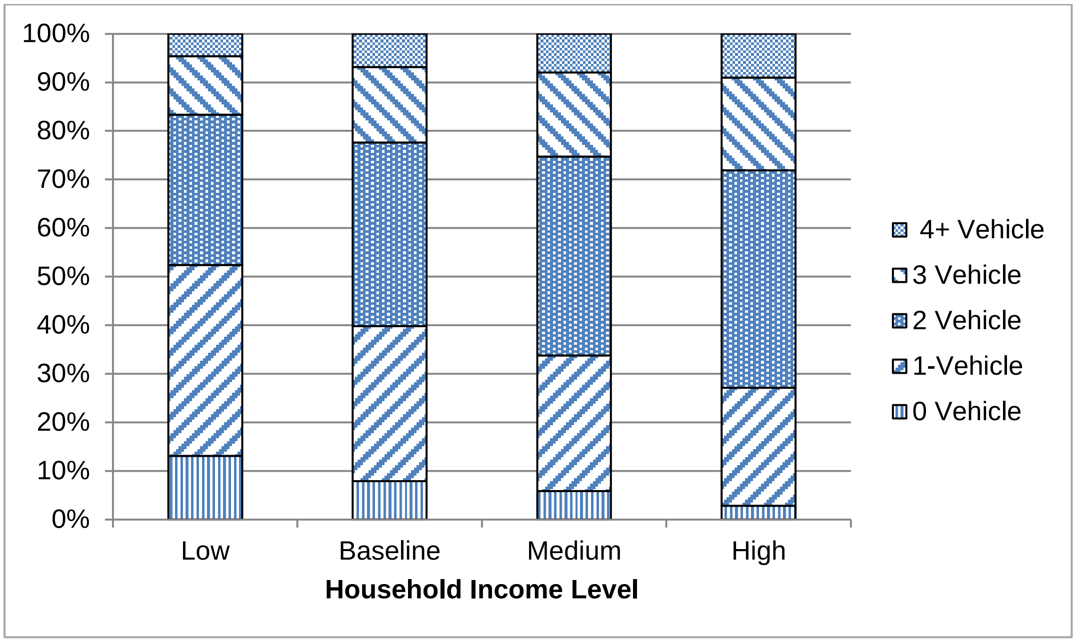


2. Household Income Distribution

Household income distribution plays an important role in the trip generation step of the travel demand model. Household income is linked to the available number of vehicles which then impacts the total number of trips. The expectation of the income distribution sensitivity test is that as household income increases, so will the proportion of households with a greater number of vehicles. Given the predetermined trip generation rates in the model, if a household has more vehicles, it generates more trips and more VMT. If the income distribution shifts downward, it is expected that the vehicle ownership model will predict more households with fewer available vehicles and similarly, fewer trips and less VMT.

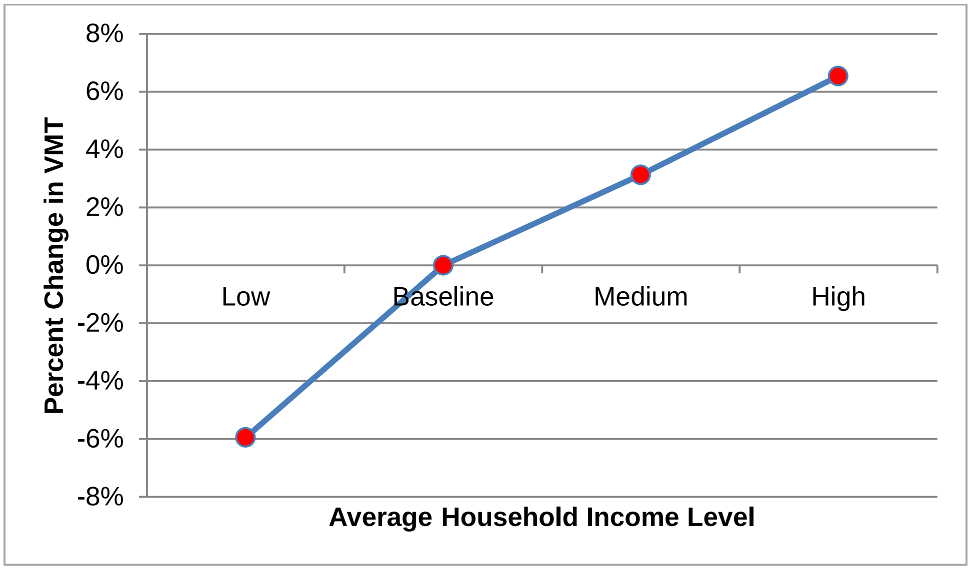
To test the responsiveness of the KernCOG model to changes in household income distribution, three scenarios were designed and tested using the average household income as an indicator, while controlling the total number of households at approximately the same as in the base case. The 2008 average household income of $45,117.69 from the KernCOG model was used as the base case. ARB staff designed three scenarios with average household incomes of Low ($37,471), Medium ($53,769) and High ($70,529). Figure 11 summarizes the auto ownership changes under the different household income scenarios. As expected, households shift towards having more vehicles available as household income increases, and vice versa.

Figure 11: Household Vehicle Ownership Distribution



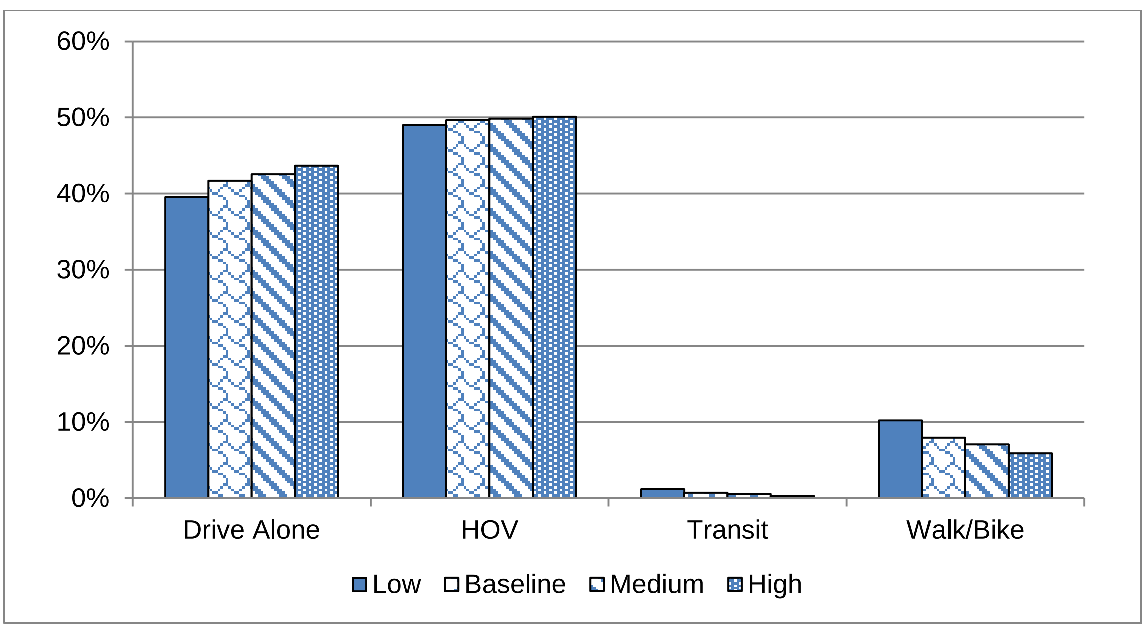
There is relatively little in the empirical literature that cites the direct effect of household income on household VMT. Murakami and Young (1997) report that low income households make 20 percent fewer trips than other households. Since this number counts all trips (including walking and transit), the effect on VMT is even more significant: VMT per household in low income households is about half of that in other households. Figure 12 shows the change in VMT for each household income scenario. The test results showed the KernCOG model responds to changes in household income distribution in the right direction (i.e., more income correlates with more VMT), but the degree of change cannot be evaluated since no elasticities specific to income were identified in the empirical literature. However, the responsiveness of the KernCOG model to the change in average household income is similar to that of other MPO models in California.

Figure 12: VMT Changes for Household Income Distribution Scenarios



The impact of household income on daily mode share was also examined. It is expected that as household income increases, travelers will be more likely to drive autos or use the auto mode in general. As shown in Figure 13 the mode share responded to household income distribution changes as expected. The drive alone share increased when household income increased while transit and non-motorized trips decreased.

Figure 13: Mode Share Response to Household Income Changes



3. Transit Frequency

Transit service frequency is a key to the effectiveness of regional transit service. To determine the responsiveness of the KernCOG model to transit frequency, three alternative frequencies were tested: 1) 50 percent increase; 2) 50 percent decrease; and 3) 75 percent decrease. As transit service becomes more frequent, transit ridership is expected to increase, and conversely, transit ridership is expected to decline with decreasing frequency. Table 21 summarizes the response of ridership to the change in transit frequency. The test results were compared to expected values based on the empirical literature[40] which suggests that a one percent increase in frequency results in a 0.5 percent increase in ridership. As expected, the modeled transit ridership decreases as transit frequency declines compared to the base case, and vice versa. The change in magnitude is not as great as the nationwide average, probably due to less public transit service coverage and transit users in the KernCOG region relative to urban transit centers that were studied in the national surveys.

Table 21: Transit Frequency Impact on Ridership

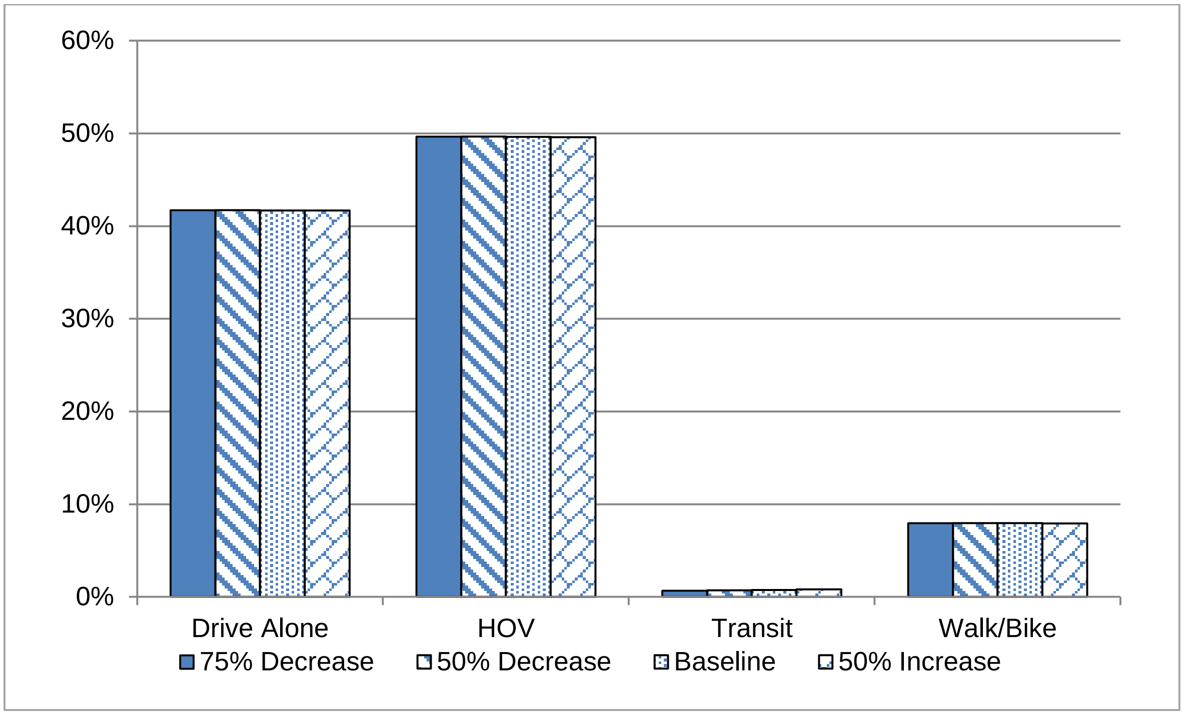
Test	Modeled Transit Ridership	Expected Transit Ridership	Modeled Urban Transit Ridership	Expected Urban Transit Ridership
75% Decrease from Base Case	24,732	16,735	15,116	10,129
50% Decrease from Base Case	25,209	20,082	15344	12,155
Base Case (2008)	26,776	--	16,206	--
50% Increase from Base Case	29,856	33,470	18,252	20,258

Source: Evans (2004), bus ridership increases by 0.5% for each 1% increase in service frequency. Taylor et al. (2009), total ridership increases by 0.5% for each 1% increase in service frequency.

Figure 14 shows the change in mode share as transit frequency changes. When transit frequency increases, it is expected that transit mode share will increase as travelers are more attracted to use public transit when waiting time is shortened. The test results do not show a significant difference from one test scenario to another. The overall transit mode share in KernCOG is very low and transit coverage in the base year is limited, so it is reasonable there is almost no change. Although the magnitude of change in mode share is subtle, the model is sensitive to change in transit frequency directionality. For example, with a 50 percent increase in transit frequency, the transit mode share peaks with 0.82 percent of the total trips, whereas the 75 percent decrease in transit frequency results in a transit mode share of 0.62 percent of total trips.

[40] The empirical literature cited in the ARB-funded policy brief on the Impact of Transit Service Strategies on Passenger Vehicle Use and Greenhouse Gas Emissions, which can be found at http://www.arb.ca.gov/cc/sb375/policies/transitservice/transit_brief.pdf

Figure 14: Impact of Transit Frequency on Mode Share

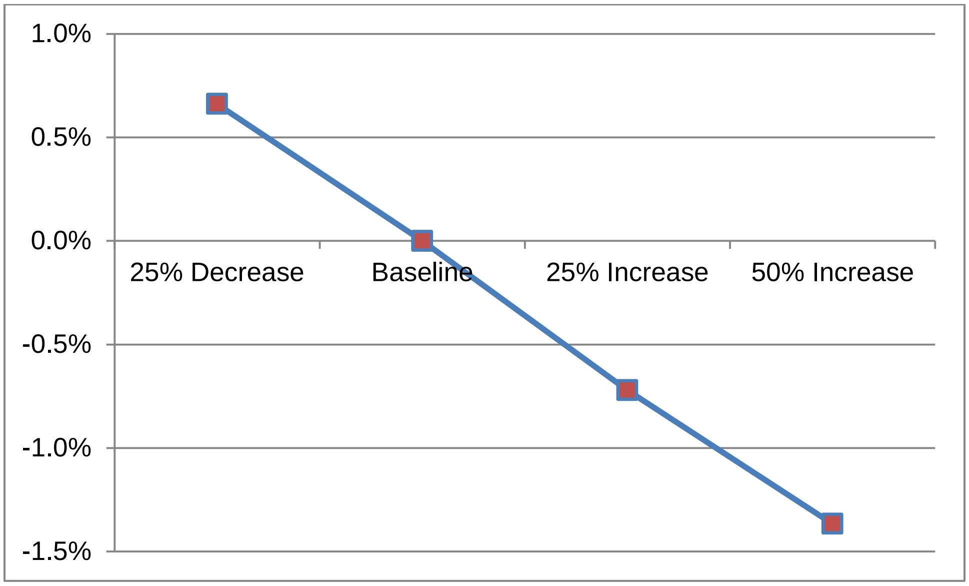


4. Proximity to Transit

The responsiveness of the KernCOG model to residential proximity to transit was tested by reallocating households to be along existing transit corridors (i.e., in transit-oriented development areas). Households relocated to transit corridors would be more likely to use transit which would, in turn, increase transit ridership.

KernCOG consulted with ARB and tested the responsiveness of the model to proximity to transit by placing more or less housing units in TAZs within a half-mile of transit stops or stations. Using the 2008 totals for each housing type as a base case, TAZs within a half-mile of a transit line either lost or gained units to represent decreases and increases in density, respectively. The total household counts for each TAZ were adjusted proportionally to maintain countywide totals. The aggregated household total for TAZs near transit was compared against the base household count to calculate the countywide residential housing unit redistribution. Figure 15 shows the change of VMT with respect to changes in proximity to transit. As expected, regional VMT decreases when the number of residential units near transit increases, and vice versa.

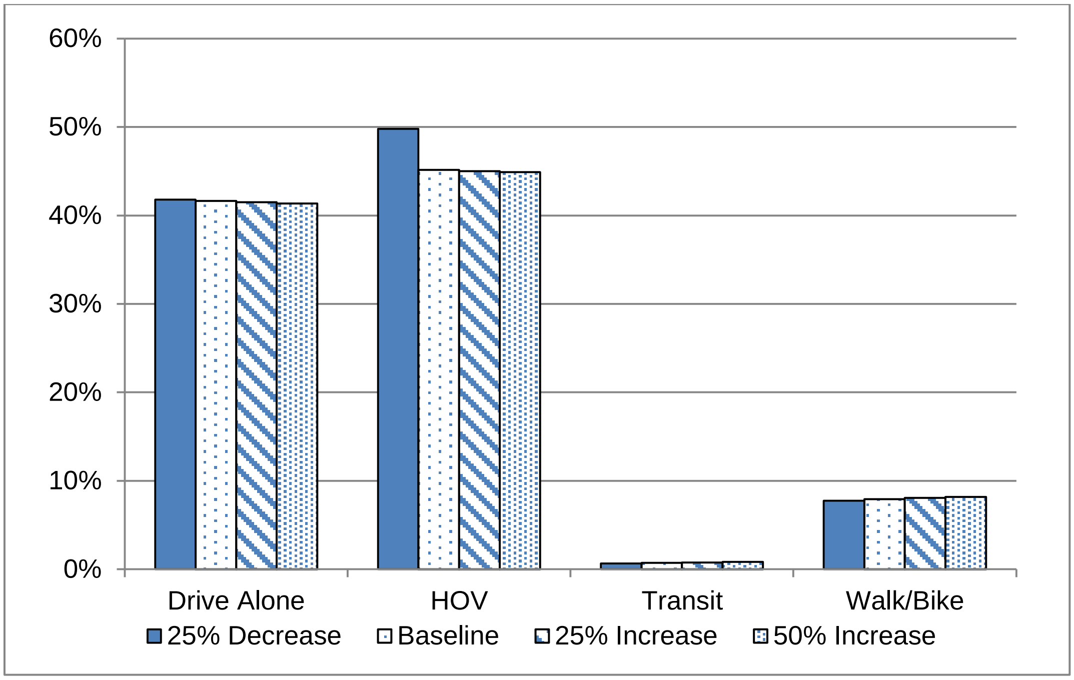
Figure 15: Impact of Residential Density near Transit on VMT



The model is directionally sensitive to the change in residential density near transit. KernCOG explained the low magnitude of change from scenario to scenario is likely due to the limited transit options in the region.

Figure 16 summarizes the change in mode share as residential density near transit changes. Though not large in magnitude, transit mode share increases slightly, and overall auto mode share decreases, as residential density increases near transit stops or stations. The model is sensitive directionally to the change in residential density near transit. KernCOG explained the low magnitude of change from scenario to scenario is likely due to the limited transit options in the region.

Figure 16: Mode Share Changes in Response to Change in Residential Density Near Transit



5. Residential Density

Residential density is usually defined as the number of housing units per acre. Increasing residential density has been considered an effective land use strategy to reduce VMT in a region because denser residential developments tend to be associated with fewer trips and less VMT.

KernCOG, with assistance from ARB staff, developed a methodology to examine the sensitivity of the model to changes in residential density. The three sensitivity tests involved a 25 percent decrease, 25 percent increase, and 50 percent increase in average residential density. Changes to residential density focused on the urban areas of the KernCOG region to match the urban area focus of the empirical literature. For each test, KernCOG kept the totals for each housing type the same as the 2008 base case. For the density-increasing scenarios, KernCOG assumed that TAZs that currently have higher than average residential density would be more likely to gain more housing units than those with a lower than average residential density. KernCOG incorporated a residential index system to indicate which TAZs have higher and which TAZs have lower than average residential density as compared to the regional average.

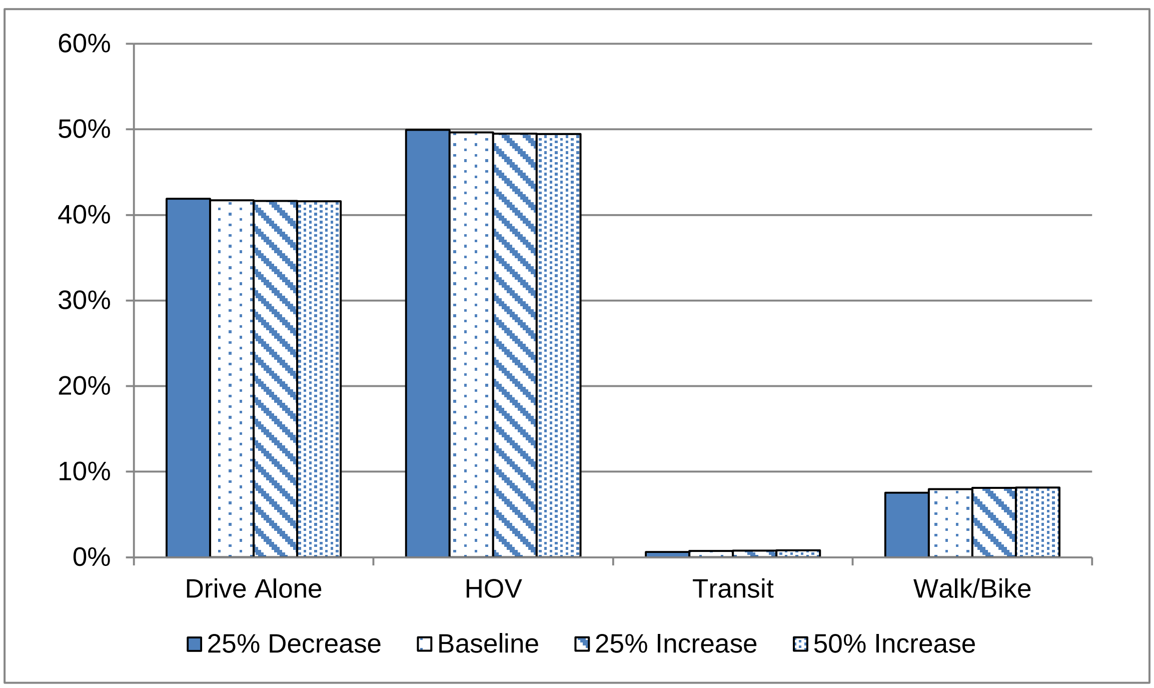
Most of the studies cited in the empirical literature that relate to residential density focus on overall population density, which is probably the best proxy for residential density. The elasticities for the impacts of population density on VMT cited in the literature range from -0.05 to -0.12 (Boarnet and Handy, 2014). As expected, when residential density increases, VMT decreases, and vice versa (Table 22). KernCOG's sensitivity analysis indicates that the model is directionally sensitive to changes in residential density. The change in magnitude in some scenarios is lower than observations from the case studies in large urban areas. This is probably due to that fact that the KernCOG region is less populated, and transportation connectivity in the region is not as developed as regions cited in the empirical literature.

Table 22: Impact of Residential Density on VMT

Test	Modeled VMT	Expected VMT
25% Decrease from Base Case	21,956,830	21,858,676 - 22,236,480
Base Case (2008)	21,588,816	--
25% Increase from Base Case	21,355,798	20,941,151 - 21,318,956
50% Increase from Base Case	21,254,858	20,293,487 - 21,049,095
Source: Boarnet and Handy (2013) the impacts of population density on VMT range from -0.05 to -0.12.		

As residential density in the region increases, mode shares for auto decrease slightly due to some travelers switching to using transit and non-motorized modes (Figure 17). The KernCOG model is sensitive directionally but not in magnitude to changes in residential density, likely due to limited existing transit options and walk/bike facilities in the region.

Figure 17: Impact of Residential Density on Mode Share



E. SCS Performance Indicators

ARB staff examined changes in non-GHG indicators that describe SCS performance to determine if they can provide qualitative evidence that the SCS could meet the region's targets. The evaluation looked at directional consistency of the indicators with

KernCOG's modeled GHG emissions reductions, as well as the general relationships between those indicators and GHG emissions reductions based on the empirical literature as discussed in the ARB-published policy briefs and corresponding technical background documents.[41] The SCS performance indicators evaluated include residential density, mix of housing types, jobs-housing balance, jobs and housing near transit, per capita passenger VMT, bus rapid transit service coverage, and transportation investment.

1. Land Use Indicators

The evaluation focused on four performance indicators related to land use: changes in residential density, jobs-housing balance, mix of housing types, and jobs and housing near transit. These four indicators pertain to new development only between the base year (2008) and 2035. The 2014 RTP/SCS focuses most of the population and housing growth in Metropolitan Bakersfield, the region's largest urban area. Therefore, ARB staff examined the land use performance indicators related to residential density and housing-mix for the Metropolitan Bakersfield area only. The remaining indicators – jobs-housing balance and housing near transit – are based on region-wide changes.

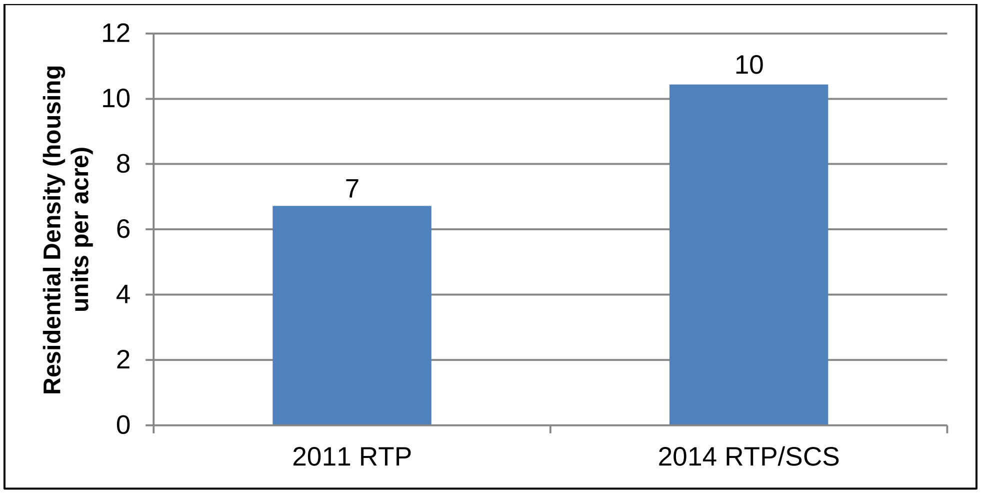
Residential Density

Residential density is a measure of the average number of dwelling units per acre of developed residential land. When residential density increases, it is expected to change travel behavior including a reduction in average trip length, and a related decrease in regional VMT, which is supported by relevant empirical literature. Brownstone and Golob (2009) analyzed National Household Travel Survey (NHTS) data and observed that denser housing development significantly reduces annual VMT and fuel consumption, which directly results in the reduction in GHG emissions. They also reported that households in areas with 1,000 or more units per square mile drive 1,171 fewer miles per year per household and consume 64.7 fewer gallons of fuel per year per household than households in less dense areas. Boarnet and Handy (2014) reported that doubling residential density reduces VMT an average of five to 12 percent.

Based on the land use data provided by KernCOG, residential density of new development for Metropolitan Bakersfield will increase to from 6.7 to 10.4 dwelling units per acre between 2008 and 2035 (Figure 18). The residential density associated with new growth increased by 55 percent in the 2014 RTP/SCS compared to the 2011 RTP. Based on findings from existing literature, this increase in residential density will reduce household VMT, and the resulting reduction in CO_2 emissions. The reduction in VMT can be attributed to shorter auto trips and, shifts in travel mode away from single occupant vehicles.

[41] These policy briefs and technical background documents, which seek to identify the impacts of key transportation and land use policies on vehicle use and greenhouse gas emissions, based on the scientific literature, can be found at http://arb.ca.gov/cc/sb375/policies/policies.htm

Figure 18: Residential Density of New Development for Metropolitan Bakersfield (2008 – 2035)

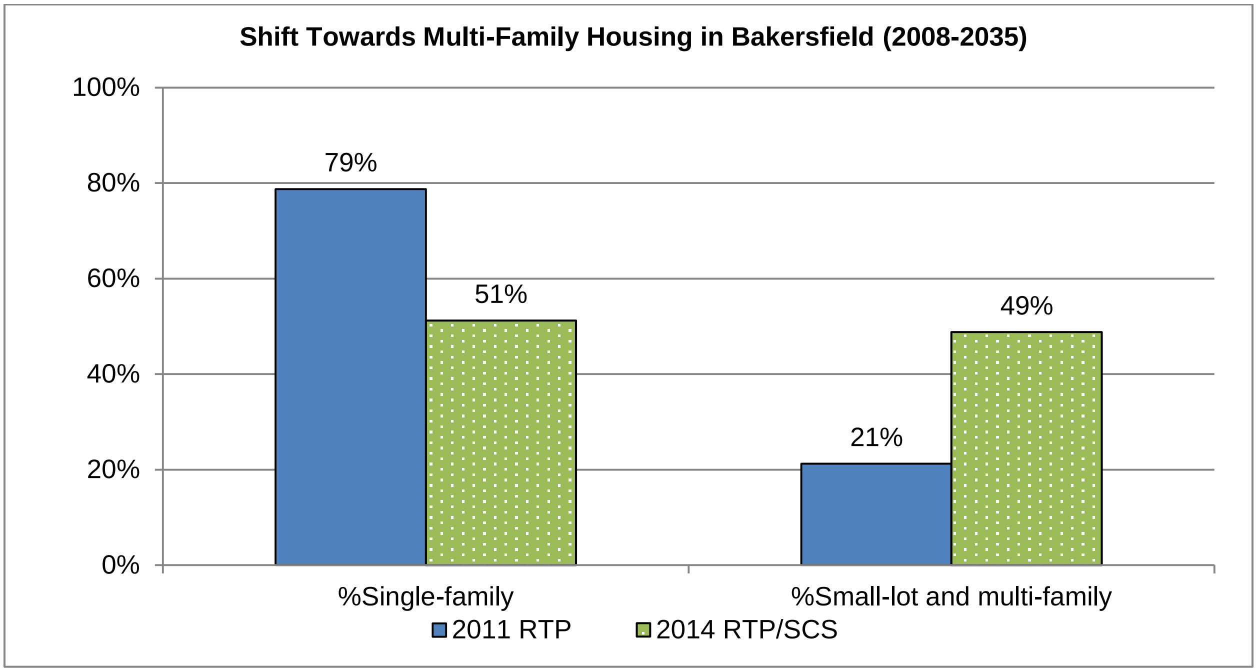


Mix of Housing Types

The mix of single-family and multi-family housing influences the land use patterns in a region. The greater the proportion of housing growth that is small-lot and attached housing types, the more opportunity a region has to accommodate future growth through a more compact land use pattern. As the housing market shifts from an emphasis on single unit homes on large lots to single unit homes on smaller lots and multi-family housing, the travel characteristics in the KernCOG region are expected to change.

KernCOG's 2014 RTP/SCS indicates such a shift towards a greater percentage of new small-lot single family and multi-family housing units. Figure 19 shows the percentage of new housing types anticipated by the 2014 RTP/SCS as compared to the prior plan. By 2035, the share of new small-lot and multi-family housing units is forecasted to increase from 21 percent of the total new housing units (2011 RTP) to 49 percent (2014 RTP/SCS). The share of single-family units decreases from 79 percent of new units to 51 percent of new units by 2035.

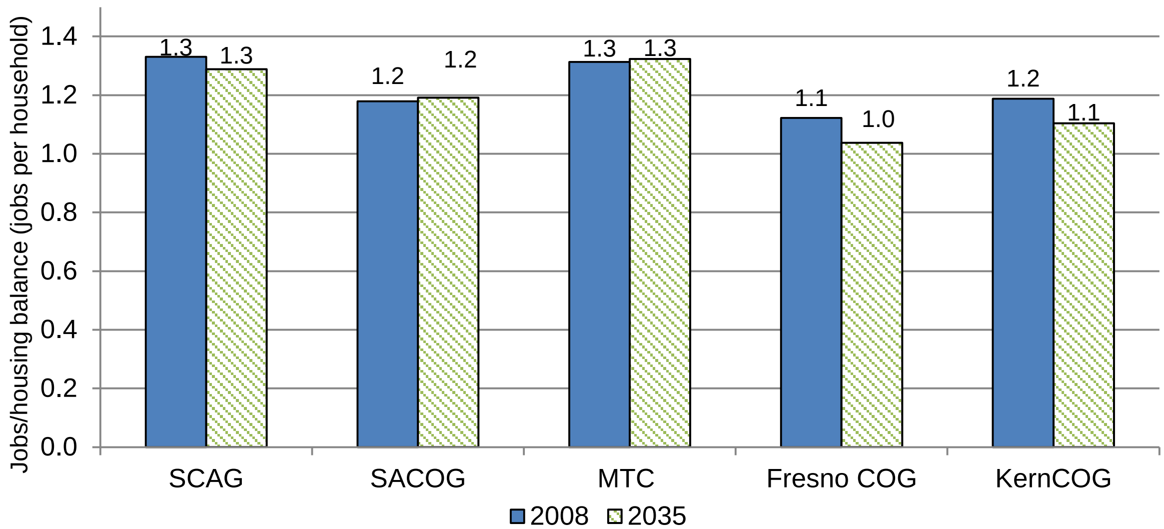
Figure 19: Shift towards Multi-Family Housing in Metropolitan Bakersfield (2008-2035)



Jobs-Housing Balance

Jobs-Housing balance refers to the approximate distribution of employment opportunities and workforce population across a geographical area. It is usually expressed as the number of jobs per household. For example, a job/housing balance of 1.25 means there are 1.25 jobs per household on average. The aim of job/housing balance is to provide local employment opportunities that may reduce overall commuting distance among residents, and also the reverse – to provide homes near workplaces. The literature reports that a jobs/housing balance is sensitive to the area of analysis. One study defined a “commute shed” as an area with a 14-mile radius around an employment center, and concluded that a jobs/housing ratio between 1.0 and 1.3 is “balanced” (Armstrong, 2001). Generally, a jobs/housing ratio near 1.3 is accepted as “balanced” considering that California’s households have an average of 1.3 workers (Kroll 2008). Figure 20 summarizes the jobs/housing ratios of KernCOG and major MPOs in California in 2008 and 2035, based on their latest adopted SCS. For KernCOG, the ratio falls between 1.1 and 1.2, which indicates a “balanced” condition. Compared to the other MPOs, KernCOG’s job-housing balance ratio in 2008 and 2035 is within a similar range.

Figure 20: Comparison of Jobs/Housing Ratio of Major MPOs



* The total numbers of jobs and employment in 2008 in MTC were estimated by interpolation with 2005 and 2010 data.

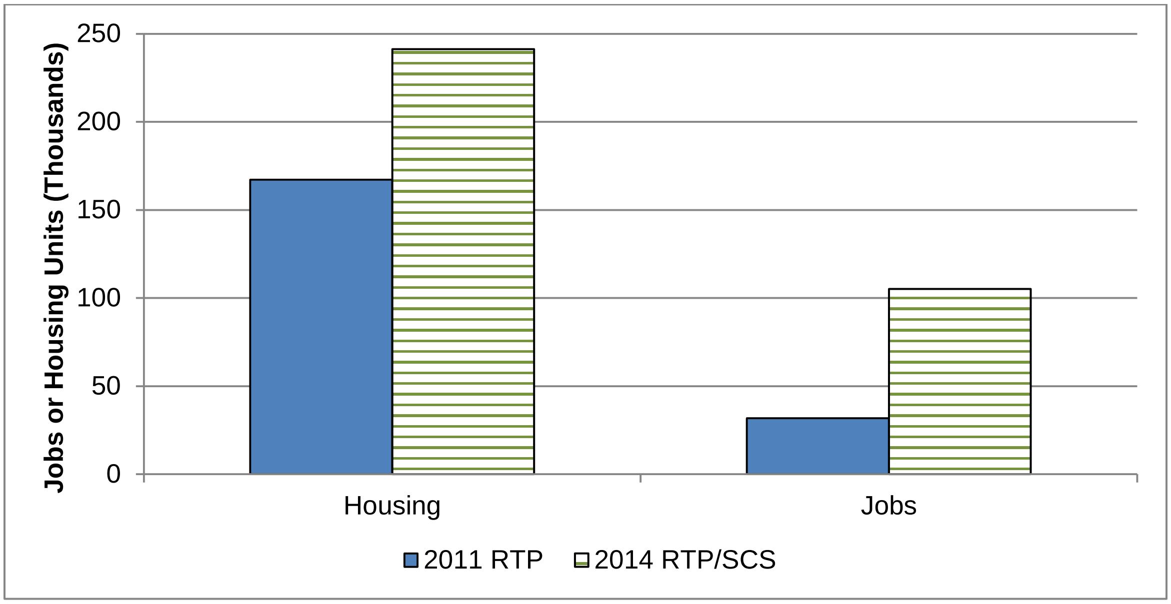
Jobs and Housing Near Transit

Proximity of housing and employment to transit is a commonly used performance indicator for evaluating the effectiveness of transit-oriented development (TOD). The empirical literature indicates that focusing growth in areas with access to transit will encourage the use of transit, reduce vehicle trips, and subsequently reduce passenger vehicle-related GHG emissions.

One study shows that proximity of housing and employment to transit stations or stops is highly correlated with increased transit ridership as housing and employment increases within a one mile radius of transit stations (Kolko 2011). Another study also illustrates significant VMT reductions through placement of housing and employment closer to rail stations and bus stops (Tal, et.al 2013).

Figure 21 summarizes the forecasted number of jobs and housing units within one-half mile of transit stations or stops based on KernCOG's 2014 RTP/SCS. Compared to the prior plan, the 2014 RTP/SCS shows an increase in the numbers of jobs and housing units near transit, between 2008 and 2035.

Figure 21: Jobs and Housing Near Transit in the Kern Region (2008 – 2035)



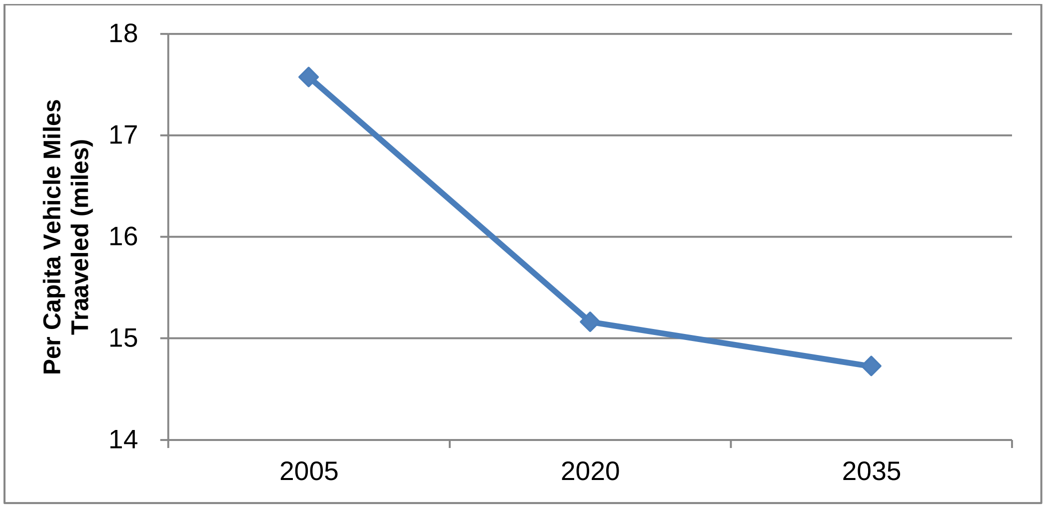
2. Transportation-related Indicators

Besides the land use-related performance indicators, ARB staff also evaluated three transportation-related performance indicators along with supporting data inputs, assumptions, and sensitivity analyses. These indicators are passenger VMT, mode share, and transportation investments. It is important to note that this section represents plan performance in future years compare to a base year of 2008.

Per Capita VMT

The KernCOG 2014 RTP/SCS shows a decline in per capita passenger vehicle VMT between 2005 and 2035, as shown in Figure 22. Per capita VMT decreases by 14 percent between 2005 and 2020, and by 16 percent between 2005 and 2035. Supporting statistics provided by KernCOG show that average weekday trip length for auto trips including single-occupancy vehicle (SOV) and high-occupancy vehicle (HOV) for all trip purposes, which together make up over 90 percent of all vehicle trips in the region, will be reduced from 2008 to 2035 consistently. Reduction in per capita VMT indicates reduction in per capita GHG emissions because the quantification of GHG emissions from passenger vehicles is a function of VMT and vehicle speeds. These results are directionally consistent and support KernCOG's reported per capita GHG emissions reduction trend over time.

Figure 22: Per Capita Passenger VMT

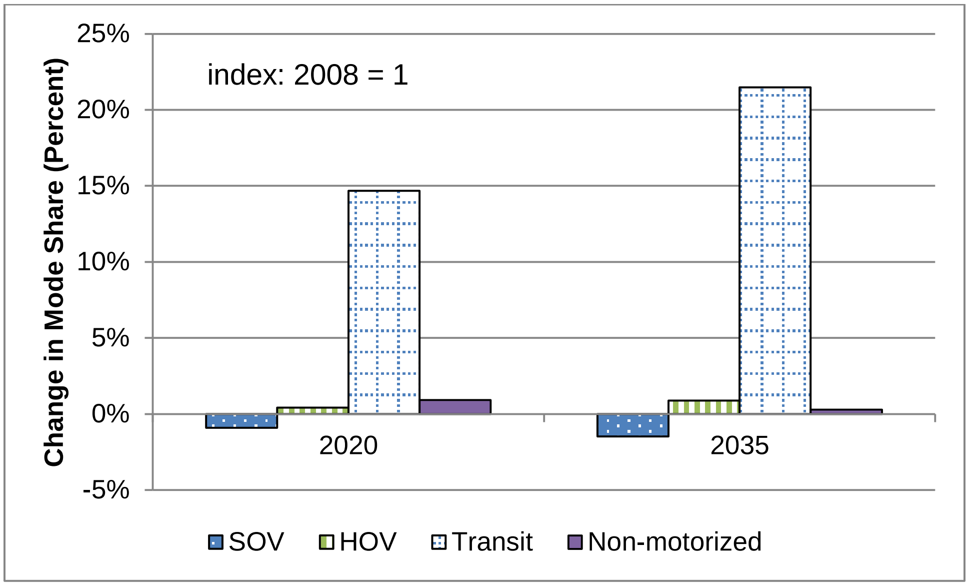


Passenger Mode Share

Mode share is a performance indicator that helps to understand the effectiveness of new investments in transit and active transportation. Figure 23 shows the change in whole-day mode share in 2020 and 2035 compared to the 2008 model base year. Compared to 2008, the single-occupancy vehicle (SOV) of total trips declines, whereas the share of transit mode increases significantly by 2035. The declines in single-occupancy vehicle (SOV) are matched by an increase in high-occupancy vehicle (HOV) share. The increase in transit use is due to an increase in population and transit investment. The subtle increase in non-motorized mode is also due to additional lane miles of Class II[42] and Class III[43] bike lanes and sidewalks. KernCOG mentioned that bike lanes and sidewalk are not included in the current transportation network of the KernCOG Model, so the modeled non-motorized mode share does not reflect actual change. More detail of non-motorized travel is discussed in the active transportation section. Though the change of the mode share of non-motorized mode is smaller in 2035 compared to 2020, the number of non-motorized trips increases consistently from 2008 to 2035. These trends further support the GHG emissions reductions estimated to result from implementation of the SCS.

[42] Class II bike lane provides a striped lane for one-way bike travel on a street or highway.
[43] Class III bike route provides for shared use with pedestrian or motor vehicle traffic.

Figure 23: Mode Share Change Relative to 2008 (Whole Day)

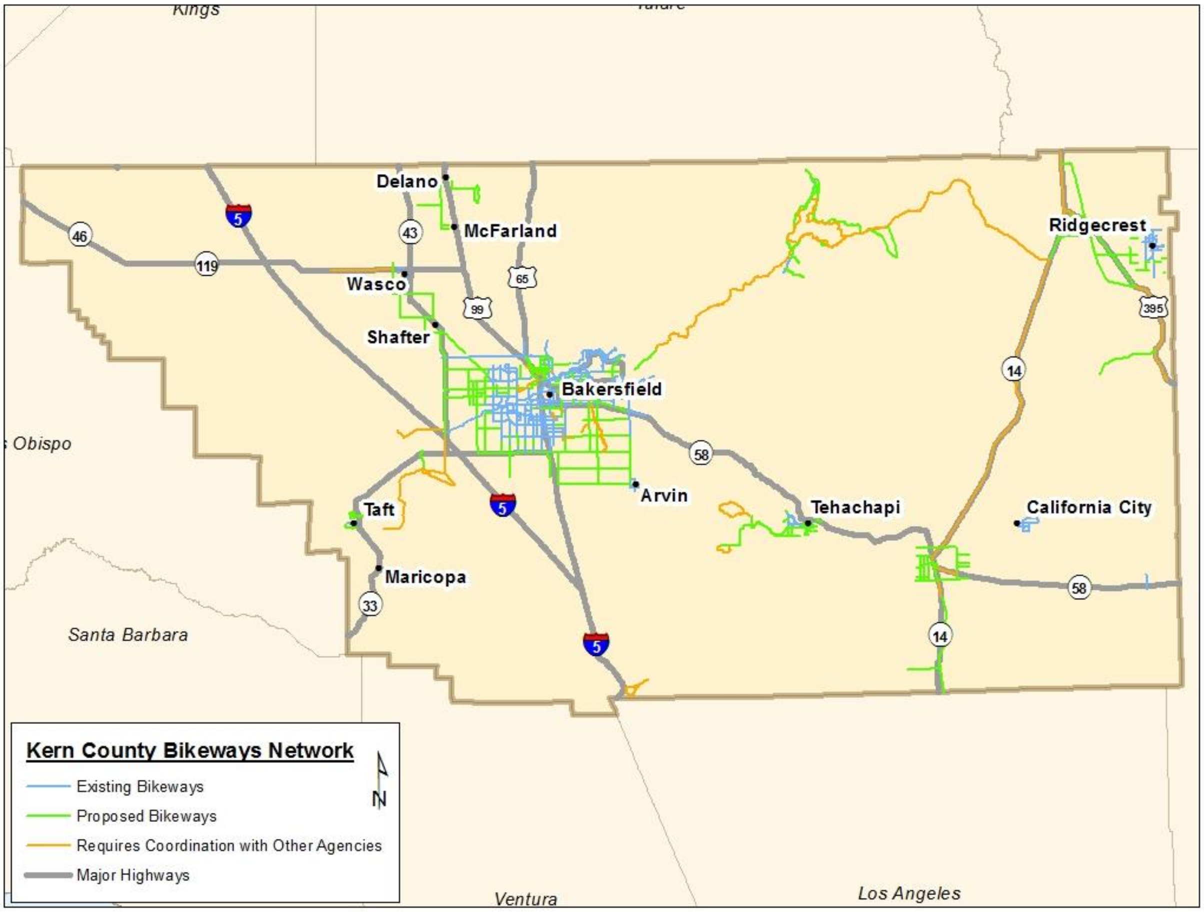


Active Transportation

Active transportation methods refer to a variety of modes of travel that are generally human powered, such as bicycling and walking. In most cases, when a person chooses to replace a car trip with a bike or walk trip to a destination, passenger VMT is reduced, along with GHG emissions. In reviews of the empirical literature related to the impacts of putting bicycling- and pedestrian-related strategies in place, Handy, Sciara, et.al. (2010, 2011) found that a variety of strategies have the potential to reduce vehicle trips and VMT. Increasing the number of miles of bikeways and sidewalks, making changes to existing bike/pedestrian infrastructure to improve the safety, security, or comfort of cyclists and pedestrians, or creating better bike/pedestrian links to transit stations are among the strategies that have been found to increase the likelihood of a shift in trips from cars to bicycles, walking, and/or transit.

KernCOG's SCS focuses on developing a network of bicycle and pedestrian facilities that provide better bike/walk access to transit facilities, maintaining the existing bike/walk facilities, and creating a safer and more secure active transportation system (see Figure 24). KernCOG's 2014 RTP/SCS includes more than 700 miles of new bikeways throughout the region, more than doubling the existing number of miles since 2008, bringing the total to 618 miles of bikeways by 2035. KernCOG's 2014 RTP/SCS includes a significant commitment of $755 million dedicated to active transportation measures. Compared to 2008, the KernCOG model estimate indicates that the number of non-motorized trips will increase by 63 percent by 2035. This trend further supports the GHG emissions reductions estimated to result from implementation of the SCS.

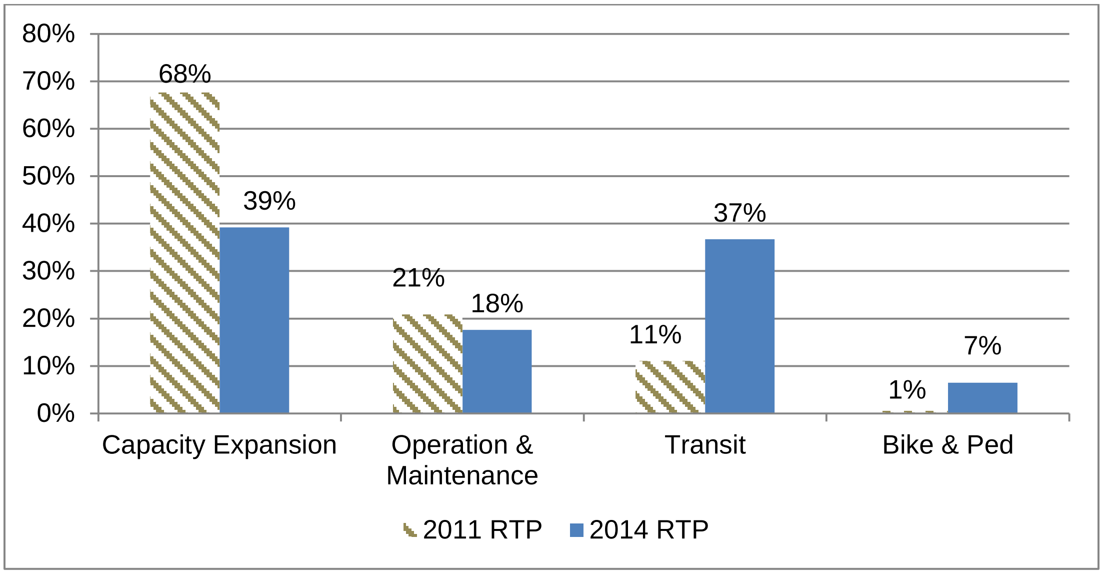
Figure 24: Existing and Proposed Bicycle Facilities



Transportation Investment

The 2014 RTP/SCS significantly increases investment in bike and walk facilities (10 times) and public transit (three times) as compared to the 2011 RTP (Figure 25). Investment in bike and pedestrian infrastructure increases from less than one percent of the total RTP budget to about seven percent of the total budget, or $755 million. Similarly, investment in transit, including high-speed rail, increases from 11 percent to about 37 percent of the total budget, or $4.3 billion. These increases are expected to provide greater opportunities for travelers to take advantage of these non-automobile modes of travel, thereby encouraging a shift away from vehicle use and with it, a reduction in GHG emissions. The following figure shows the investment in year of expenditure dollars.

Figure 25: Increased Investment in Transit and Bike/Walk Facilities



III. Conclusion

This report documents ARB staff's technical evaluation of KernCOG's adopted 2014 RTP/SCS. This evaluation affirms that the SCS would, if implemented, meet the Board adopted per capita GHG emissions reduction targets of five percent reduction in 2020 and 10 percent reduction in 2035.

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APPENDIX A. KernCOG'S Modeling Parameters for SCS Evaluation (Data Table)

This appendix contains KernCOG's June 22, 2015 responses to ARB data requests, to supplement ARB staff's evaluation of KernCOG's quantification of GHG emissions. ARB requested this data in accordance with the general approach described in ARB's July 2011 evaluation methodology document.

Modeling Parameters	2005	2008 (base Year)	2010	2020 With Project	2020 Without Project	2015 With Project	2015 Without Project	2040 With Project	2040 Without Project	Data Source(s)
DEMOGRAPHICS										
Total population	762,000	819,900	845,600	1,010,800	1,010,800	1,321,000	1,321,000	1,444,100	1,444,100	Kern Growth Forecast
Group quarters population	34,200	38,400	-	44,300	44,300	57,800	57,800	63,200	63,200	Kern Growth Forecast, DOF-E6 Estimate to July using E-5
Total employment (employees)	286,432	297,016	-	365,700	365,700	460,674	460,674	501,710	501,710	Kern Growth Forecast
Average unemployment rate (%)	8.4%	9.8%	-	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	California EDD
Total number of households	232,600	250,100	256,300	319,200	319,200	417,200	417,200	456,100	456,100	Kern Growth Forecast, DOF-E6 Estimate to July using E-5
Persons per household	3.13	3.12	-	3.03	3.03	3.03	3.03	3.03	3.03	Calculated
Auto ownership per household	1.9	1.9	-	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	1-yr ACS
Median household income	40,200	44,700	-	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	1-yr ACS
Total acres within MPO	5,227,647	5,227,647	5,227,647	5,227,647	5,227,647	5,227,647	5,227,647	5,227,647	5,227,647	GIS Analysis
Total resource area acres (CA GC Section 65080.01) (2013 Base Year)	Not Available	3,879,908	-	3,872,553	3,871,114	3,860,770	3,854,079	3,857,479	3,847,516	GIS Analysis

Modeling Parameters	2005	2008 (base Year)	2010	2020 With Project	2020 Without Project	2015 With Project	2015 Without Project	2040 With Project	2040 Without Project	Data Source(s)
Total farmland acres (SB375) (CA GC Section 65080.01) (Future Years from 2010 Base Year)	Not Available	803,533	784,485	784,325	784,302	783,763	783,352	783,572	783,121	FMMP 2010 Data/GIS Analysis
Farmland (SB 375) to Urban/Built Up (Future Years from 2010 Base)	Not Available	Not Available	Not Available	289	453	723	1,133	914	1,365	FMMP 2010 Data/GIS Analysis; 2020 interpolated from 2035
Developed acres (Future Years from 2010 Base)	Not Available	138,469	141,898	159,928	162,098	187,618	195,028	199,918	207,998	GIS Uplan Data, 2010 FMMP/Assor.
Commercial developed acres	Not Available	68,694	71,092	74,912	75,202	82,282	82,542	86,012	85,222	GIS Uplan Data (non-residential)
Residential developed acres	Not Available	69,775	70,806	85,016	86,896	105,336	112,486	113,906	122,776	GIS Uplan Data, 2010 FMMP, GPs
Metro Bakersfield - Total Developed acres	Not Available	78,377	82,341			89,587	96,273	90,755	102,528	Metro Data summed at TAZ level
Metro Bakersfield - Residential Developed Acres	Not Available	49,932	51,772			61,346	67,651	61,438	73,360	Metro Data summed at TAZ level
Total **Households**	232,600	258,400	-	319,200	319,200	417,200	417,200	456,100	456,100	Kern Growth Forecast
Metro Bakersfield - Total Households	Not Available	165,400	-	214,600	214,600	284,500	284,500	312,300	312,300	Metro Data summed at TAZ level
Housing vacancy rate	10.1%	10.6%	-	9.9%	9.9%	9.9%	9.9%	9.9%	9.9%	2005/08 DOF E-8, Growth Forecast
Single Family Residential	Not Available	206,550	-	250,900	261,800	305,800	342,883	324,795	375,050	ACS (2008); Uplan Data (generalized to match ACS housing types)
Small Lot & 2-4 Unit Multifamily	Not Available	20,883	-	37,400	32,200	62,400	42,496	74,467	46,604	
Multifamily 5+ units	Not Available	22,667	-	30,900	25,200	49,000	31,820	56,838	34,446	
Metropolitan Bakersfield: Single Family Residential	Not Available	125,704	-	153,400	164,300	186,700	219,500	189,800	241,500	ACS (2008); Uplan Data (generalized to

Modeling Parameters	2005	2008 (base Year)	2010	2020 With Project	2020 Without Project	2015 With Project	2015 Without Project	2040 With Project	2040 Without Project	Data Source(s)
Metropolitan Bakersfield: Small Lot & 2-4 Unit Multifamily	Not Available	21,502	-	33,100	27,900	54,400	37,000	69,900	40,600	match ACS housing types)
Metropolitan Bakersfield: Multifamily 5+ units	Not Available	18,194	-	28,000	22,400	43,400	28,000	52,600	30,200	
Total single-family detached **households**	Not Available	182,810	-	183520 to 224600	183520 to 235520	184270 to 279520	184580 to 316560	184710 to 298480	184950 to 348730	Uplan Data
Total small-lot single family detached households (6,000 sq. ft. lots and smaller)	Not Available	20,913	-	20910 to 32490	20910 to 27220	20910 to 57480	20910 to 37570	20910 to 69540	20910 to 41680	(1) Uplan medium density can be either detached or attchd.
Total conventional-lot single family detached households (between 6,000 and 10,900 sq. ft. lots)	Not Available	117,620	-	158,697	169,619	212,870	249,601	231,390	281,403	Uplan Data
Total large-lot single family detached households (10,900 sq ft. lots and larger)	Not Available	44,277	-	44,987	44,988	45,736	46,050	46,174	46,415	Uplan Data
Total single-family attached **households**	Not Available	7,784	-	7780 to 19360	7780 to 14090	7780 to 44360	7780 to 24440	7780 to 56410	7780 to 28550	Uplan Data
Total multi-family **households**	Not Available	44,546	-	54080 to 65660	48430 to 54740	72170 to 108740	55040 to 71690	80050 to 128680	57660 to 78420	Uplan Data
Total mobile home & other **households**	Not Available	23,260	-	23350 to 28580	23350 to 29970	23450 to 35560	23490 to 40280	23500 to 37980	23530 to 44370	maintains '08 MH/dtchd. ratio
Total infill **households** (**Growth Only** - 2010 Base)	Not Available	Not Available	-	9,120	2	27,150	4	33,040	1,080	Uplan Data
Total mixed use **acres**	Not Available	557	-	631	601	753	672	794	701	Uplan Data
Metro Bakersfield - Total infill **households**	Not Available	Not Available	-	9,120	2	27,150	4	33,040	1,080	Uplan Data
Metro Bakersfield - Total mixed use **acres**	Not Available	555	567	-	-	751	672	-	-	Uplan Data

Modeling Parameters	2005	2008 (base Year)	2010	2020 With Project	2020 Without Project	2015 With Project	2015 Without Project	2040 With Project	2040 Without Project	Data Source(s)
Total **households** within 1/4 mile of transit stations and stops	Not Available	33,146	58,400	144,668	118,456	159,517	124,326	159,658	124,326	GIS Analysis, 2008 estimated
Total **households** within 1/2 mile of transit stations and stops	Not Available	40,595	75,740	207,336	194,884	281,808	207,842	282,346	207,842	GIS Analysis
Total **employment** within 1/4 mile of transit stations and stops	Not Available	32,207	65,340	184,728	158,274	253,680	175,106	275,380	178,794	GIS Analysis, 2008 estimated
Total **employment** within 1/2 mile of transit stations and stops	Not Available	39,912	87,844	231,116	212,732	349,638	244,521	377,697	251,736	GIS Analysis, 2008 estimated
Total **households** within 1/2 mile of rail transit stations and **high frequency (<15 min.) transit** routes	Not Available	5,000	2,284	83,663	74,766	199,403	77,329	263,115	77,335	GIS Analysis
Total employment within 1/2 mile of rail transit stations and **high frequency (<15 min.) transit** routes	Not Available	5,600	2,339	61,014	44,215	147,570	44,277	209,909	44,437	GIS Analysis
TRANSPORTATION SYSTEM										
Freeway and general purpose lanes – mixed flow lane miles	Not Available	14,500	-	15,617	16,391	20,473	23,942	28,179	34,869	MIP - 2013
Highway (lane miles)	Not Available	1,250	-	1,329	1,379	1,461	1,482	1,461	1,704	MIP - 2013
Expressway (lane miles)	Not Available	193	-	206	206	225	225	225	225	MIP - 2013
HOV (lane miles)	Not Available	-	-	-	-	16	-	16	-	MIP - 2013 - excludes ramps
Arterial (lane miles)	Not Available	5,109	-	5,552	5,572	6,800	6,863	6,809	6,861	MIP - 2013
Collector (lane miles)	Not Available	712	-	733	729	962	961	959	962	MIP - 2013
Local (lane miles)	Not Available	7,149	-	7,700	8,400	10,900	14,300	18,600	25,000	maintains 2008 HPMS ratio

Modeling Parameters	2005	2008 (base Year)	2010	2020 With Project	2020 Without Project	2015 With Project	2015 Without Project	2040 With Project	2040 Without Project	Data Source(s)
Freeway-Freeway (lane miles)	Not Available	87	-	96	105	110	111	110	119	MIP - 2013
Local, express bus, and neighborhood shuttle operation miles	Not Available	10,800	-	12,283	13,391	13,730	13,415	13,730	13,415	GIS analysis (assumes avg. 12 trips/day/route)
Bus rapid transit bus operation miles	Not Available	-	-	1,375	-	1,650	-	1,650	-	GIS analysis (15 min. headways)
Passenger rail operation miles	Not Available	348	-	348	348	380	348	460	348	GIS analysis (Metrolink/Amtrak)
Transit total daily vehicle service hours	Not Available	1,164	-	1,862	1,606	3,621	2,328	4,197	2,570	Estimate from transit operating expenditure
Bicycle trail/lane miles	Not Available	288	-	382	302	618	324	1,011	331	2040 With Project - 2014 RTP 2008 Base Year - 2014 RTPOther Years estimated from Bike & Ped expenditure
Pedestrian Facilities (new residential construction only)	Not Available	Not Available	-	-	-	-	-	503	-	
Vanpool (total riders per weekday)	Not Available	1,240	-	1,567	1,580	2,031	2,058	2,185	2,239	CalVans, Enterprise, VRide
Number of trips by trip purpose (person trips)	Not Available	2,229,378	-	2,805,261	2,817,220	3,619,414	3,644,694	3,898,355	3,953,510	MIP - 2013
Home-based work	Not Available	345,558	-	417,258	421,532	533,987	540,945	570,455	583,595	MIP - 2013
Home-based other	Not Available	1,194,913	-	1,470,857	1,477,545	1,903,017	1,920,216	2,044,373	2,081,828	MIP - 2013
Non-home-based work	Not Available	166,754	-	220,728	220,638	285,240	284,919	310,699	311,049	MIP - 2013
Non-home-based other	Not Available	522,153	-	696,418	697,505	897,170	898,614	972,828	977,037	MIP - 2013
Number of trips by trip purpose (vehicle trips)	Not Available	1,675,896	-	2,103,552	2,112,625	2,706,443	2,724,840	2,913,887	2,953,613	MIP - 2013
Home-Work	Not Available	348,037	-	420,234	424,118	534,429	540,755	570,853	582,891	MIP - 2013

Modeling Parameters	2005	2008 (base Year)	2010	2020 With Project	2020 Without Project	2015 With Project	2015 Without Project	2040 With Project	2040 Without Project	Data Source(s)
Home-Shop	Not Available	184,683	-	227,148	228,377	292,353	294,443	315,493	319,141	MIP - 2013
Home-Other	Not Available	630,233	-	774,537	777,811	1,001,498	1,010,761	1,074,432	1,095,268	MIP - 2013
Work-Other	Not Available	150,256	-	198,273	198,206	255,725	255,449	278,284	278,586	MIP - 2013
Other-Other	Not Available	362,688	-	483,361	484,114	622,439	623,433	674,826	677,728	MIP - 2013
MODE SHARE										
Vehicle Mode Share (Peak Period)										(AM+PM+MD)
SOV (% of trips)	Not Available	37.3%	-	37.0%	37.2%	36.8%	37.2%	36.7%	37.2%	MIP - 2013
HOV (% of trips)	Not Available	50.5%	-	50.7%	50.9%	51.0%	51.3%	50.9%	51.4%	MIP - 2013
Transit (% of trips)	Not Available	0.5%	-	0.6%	0.5%	0.6%	0.4%	0.7%	0.4%	MIP - 2013
Non-motorized (% of trips)	Not Available	11.64%	-	11.61%	11.39%	11.57%	11.15%	11.77%	11.06%	MIP - 2013
SOV (# of trips)	Not Available	388,124	-	489,495	493,958	626,107	636,511	673,956	690,774	MIP - 2013
HOV (# of trips)	Not Available	525,941	-	670,916	675,043	869,425	878,469	935,211	955,526	MIP - 2013
Transit (# of trips)	Not Available	5,673	-	8,130	6,165	11,048	7,117	12,339	7,117	MIP - 2013
Non-motorized (# of trips)	Not Available	121,157	-	153,558	151,109	197,068	191,029	216,245	205,652	MIP - 2013
Vehicle Mode Share (Whole Day)										
SOV (% of trips)	Not Available	41.7%	-	41.3%	41.5%	41.1%	41.4%	40.9%	41.3%	MIP - 2013
HOV (% of trips)	Not Available	49.6%	-	49.8%	50.1%	50.1%	50.4%	50.0%	50.5%	MIP - 2013
Transit (% of trips)	Not Available	0.73%	-	0.83%	0.63%	0.88%	0.56%	0.92%	0.52%	MIP - 2013
Non-motorized (% of trips)	Not Available	7.9%	-	8.0%	7.8%	8.0%	7.7%	8.1%	7.6%	MIP - 2013
SOV (# of trips)	Not Available	929,538	-	1,158,906	1,168,192	1,486,722	1,507,382	1,596,356	1,632,882	MIP - 2013
HOV (# of trips)	Not Available	1,106,591	-	1,398,157	1,410,269	1,812,495	1,836,476	1,949,546	1,998,047	MIP - 2013
HOV 2		551,153	-	699,936	-	904,696	-	975,459	-	
HOV 3+		555,438	-	698,221	-	907,799	-	974,087	-	
Transit (# of trips)	Not Available	16,190	-	23,361	17,687	31,931	20,399	35,689	20,396	MIP - 2013
Non-motorized (# of trips)	Not Available	177,060	-	224,837	221,072	288,266	280,437	316,764	302,185	MIP - 2013

Modeling Parameters	2005	2008 (base Year)	2010	2020 With Project	2020 Without Project	2015 With Project	2015 Without Project	2040 With Project	2040 Without Project	Data Source(s)
Average weekday trip length (miles)										
SOV	Not Available	11.44	-	10.92	10.31	10.55	14.69	10.67	14.98	MIP - 2013
HOV (2)	Not Available	10.15	-	9.86	9.54	9.7	13.91	9.9	14.05	MIP - 2013
HOV (3+)	Not Available	10.39	-	10.56	9.97	10.68	14.54	11.07	14.55	MIP - 2013
Transit	Not Available	3.93	-	5.57	5.05	5.71	8.16	5.57	8.17	MIP - 2013
Walk & Bike	Not Available	1.84	-	2.37	3.13	1.95	5.2	1.96	5.28	MIP - 2013
Average weekday travel time (minutes)										
SOV	Not Available	15.19	-	14.91	15.91	14.79	14.09	15.28	14.48	MIP - 2013
HOV	Not Available	13.79	-	14.11	17.1	14.03	13.41	14.54	13.57	MIP - 2013
Transit	Not Available	33.93	-	34.04	34.91	33.75	33.32	33.56	33.33	MIP - 2013
Walk & Bike	Not Available	5	-	8.54	13.89	5.14	5.2	5.18	5.28	MIP - 2013
TRAVEL MEASURES										
Total VMT per weekday for passenger vehicles (ARB vehicle classes of LDA, LDT1, LDT2 and MDV) (+XX, miles)	13,390,628	15,856,655	-	20,124,898	20,340,554	26,150,101	26,758,917	28,089,165	29,477,282	2005 VMT for passenger vehicles was backcast using HPMS from the travel model validated in '06. 2005 reflects original passenger vehicle SB375 Emfac2011 run excluding thru travel (XX). All other years use special Emfac2011 runs for SB375 VMT (including XX) from Emfac outputs per ARB request. SB375 VMT for II, IXXI, and XX are calculated by the corresponding ratio for all VMT from Emfac2011 Transportation Data Table (TDT) input.
SB375 VMT by Passenger Vehicles per Weekday (-XX, miles)	13,390,628	12,538,920	-	15,325,118	15,540,798	19,452,503	20,059,832	21,205,755	22,156,148	
Total II (Internal) VMT per weekday for passenger vehicles (miles)	11,396,528	10,671,654	-	13,195,827	13,382,856	17,010,530	17,528,075	18,625,796	19,381,787	
Total IX/XI VMTper weekday for passenger vehicles (miles)	1,994,100	1,867,266	-	2,129,291	2,157,942	2,441,973	2,531,756	2,579,958	2,774,360	
Total XX VMT per weekday for passenger vehicles (miles)	Not Available	3,317,736	-	4,799,780	4,799,756	6,697,598	6,699,085	6,883,410	7,321,135	

Modeling Parameters	2005	2008 (base Year)	2010	2020 With Project	2020 Without Project	2015 With Project	2015 Without Project	2040 With Project	2040 Without Project	Data Source(s)
Congested Peak Hour VMT on freeways (AM+MD+PM) (Lane Miles, V/C ratios >0.75)	Not Available	293,582	-	5,652,974	4,040,467	17,843,850	12,147,033	20,969,639	14,372,981	MIP - 2013
Congested Peak VMT on all other roadways (AM+MD+PM) (Lane Miles, V/C ratios >0.75)	Not Available	317,933	-	366,993	437,851	619,329	666,769	934,291	853,438	MIP - 2013
CO2 EMISSIONS										
Total CO2 emissions per weekday for passenger vehicles (ARB vehicle classes LDA, LDT1, LDT2, and MDV) (tons)	6,357	7,731	-	9,799	9,928	12,699	12,973	13,607	14,204	2005 CO2 for passenger vehicles used the above VMT in Emfac2011 using approved CO2 method. 2005 reflects original passenger vehicle SB375 Emfac2011 run XX. All other years include XX from Emfac outputs per ARB request. SB375 CO2 for II, IXXI, and XX are calculated using the above corresponding ratio for VMT.
Total SB375 CO2 Emissions (-XX Tons)	6,357	5,967	-	7,253	7,328	9,196	9,455	10,039	10,430	
Total II (Internal) CO2 emissions per weekday for passenger vehicles (tons)	4,176	5,078	-	6,245	6,310	8,042	8,262	8,817	9,124	
Total IX / XI trip CO2 emissions per weekday for passenger vehicles (tons)	2,181	889	-	1,008	1,018	1,154	1,193	1,221	1,306	
Total XX trip CO2 emissions per weekday for passenger vehicles (tons)	Not Available	1,764	-	2,546	2,600	3,503	3,518	3,568	3,774	
INVESTMENT (Billions)										
Total RTP Expenditure (Year of Expenditure $)	Not Available	$7,474,000,000	-	$2,629,590,000	$3,216,910,000	$9,260,730,000	$7,443,780,000	$11,607,686,000	$8,994,570,000	**2008 Base year** = 2007 RTP for the 23-yrs out to 2030; **With Project** = 2014
Highway capacity expansion (Year of	Not Available	$1,700,000,000	-	$587,002,780	$1,803,196,000	$2,067,270,660	$3,723,482,000	$2,743,772,000	$4,499,207,417	

Modeling Parameters	2005	2008 (base Year)	2010	2020 With Project	2020 Without Project	2015 With Project	2015 Without Project	2040 With Project	2040 Without Project	Data Source(s)
Expenditure $)										RTP out to year 2040 (RTP Table 6-1); **Without Project** = 2011 RTP out to year 2035 and extrapolated to 2040. Future years include total expenditures since 2014 for "With Project" & 2011 for "Without Project".
Other road capacity expansion (Year of Expenditure $)	Not Available	$2,800,000,000	-	$415,975,470	$498,180,000	$1,464,957,090	$1,311,000,000	$1,808,589,000	$1,584,125,000	
Roadway maintenance (Year of Expenditure $)	Not Available	$1,550,000,000	-	$545,560,000	$589,000,000	$1,921,320,000	$1,550,000,000	$2,042,000,000	$1,872,916,667	
BRT projects (Year of Expenditure $)	Not Available	$0	-	$4,140,000	$0	$14,580,000	$0	$18,000,000	$0	
Transit capacity expansion (Year of Expenditure $)	Not Available	$700,000,000	-	$554,300,000	$42,864,000	$1,952,100,000	$112,800,000	$2,393,100,000	$136,300,000	
Transit operations (Year of Expenditure $)	Not Available	$709,000,000	-	$424,925,000	$269,420,000	$1,496,475,000	$709,000,000	$1,847,500,000	$856,708,333	
Bike and pedestrian projects, incl. maint.(Yr. of Expend. $)	Not Available	$15,000,000	-	$97,686,750	$14,250,000	$344,027,250	$37,500,000	$754,725,000	$45,312,500	
TRANSPORTATION USER COSTS										
Vehicle operating costs (Year 2000 $ per mile)	0.1134	0.1534	-	0.1778	0.1778	0.1885	0.1885	0.1920	0.1920	MIP - 2013 - default cost based on Bay Area MTC
Gasoline price (Year 2000 $ per gallon)	2.52	3.11	-	4.46	4.46	6.06	6.06	6.59	6.59	2008 interpolated using default MIP auto operating cost, 2040 extrapolated
Average transit fare (Year 2000 $)	Not Available	$1	-	$1	$1	$1	$1	$1	$1	MIP - 2013
Parking cost (Year 2000 $)	Not Available	Varies	-	No Change	No Change	No Change	No Change	No Change	No Change	MIP - 2013

APPENDIX B. 2010 CTC RTP Guidelines Addressed in KernCOG's RTP

This appendix lists the requirements in the California Transportation Commission's (CTC) Regional Transportation Planning (RTP) Guidelines that are applicable to the KernCOG regional travel demand model, and which KernCOG followed. In addition, listed below are the recommended practices from the CTC RTP Guidelines that KernCOG incorporated into its modeling system.

Requirements

- Each MPO shall model a range of alternative scenarios in the RTP Environmental Impact Report based on the policy goals of the MPO and input from the public.
- MPO models shall be capable of estimating future transportation demand at least 20 years into the future. (Title 23 CFR Part 450.322(a))
- For federal conformity purposes, each MPO shall model criteria pollutants from on-road vehicles as applicable. Emission projections shall be performed using modeling software approved by the EPA. (Title 40 CFR Part 93.111(a))
- Each MPO shall quantify the reduction in greenhouse gas emissions projected to be achieved by the SCS. (California Government Code Section 65080(b)(2)(G))
- The MPO, the State(s), and the public transportation operator(s) shall validate data utilized in preparing other existing modal plans for providing input to the regional transportation plan. In updating the RTP, the MPO shall base the update on the latest available estimates and assumptions for population, land use, travel, employment, congestion, and economic activity. The MPO shall approve RTP contents and supporting analyses produced by a transportation plan update. (Title 23 CFR Part 450.322(e))
- The metropolitan transportation plan shall include the projected transportation demand of persons and goods in the metropolitan planning area over the period of the transportation plan. (Title 23 CFR Part 450.322(f)(1))
- The region shall achieve the requirements of the Transportation Conformity Regulations of Title 40 CFR Part 93.
- Network-based travel models shall be validated against observed counts (peak- and off-peak, if possible) for a base year that is not more than 10 years prior to the date of the conformity determination. Model forecasts shall be analyzed for reasonableness and compared to historical trends and other factors, and the results shall be documented. (Title 40 CFR Part 93.122 (b)(1)(i))
- Land use, population, employment, and other network-based travel model assumptions shall be documented and based on the best available information. (Title 40 CFR Part 93.122 (b)(1)(ii))
- Scenarios of land development and use shall be consistent with the future transportation system alternatives for which emissions are being estimated. The distribution of employment and residences for different transportation options shall be reasonable. (Title 40 CFR Part 93.122(b)(1)(iii))
- A capacity-sensitivity assignment methodology shall be used, and emissions estimates shall be based on methodology which differentiates between peak-

and off-peak link volumes and speeds and uses speeds based on final assigned volumes. (Title 40 CFR Part 93.122 (b)(1)(iv))

- Zone-to-zone travel impedance used to distribute trips between origin and destination pairs shall be in reasonable agreement with the travel times that are estimated from final assigned traffic volumes. (Title 40 CFR Part 93.122(b)(1)(v))
- Network-based travel models shall be reasonably sensitive to changes in the time(s), cost(s), and other factors affecting travel choices. (Title 40 CFR Part 93.122 (b)(1)(vi))
- Reasonable methods in accordance with good practice shall be used to estimate traffic speeds and delays in a manner that is sensitive to the estimated volume of travel on each roadway segment represented in the network-based travel model. (Title 40 CFR Part 93.122(b)(2))
- Highway Performance Monitoring System (HPMS) estimates of vehicle miles travel (VMT) shall be considered the primary measure of VMT within the portion of the nonattainment or maintenance area and for the functional classes of urban area basis. For areas with network-based travel models, a factor (or factors) may be developed to reconcile and calibrate the network-based travel model estimates of VMT in the base year of its validation to the HPMS estimates for the same period. These factors may then be applied to model estimates of future VMT. In this factoring process, consideration will be given to differences between HPMS and network-based travel models, such as differences in the facility coverage of the HPMS and the modeled network description. Locally developed count-based programs and other departures from these procedures are permitted subject to the interagency consultation procedures of Section 93.105(c)(1)(i). (Title 40 CFR Part 93.122(b)(3))

Recommendations

- The models should account for the effects of land use characteristics on travel, either by incorporating effects into the model process or by post-processing.
- During the development period of more sophisticated/detailed models, there may be a need to augment current models with other methods to achieve reasonable levels of sensitivity. Post-processing should be applied to adjust model outputs where the models lack capability, or are insensitive to a particular policy or factor. The most commonly referred to post-processor is a “D’s” post-processor, but post-processors could be developed for other non-D factors and policies, too.
- The models should address changes in regional demographic patterns.
- Geographic Information System (GIS) capabilities should be developed in these counties, leading to simple land use models in a few years.
- All natural resources data should be entered into the GIS.
- Parcel data should be developed within a few years and an existing land use data layer created.
- For the current RTP cycle (post last adoption), MPOs should use their current travel demand model for federal conformity purposes, and a suite of analytical tools, including but not limited to, travel demand models (as described in Categories B through E), small area modeling tools, and other generally accepted analytical methods for determining the emissions, VMT, and other performance factor impacts of sustainable communities strategies being considered pursuant to SB 375.

- Measures of means of travel should include percentage share of all trips (work and non-work) made by all single occupant vehicle, multiple occupant vehicle, or carpool, transit, walking, and bicycling.
- To the extent practical, travel demand models should be calibrated using the most recent observed data including household travel diaries, traffic counts, gas receipts, Highway Performance Monitoring System (HPMS), transit surveys, and passenger counts.
- It is recommended that transportation agencies have an on-going model improvement program to focus on increasing model accuracy and policy sensitivity. This includes on-going data development and acquisition programs to support model calibration and validation activities.
- When the transit mode is modeled, speed and frequency, days, and hours of operation of service should be included as model inputs.
- When the transit mode is modeled, the entire transit network within the region should be represented.
- Agencies are encouraged to participate in the California Inter-Agency Modeling Forum. This venue provides an excellent opportunity to share ideas and help to ensure agencies are informed of current modeling trends and requirements.
- MPOs should work closely with State and federal agencies to secure additional funds to research and implement the new land use and activity-based modeling methodologies. Additional research and development is required to bring these new modeling approaches into mainstream modeling practice.
- These regions should develop 4-step travel models as soon as is possible. In the near-term, post-processing should be used.
- The travel model set should be run to a reasonable convergence towards equilibrium across all model steps.
- Simple land use models should be used, such as GIS rule-based ones, in the short term.
- Parcel data and an existing urban layer should be developed as soon as is possible.
- A digital general plan layer should be developed in the short-term.
- A simple freight model should be developed and used.
- Several employment types should be used, along with several trip purposes.
- The models should have sufficient temporal resolution to adequately model peak and off-peak periods.
- Agencies should, at a minimum, have four-step models with full feedback across travel model steps and some sort of land use modeling.
- In addition to the conformity requirements, these regions should also add an auto ownership step and make this step and the mode choice equations for transit, walking and bicycling and the trip generation step sensitive to land use variables and transit accessibility.
- Walk and bike modes should be explicitly represented.
- The carpool mode should be included, along with access-to-transit sub modes.
- Feedback loops should be used and take into account the effects of corridor capacity, congestion and bottlenecks on mode choice, induced demand, induced growth, travel speed and emissions.
- Freight models should be implemented in the short term and commodity flows models within a few years.

- Simple Environmental Justice analyses should be done using travel costs or mode choice log sums, as in Group C. Examples of such analyses include the effects of transportation and development scenarios on low-income or transit-dependent households, the combined housing/transportation cost burden on these households, and the jobs/housing fit.