GROWTH FORECAST APPENDIX

REGIONAL TRANSPORTATION PLAN
2012–2035
SUSTAINABLE COMMUNITIES STRATEGY
Towards a Sustainable Future
RTP

Southern California Association of Governments

PROPOSED FINAL
APRIL 2012

GROWTH FORECAST

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Introduction

The regional growth forecast represents the most likely growth scenario for the Southern California region in the future, taking into account a combination of recent and past trends, reasonable key technical assumptions, and local or regional growth policies. The Integrated Growth Forecast at the regional and small geographic area level is the basis for developing the Regional Transportation Plan (RTP), Sustainable Communities Strategy (SCS), Program Environmental Impact Report (PEIR), and the Regional Housing Needs Assessment (RHNA). The development of the Integrated Growth Forecast is driven by a principle of collaboration between SCAG and local jurisdictions who are major contributors to the process. The integration of the regional and local forecasts is achieved through the joint efforts and collaboration among the various contributors. SCAG's Community, Economic and Human Development (CEHD) Committee provided direction to the growth forecast update process for the 2012–2035 RTP/SCS/PEIR/RHNA. SCAG's Plans & Programs Technical Advisory Committee (P&P TAC) assisted in the forecasting process by providing valuable technical input.

The Growth Forecast Appendix is comprised of four major sections. Section I introduces the major source of challenges in producing the 2012–2035 RTP/SCS growth forecast, and summarizes the nineteen forecasting milestones of forecasting development. Section II describes the past growth trends and describes the size and characteristics of the projected population, households and employment. Section III discusses the forecasting framework, methodology and assumptions. Section IV introduces the SCAG PECAS land use model, including its structure, specifications, calibration, and an example scenario.

Section I: Challenges, Forecasting Timeline and Milestones

Challenges

The new state law requirement (i.e., SB 375) and the Great Recession (2007–2009) posed new challenges in the development of the 2012–2035 RTP/SCS growth forecast. With the introduction of SB 375 in California, federal program/requirement (RTP and conformity analysis) and two state programs (RHNA and Blueprint) as well as local general plans have become more strongly interlinked. Furthermore, as the foundation for developing these plans and programs, the 2012–2035 RTP/SCS growth forecast is required to be consistent.

SCAG began developing the long term growth forecasts for the 2012–2035 RTP/SCS in the middle of the Great Recession (2007–2009). The traditional long term perspective, which might not reflect on-going economic trends and frequently updated short term economic forecasts, had the potential to result in a serious bias in the short term population projections. The most important source of potential projection errors was the unstable/uncertain nature of the key economic-demographic assumptions. Two of the key assumptions were short-term unemployment and migration rates.

Due to the current economic climate and the uncertain nature of the short term economic future in the region, the accuracy and the reasonableness of population projections (and assumptions) by the US Census Bureau and the California Department of Finance (DOF) were questioned by regional demographers and economists. In addition, relevant statistical data has not always been made available to regional planners in a timely manner.

There was also a significant gap between the US Census Bureau and the DOF population estimates during the intercensal period. Both agencies have used their own methods in generating population estimates for this period. The gap in population estimates in the late 2000s was very high. In the SCAG region, the difference was 4.2 percent in 2009. SCAG generally uses the CA DOF population estimates for planning and forecasting purposes. The gap issue was resolved as DOF benchmarked its estimates to the 2010 Census count. Nevertheless, the adjustment process of the preliminary growth forecast was quite challenging, due to the limited time available to produce the revised growth forecast for the 2012–2035 RTP/SCS.

Forecasting Timeline and Milestones

TABLE 1 lists the forecasting timeline and milestones for the development of the regional growth forecast for the 2012–2035 RTP/SCS. SCAG began its forecast update process by conducting subregional workshops throughout the region in September 2008. When necessary, one-on-one meetings were arranged for local jurisdictions or subregions in the SCAG region. Through these workshops and one-on-one meetings, SCAG confirmed the accuracy of the small area socioeconomic data (SED), existing land use as of 2008, and local general plan information. As a result of the workshops and one-on-one meetings, SCAG revised and updated the 2008 regional growth forecast methodology and its key

assumptions, and developed the framework for future dialogue between SCAG planners and local and subregional planners.

During the first quarter of 2009, SCAG developed an initial range of the regional growth forecasts for the 2012–2035 RTP/SCS, which was released in April 2009. Since the Great Recession was in full force at that time, the region had experienced an enormous job reduction accompanied by high unemployment rates. With a high degree of uncertainty on the short term job growth and its potential impact on domestic and international migration, SCAG adjusted its forecasting framework for both the short term and long term perspectives. The direction of the short term economic perspective was considered important in the uncertain forecasting context. Three scenarios of job growth, high, mid, and low were used as a major driver of the region's population growth, which eventually influences household growth.

In May 2009, a first panel of experts meeting was held to review an initial range of regional growth forecasts and related assumptions. The panel of experts was composed of fifteen experts in the field of regional and national economics and demography. Experts were provided with a list of questions regarding assumptions with background information (e.g., historical data and a preliminary range of forecast by the moderator) before the panel of experts meeting. SCAG incorporated the recommendations of the panel of experts into the refined range of regional growth forecasts, and developed a recommended preliminary set of regional growth forecasts in June 2009. The preliminary county and sub-county sets of growth forecasts, reflecting recent trends, were released in July 2009.

Between July 2009 and February 2010, SCAG conducted a second round of local/subregional review through workshops and one-on-one meetings with local jurisdictions and subregions. First, SCAG provided local jurisdictions with the preliminary set of growth forecasts at the city and 2000 census tract, and transportation analysis zone levels. Second, SCAG held a workshop to explain the methods and assumptions of how the growth forecasts at jurisdictional/census tract/transportation analysis zone level were developed. Third, the local jurisdictions or subregions provided SCAG with their input on those growth forecasts along with proper documentation. In February 2010, SCAG released a local input/general plan growth forecast for 2012–2035 RTP/SCS. In fact, this SED data was used for developing the SCAG suggested emission reduction targets for the years 2020 and 2035.

The local input SED data resulted in an imbalance of regional population and employment for the year 2035. As usually occurs, the local input SED data tends to have less regional population (labor force or workers) than required to meet the projected employment in 2035. In April 2010, SCAG began analyzing the sensitivity of the labor force participation level, given population and employment. In May 2010, the second panel of experts meeting was held to evaluate local input, and new Bureau of Labor Statistics (BLS) and US Census projections. The expert panel recommended SCAG reduce employment to maintain a reasonable relationship between population and employment. The relationship between the two regional forecasts is usually assessed using the double jobbing rate, the implied unemployment rate, and labor force participation rates. These factors were assumed to remain unchanged from historical levels. SCAG focused on the uncertainty of the labor force participation rate due to (1) the increasing share of female workers, (2) a higher survival rate, and (3) the sensitivity to extra job opportunities and supply of a skilled workforce. SCAG found that the aging population would effectively respond to the shortage of workforce in the region by increasing their labor force participation rate.

SCAG adjusted the local input regional growth forecast with a 2035 employment reduction between December 2010 and January 2011. This SED data was used for the preliminary regional transportation model calibration and validation for the 2012–2035 RTP/SCS. Between January 2011 and March 2011, SCAG conducted further data gathering workshops and, as necessary, made revisions to the local input growth forecast.

In May 2011, SCAG conducted the third and final panel of experts survey to evaluate new 2010 Census data and existing demographic and economic assumptions. The third expert panel consisted of the same panel members, who had participated in the first and second panel of experts meeting. They provided SCAG with updated perspectives of the short term economic future of the region and its implication for population and household forecasts. SCAG continued collecting and updating the local growth forecasts and revised them as necessary between June 2011 and July 2011. During the same time period, SCAG consulted HCD/DOF for SCAG region growth forecasts and RHNA determination, and held RTP/SCS workshops across the region and conducted public outreach for review of the socioeconomic data.

After developing the draft 2012–2035 RTP/SCS between July 2011 and November 2011, SCAG released the draft plan in December 2011. SCAG distributed the draft RHNA allocation plan in February 2012. The Regional Council will be adopting the 2012–2035 RTP/

SCS in April 2012. The regional growth forecast is adopted as part of the 2012–2035 RTP/SCS and RHNA process.

TABLE 1 Forecasting Timeline and Milestones

	Milestone	Date/Period
1	Adopted 2008 RTP growth forecasts.	May 2008
2	Conducted subregional workshops across the region in anticipation of 2012–2035 RTP/SCS growth forecast, data and tool requirements under the SB 375.	September 2008–January 2009
3	Developed an initial range of preliminary 2012–2035 RTP/SCS regional growth forecasts with major demographic and economic assumptions.	April 2009
4	Held the first panel of experts meeting to assess BLS, Census, and DOF projections and to discuss demographic and economic trends and assumptions.	May 2009
5	Developed a recommended preliminary set of regional growth forecasts.	June 2009
6	Developed a preliminary set of growth forecasts at the county and sub-county level, reflecting the recent trends.	July 2009
7	Held subregional workshops across the region and conducted outreach for local review.	July 2009 – February 2010
8	Released local input/general plan growth forecast for 2012–2035 RTP/SCS. This dataset was used for target setting recommendation.	February 2010
9	Observed the imbalance of 2035 regional population and employment from local input.	April 2010
10	Held the second panel of experts meeting to evaluate local input, and evaluate new BLS and Census projections.	May 2010
11	Local input regional growth forecast with 2035 employment reduction.	December 2010–January 2011
12	Conducted data gathering workshops & made revisions.	January 2011–March 2011
13	Conducted the third panel of experts survey to evaluate new 2010 Census data and existing demographic and economic assumptions.	May 2011
14	Collected local input and revised forecasting data as necessary.	May 2011–August 2011
15	HCD/DOF consultation for SCAG region growth forecasts and RHNA determination.	June 2011–August 2011
16	Held RTP/SCS workshops across the region and conducted public outreach for review.	June 2011–August 2011
17	Developed the draft 2012–2035 RTP/SCS. The dataset was used for regional transportation model calibration and validation.	July 2011–November 2011
18	Released the draft 2012–2035 RTP/SCS.	December 2011
19	Distributed the draft RHNA allocation plan.	February 2012
20	Will adopt the 2012–2035 RTP/SCS.	April 2012

Section II: Regional Growth: Past and Future

Growth Trends

POPULATION

The United States Census of 1850 counted the population of the Southern California Region to be 3,530. At that time, the population of the United States was 23,191,876. The regional share of the nation's population was close to zero. According to the 2010 Census, the population of the Southern California Region was 18,051,534, which represents over 5.8 percent of the US population of 308,745,538, and nearly 49 percent of California's population of 37,253,956. With the region's land area of 38,000 square miles, the region's population density is now 475 persons per square mile. The Southern California region is the 5th highest in population among states in the nation, behind Florida, and the second largest combined statistical area (CSA) in the nation behind the New York CSA.

The region's population growth over the last 160 years can be categorized into four major periods using statewide growth as a reference: very rapid growth (1850–1910), rapid growth (1910–1960), average growth (1960–1990), and slow growth (1990–2010) (see **TABLE 2**). The very rapid growth (1850–1910) represents the early stage of urbanization in the region. The railroad lines were first introduced into this agrarian region, and they played an important role in the region's growth and urbanization. The annual average growth rate of population in the region in this period was 311 percent, which is 60 times higher than the national rate, and 8 times higher than the California rate.

The rapid growth (1910–1960) period represents the beginning and rapid stages of regional growth and urbanization. The region reached one million people in 1920 for the first time, and grew to five million people by 1950. It took only three decades for the region to add four million people. The annual average growth rate of population in the region was 22 percent, which is 10 times more than that of the nation, and twice that of California.

The average growth (1960–1990) period represents regional growth and urbanization comparable to that of the state. In 1970, the SCAG region's population reached 10 million and exceeded 50 percent of the California population. By adding 4.6 million people to the region between 1970 and 1990, the region has evolved into one of the largest metropolitan regions in the nation. There was an accelerated suburbanization during this period. Four of six counties in the region exceeded one million people in 1990. The annual average growth rate of population in the region was 2.9 percent, which is 2 times more than that of the nation, and similar to that of California.

The slow growth (1990–2010) period represents the mature stage of population growth and urbanization. During this period, the region added 3.4 million people, which was a much slower growth pattern than in the previous decades. Although the regional growth stabilized during this period, urbanization and suburbanization continued. Orange County exceeded three million people, and Riverside and San Bernardino Counties exceeded two million people each in 2010. The annual average growth rate of population in the region was 1.2 percent, similar to that of California and the nation. Both the region and California became average growth areas from the perspective of the national growth.

TABLE 2 Annual Average Growth Rate of Population, 1850–2010

Periods	1850–1910	1910–1960	1960–1990	1990–2010
SCAG Region	311.0%	21.6%	2.9%	1.2%
California	41.1%	11.2%	3.0%	1.3%
US	5.0%	1.9%	1.3%	1.2%

Source: US Census Bureau.

Two factors account for population change: natural increase and net migration. Natural increase is the balance between births and deaths in a period and net migration is the sum total of people coming to and leaving the region in the same period. Net migration is of two types: domestic and international. Domestic migration is the movement in and out of the region from other parts of the country, and immigration is the flow of people from other countries. Net migration greatly influenced the region's past and recent population growth.

The region's economic growth is usually a major factor behind net migration and the consequent population growth. The availability of jobs attracts people to the region, whereas in times of recession, the reverse is true. Major economic recessions in the 1930s (1929–1933, 1937–38), 1970s (1973–1975), 1990s (1990–1993), and 2000s (2007–2009) have had a negative impact on the region's population growth. As a result, the annual average growth rate of population in the region during those periods was 2.5 percent, 1.5 percent, 1.3 percent, and 0.9 percent, respectively. The growth of the motion picture, petroleum, and aircraft industries and the region's reputation as the land of opportunity explain the tremendous growth in the region during the 1980s. It should be noted that the recession in the 1990s was the result of major cuts in the national defense budget which affected the region much more severely than the rest of the nation. The regional population over the last couple of decades has become increasingly home-grown Californians (Myers et al, 2010) as the major component of change has been natural increase.

The region currently faces serious challenges caused by the recent economic recession that began in December 2007. The region lost approximately 800,000 jobs from 2007 to 2010. Although the economic recession officially ended in 2009, the region is still struggling to bring its economy back to the pre-recession level. The future growth will depend on how the region addresses its economic challenges.

EMPLOYMENT

Both the economic recession and globalization have heavily affected the restructuring of the industrial sectors from manufacturing to more service oriented industries (see **TABLE 3**). In particular, both the construction and manufacturing sectors declined due to the recessions and globalization, respectively. The construction sector plays an important role in economic growth through diverse development activities. There is usually little development activity during the recession period. The overall share of the construction industry decreased from 5 percent in 1990 to 4 percent in 2010. At one point in 2005, its share reached 6 percent of all industry sectors and immediately declined to 4 percent in 2010 due to the economic recession. The manufacturing sector has consistently decreased its share from 17 percent in 1990 to 9 percent by 2000 and 8 percent in 2010. The manufacturing sector generally provides workers with higher pay than other sectors. With such a rapid decline in the manufacturing sector jobs, the economic quality of the region has declined. In contrast, services sectors including education, health services, and the leisure and hospitality sector showed an increase in their share of jobs in the region. Education and health service jobs increased its share from 17 percent in 1990 to 22 percent in 2010, and leisure and hospitality sector jobs increased its share from 8 percent in 1990 to 11 percent in 2010.

TABLE 3 Regional Employment Trends, 1990–2010

	1990	2000	2010	Difference (1990–10)	% Change (1990–10)
Jobs ('000)	6,906	7,482	7,225	319	4.6
Jobs by NAICS					
Agriculture & Mining (%)	1.4	1.1	1.0	-0.4	-24.3
Construction (%)	5.0	4.9	4.0	-0.9	-15.2
Manufacturing (%)	17.1	13.7	9.2	-8.0	-44.0
Wholesale Trade (%)	5.0	5.0	5.1	0.0	5.4
Retail Trade (%)	10.5	10.3	10.8	0.4	8.2
Transportation and Warehousing, and Utility (%)	4.4	4.7	4.8	0.3	12.2
Information (%)	3.6	4.3	3.5	-0.1	0.8
Financial Activity (%)	6.7	5.6	5.8	-0.9	-9.6
Professional and Business Services (%)	13.7	15.6	15.3	1.7	17.6
Education and Health Services (%)	17.0	19.1	22.0	5.0	35.3
Leisure and Hospitality (%)	8.3	8.9	10.6	2.3	33.2
Other Services (%)	3.8	3.9	4.0	0.2	10.5
Public Administration (%)	3.5	2.9	4.0	0.5	18.3
Total (%)	100.0	100.0	100.0	0.0	

Note: (1) education and health; and (2) local ground transportation/USPS and utility sectors in Public Administration from CA EDD database were reassigned to (1) education and health services and (2) transportation and utility sector, respectively. *Source: CA EDD and SCAG.*

URBANIZATION AND SUBURBANIZATION PATTERNS

Although the regional growth rate stabilized in the last 20 years, the urbanization and suburbanization of the region has continued (see **TABLE 4**). In 2010, Orange County exceeded three million people, and Riverside and San Bernardino Counties exceeded two million people each. Riverside County is now the third largest county in the region. The Counties of Riverside and San Bernardino increased their share of the population from 17.7 percent in 1990 to 23.4 percent in 2010, while Los Angeles County decreased its share from 60.5 percent in 1990 to 54.4 percent in 2010. The fast growth of population, relative to employment, in Riverside and San Bernardino Counties has led to an imbalance of jobs and housing in the SCAG region, and poses serious transportation and air quality challenges.

TABLE 4 The County Share of the Regional Population, 1990–2010

County	1990 Number	1990 %	2000 Number	2000 %	2010 Number	2010 %
Imperial	109,303	0.7%	142,361	0.9%	174,528	1.0%
Los Angeles	8,863,164	60.5%	9,519,338	57.6%	9,818,605	54.4%
Orange	2,410,556	16.5%	2,846,289	17.2%	3,010,232	16.7%
Riverside	1,170,413	8.0%	1,545,387	9.4%	2,189,641	12.1%
San Bernardino	1,418,380	9.7%	1,709,434	10.4%	2,035,210	11.3%
Ventura	669,016	4.6%	753,197	4.6%	823,318	4.6%
SCAG	14,640,832	100.0%	16,516,006	100.0%	18,051,534	100.0%

Source: US Census Bureau

ECONOMIC RECESSIONS AND GROWTH TRENDS

The period between 1990–2010 is characterized as a slow growth period. The population growth (3.4 million) and job growth (308,000) during the 1990–2010 period was seriously affected by two major economic recessions.

The first recession started in 1990 and ended in 1993. This recession was caused primarily by federal defense budget cuts. Many defense workers in the region lost their jobs during the 1990–1993 period. The job losses in the region reached 500,000 during the period and the region's unemployment rate ranged from 5.6 percent in 1990 to 9.7 percent in 1993 (see **FIGURES 1–3**). This economic recession primarily affected domestic migration into and out of the region. During the 1990–1996 period, net outmigration reached nearly 1.1 million people as a result of net domestic out-migration, while net immigration was not affected (see **FIGURES 7–8**). As a result of the change in the components of population change, the percent change of population gradually declined from 2 percent in 1990–1991 to 0.5 percent in 1994–1995 (see **FIGURES 5–6**).

The second recession started in 2007 and ended in 2009. During the 2007–2010 period, the region lost 800,000 jobs. The region's unemployment rate reached 12.3 percent in 2010 (see **FIGURE 1**). The impact of this economic recession on migration was different from the recession in 1990–1993. This recession affected both net domestic and net immigration (see **FIGURES 7–8**). During the 2007–2010 period, nearly 420,000 people left the region as a result of net domestic migration. The level of net domestic migration in the recession of 2007–2010 was much smaller than in 1990–1993. The net immigrants in the recession of 2007–2009 are estimated at 250,000 (annual estimate of 83,000), which is much smaller than 767,000 (annual estimate of 128,000) during the 1990–1996. The second recession resulted in the lowest percent change (0.4 percent) in annual population during the past 20 year span.

The number of births declined from 328,000 in 1990–1991 to 258,000 in 2009–2010 (see **FIGURE 9**). Although there was a sign of increasing births from 2001–2002 to 2007–2008, both recessions must have negatively affected the decision to have children.

With two recessions in 20 years, the region's job estimates have moved up and down (see **FIGURE 2**). The region's 6.9 million jobs in 1990 decreased to 6.4 million jobs in 1993. The region had an increase in jobs from 6.9 million in 1990 to 8 million in 2007. As a result of the second recession, the number of jobs was reduced from 8 million jobs in 2007 to 7.2 million jobs in 2010. The percent change of jobs between 1990 and 2000 is only 4.5 percent, which is much lower than the 23.4 percent population increase. Therefore, the population to employment ratio rapidly increased from 2.12 in 1990 to 2.51 in 2010 (see **FIGURE 10**).

FIGURE 1 Unemployment Rate, SCAG Region, 1990–2010

FIGURE 2 Job Growth, SCAG Region, 1990–2010

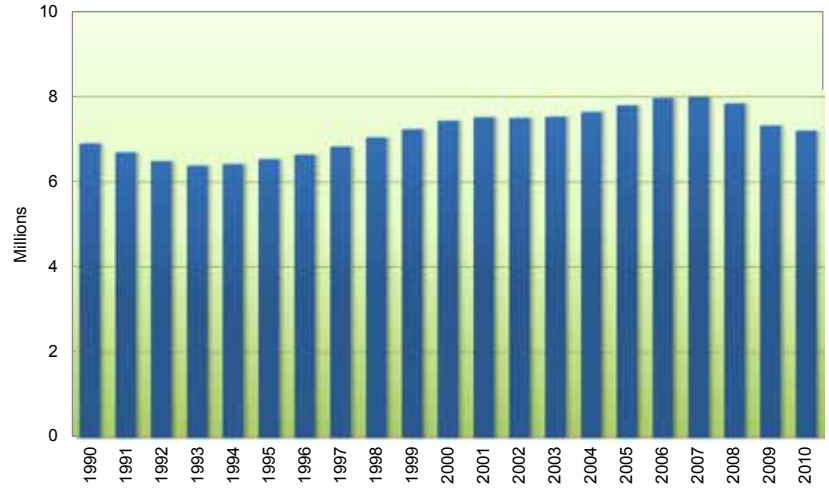


FIGURE 3 Percent Change of Jobs, SCAG Region, 1990–2010

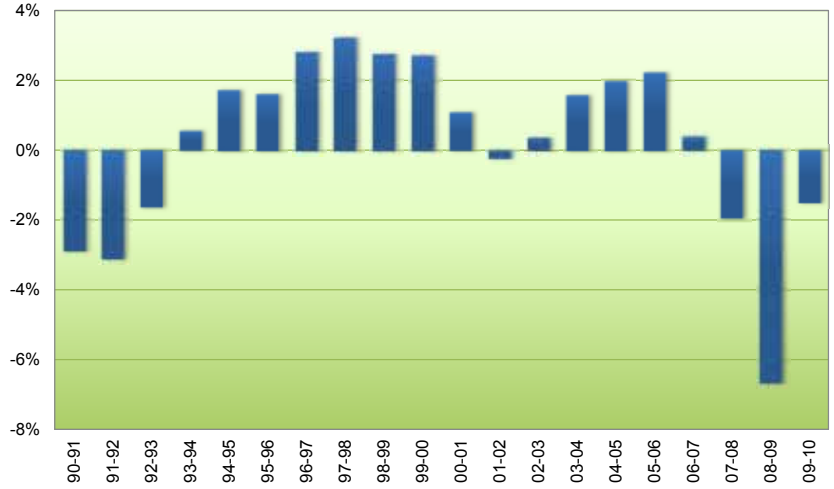


FIGURE 4 Population Growth, SCAG Region, 1990–2010

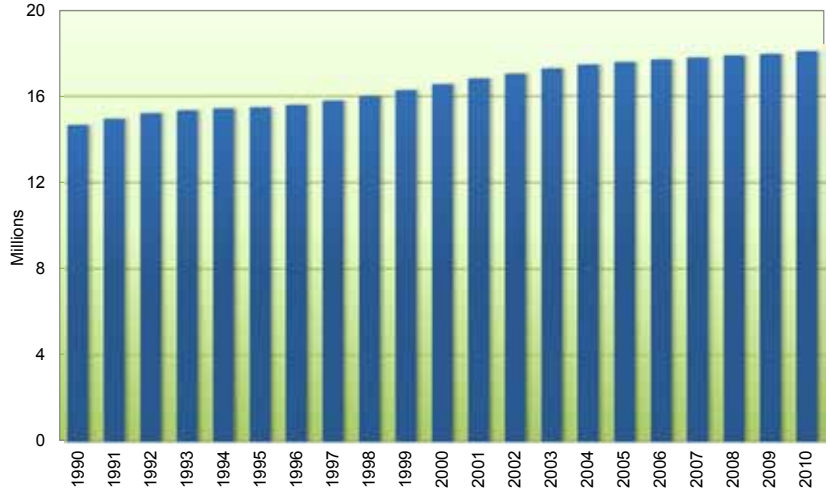


FIGURE 5 Percent Change of Population, SCAG Region, 1990–2010

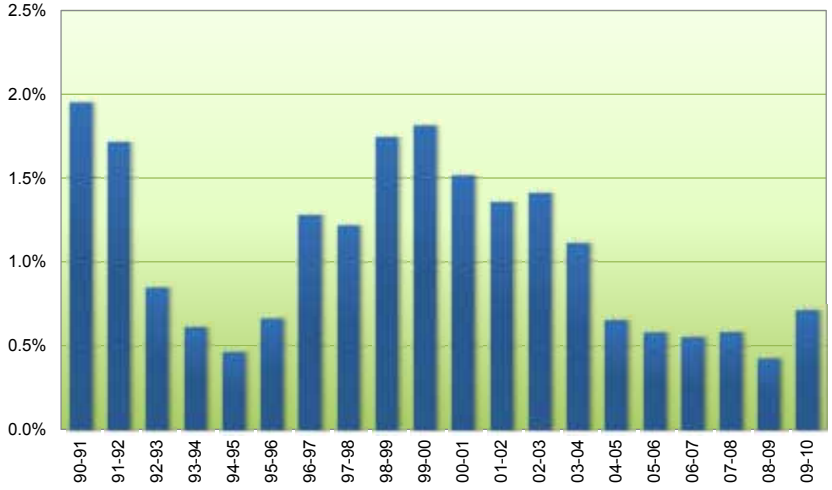


FIGURE 6 Components of Population Change, SCAG Region, 1990–2010

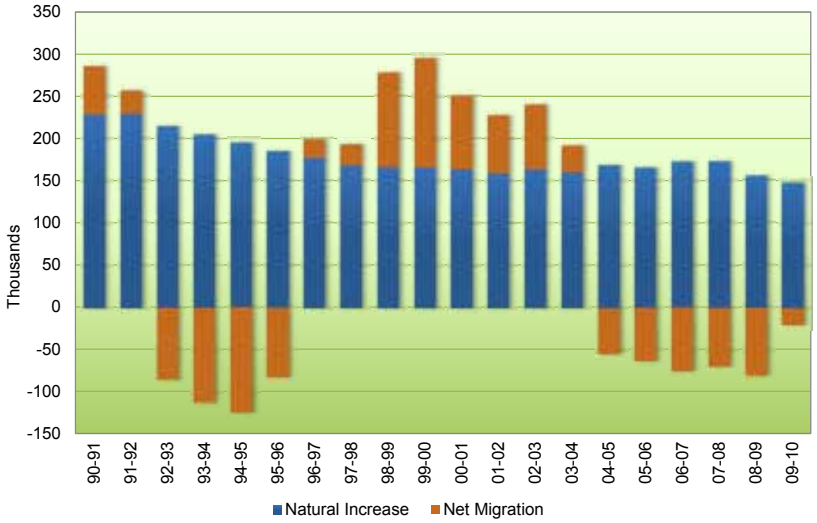


FIGURE 7 Net Domestic Migration, SCAG Region, 1990–2010

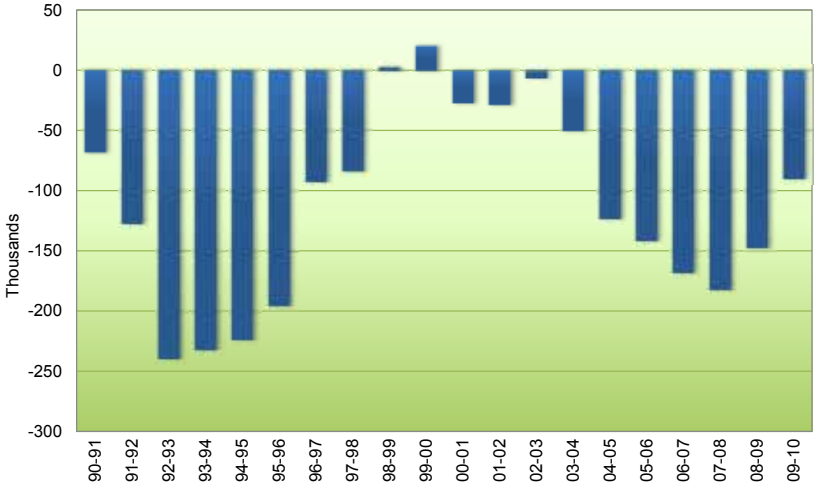


FIGURE 8 Net Immigration, SCAG Region, 1990–2010

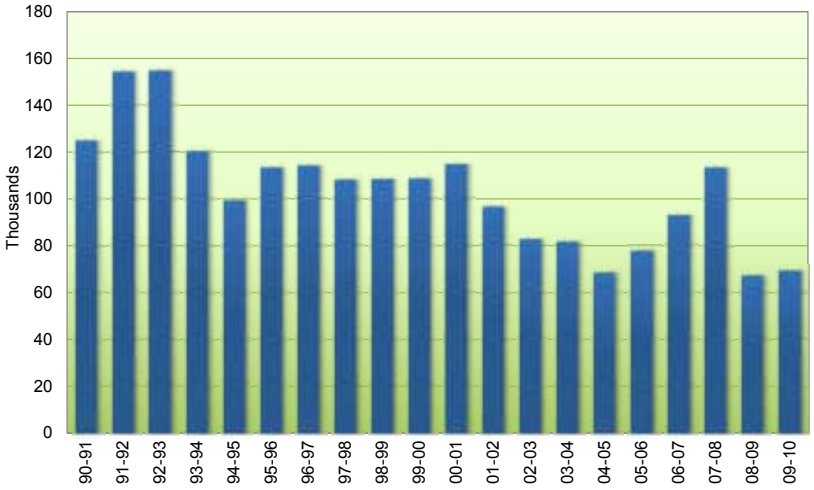


FIGURE 9 Births, SCAG Region, 1990–2010

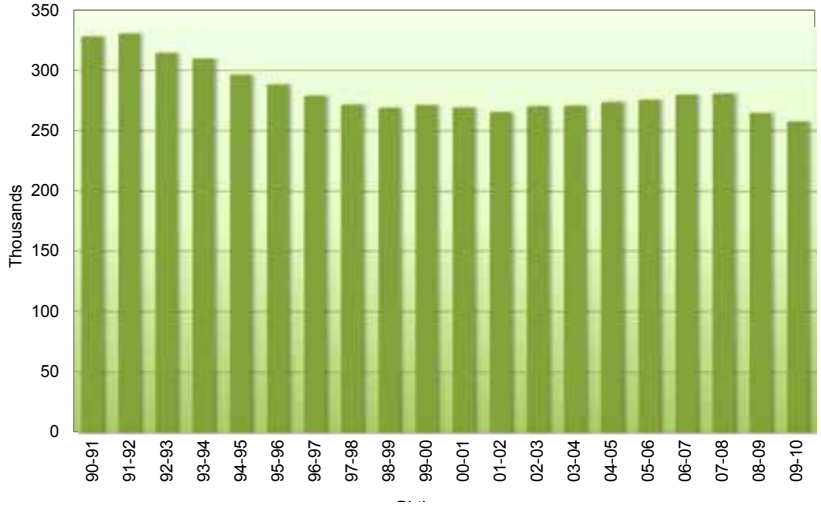
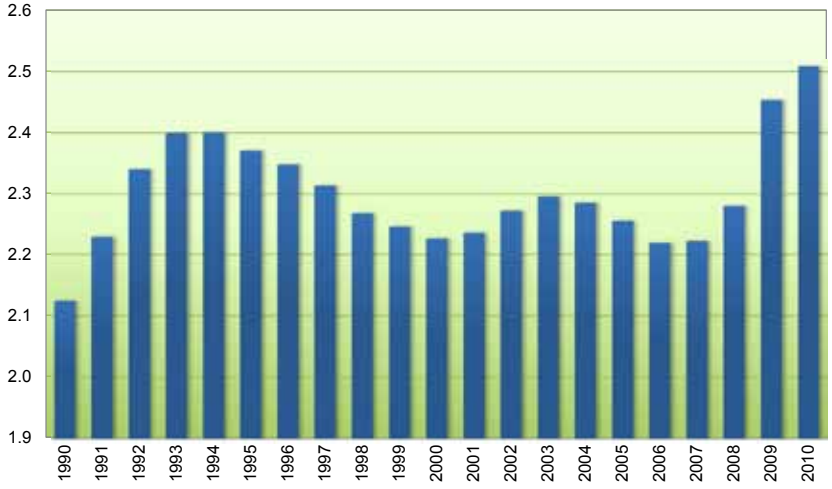


FIGURE 10 Population to Employment Ratio, SCAG Region, 1990–2010



Growth Forecast

The regional growth forecast is used as a key guide for future transportation investments in the SCAG region. The 2012–2035 RTP/SCS growth forecast was developed reflecting both the short term and long term perspectives. The latest 2010 Census data and 2011 EDD data indicate lower population, households and employment for year 2010 than forecasted in the 2008 RTP. The region is still expected to grow over the RTP planning period (2008–2035)—adding 4.2 million new residents, 1.5 million new households, and 1.7 million new jobs by 2035 (see **FIGURES 11** and **12**).

FIGURE 11 Population, Employment, and Households, SCAG Region, 2008 and 2035

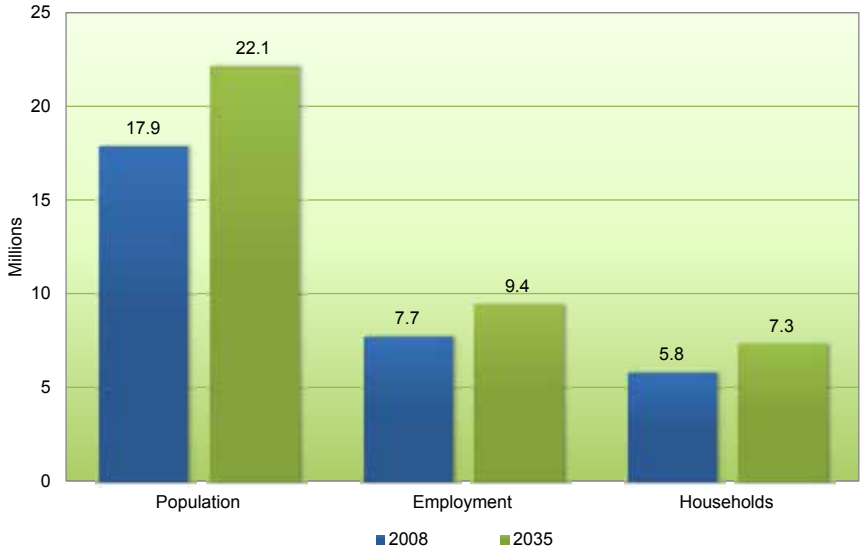


FIGURE 12 Population, Employment, and Household Growth, SCAG Region, 1970–2035

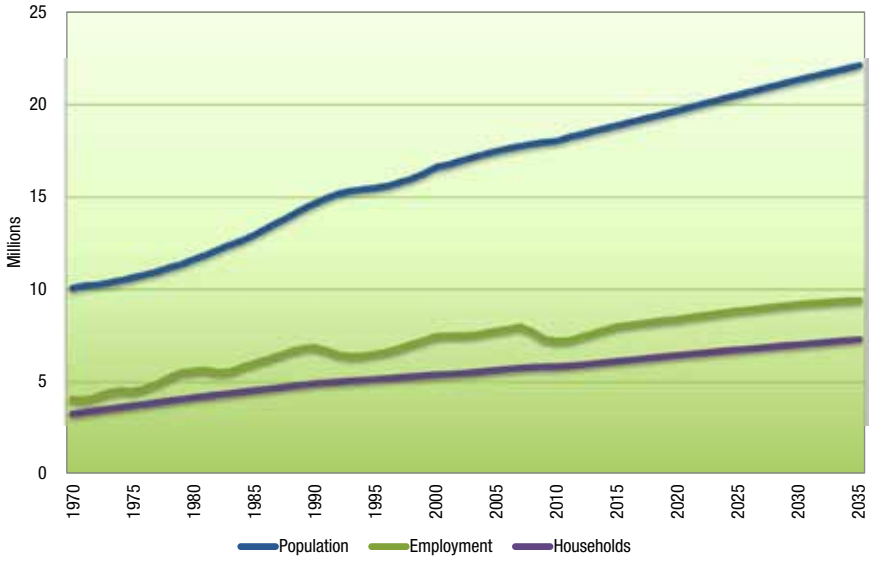
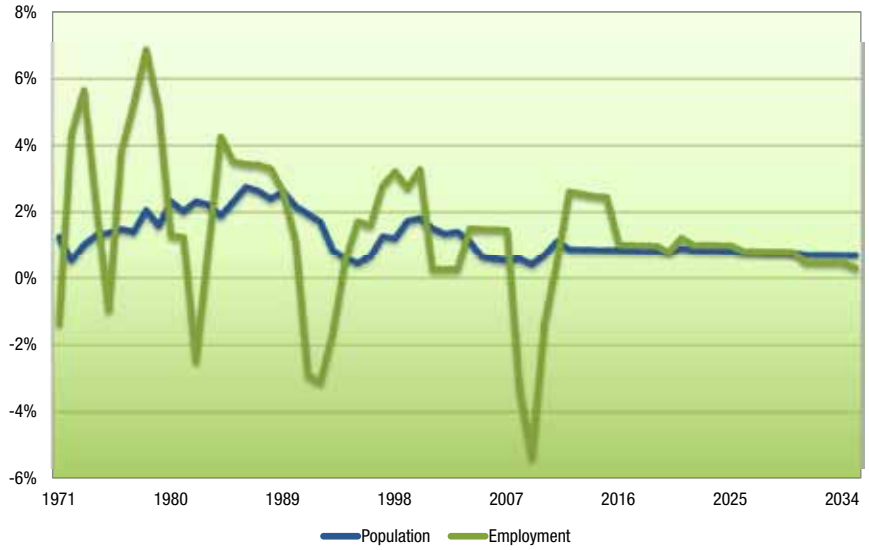


FIGURE 13 Percent Change of Population and Employment, SCAG Region, 1970–2035



POPULATION

The slower population growth pattern experienced in the last decade is expected to continue into the future. Between 2010 and 2035, the annual population growth rate will be only 0.9 percent, which is lower than the growth rate for the past 20 years. The region will grow mainly through natural increase (see **FIGURES 16–18**).

The most salient demographic characteristics of the projected population in the region will be the aging of population and shifts in ethnic distribution (see **TABLE 5** and **FIGURES 14–15**). With the aging of the baby boomer generation (born between 1946 and 1964), the median age of the population is projected to increase from 34.2 in 2010 to 36.7 in 2035. The share of the population 65 years old and over is projected to increase from 11 percent in 2010 to 18 percent in 2035, while the share of the population less than 65 years old decreases from 89 percent in 2010 to 82 percent in 2035. In particular, the share of the population of the working age 16–64 has its share sharply decline from 65 percent to 60 percent during the projection period. This implies a future shortage of workers. With the increasing share of the older population and the decreasing share of the working age population, the aged dependency ratio (i.e., the number of aged people per hundred people of working age) is projected to increase from 17 percent in 2010 to 30 percent in 2035 (an increase of 13 percent during the period).

The other characteristic of the projected population is the racial/ethnic diversity (see **TABLE 5**). The region already has a high level of racial/ethnic diversity in 2010 with a Hispanic population of 45 percent, a non-Hispanic White population of 34 percent, a non-Hispanic Asian population and others of 14 percent, and a non-Hispanic Black population of 7 percent. The region's racial/ethnic composition is projected to exhibit a rapid change toward a majority Hispanic population of 56 percent in 2035, while the share of the non-Hispanic White population is projected to drop sharply to 22 percent.

TABLE 5 Demographic Characteristics of Regional Population, 2010, 2020, and 2035

	2010	2020	2035	Difference (2010–2035)	% Change (2010–2035)
Total population ('000)	18,104	19,663	22,091	3,987	22.0
Births per 1,000 population (05–10, 15–20, 30–35)	15.4	15.3	14.5	-0.9	
Total fertility rate (per woman) (05–10, 15–20, 30–35)	2.2	2.2	2.2	0.0	
Deaths per 1,000 population (05–10, 15–20, 30–35)	6.2	6.4	7.6	1.4	
Natural increase (%) (05–10, 15–20, 30–35)	143.9	111.0	95.4		
Net migration (%) (05–10, 15–20, 30–35)	-43.9	-11.0	4.6		
Age composition of population					
Persons under 16 years old (%)	23.2	22.6	21.9	-1.3	15.2
Persons 16–64 years old (%)	65.9	63.6	60.1	-5.8	11.7
Persons 65 years old and over (%)	10.9	13.8	18.0	7.1	101.5
Total	100.0	100.0	100.0		
Median age	34.2	35.2	36.7	2.4	
Dependency ratio*					
Child dependency ratio**	35.2	35.5	36.5	1.3	
Aged dependency ratio***	16.6	21.6	29.9	13.3	
Total	51.8	57.2	66.4	14.6	
Ethnic composition of population					
Non-Hispanic White persons (%)	33.8	28.8	22.3	-11.5	-19.0
Non-Hispanic Black persons (%)	7.0	6.7	6.2	-0.8	8.5
Non-Hispanic Asian & Other persons (%)	14.0	14.5	15.1	1.2	32.6
Hispanic persons (%)	45.3	49.9	56.3	11.0	52.2
Total	100.0	100.0	100.0		

Note: *The number of children (age 0-15) and aged persons (age 65 and over) per hundred people of working age (age 16–64). ** The number of children per hundred people of working age. *** The number of aged people per hundred people of working age. *Source: SCAG*

FIGURE 14 Population Pyramids, SCAG Region, 2010 and 2020

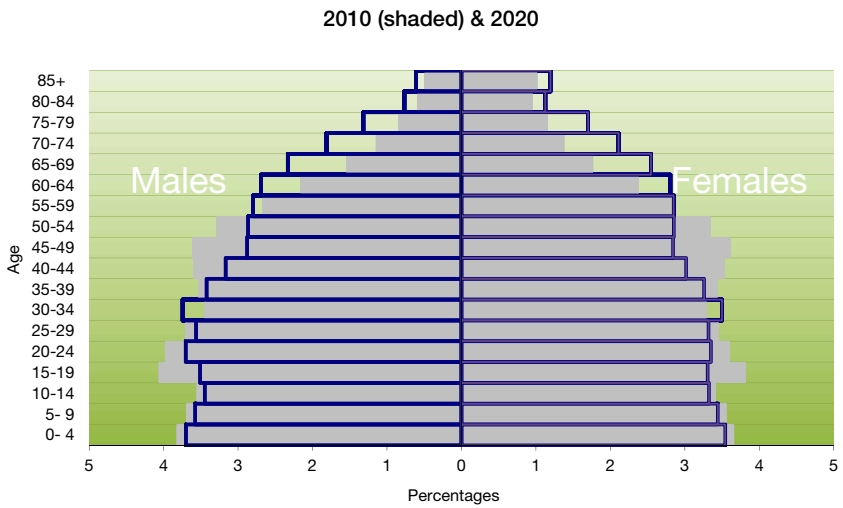


FIGURE 15 Population Pyramids, SCAG Region, 2010 and 2035

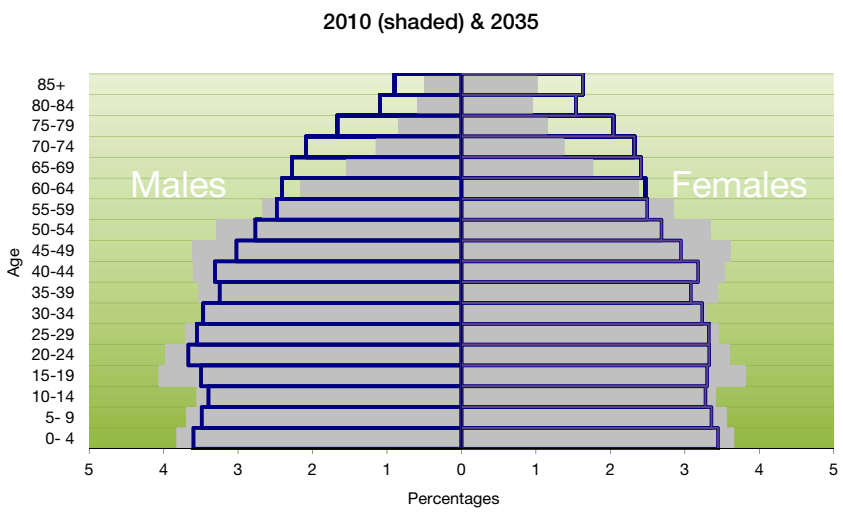


FIGURE 16 Components of Population Change, SCAG Region, 1970–2035

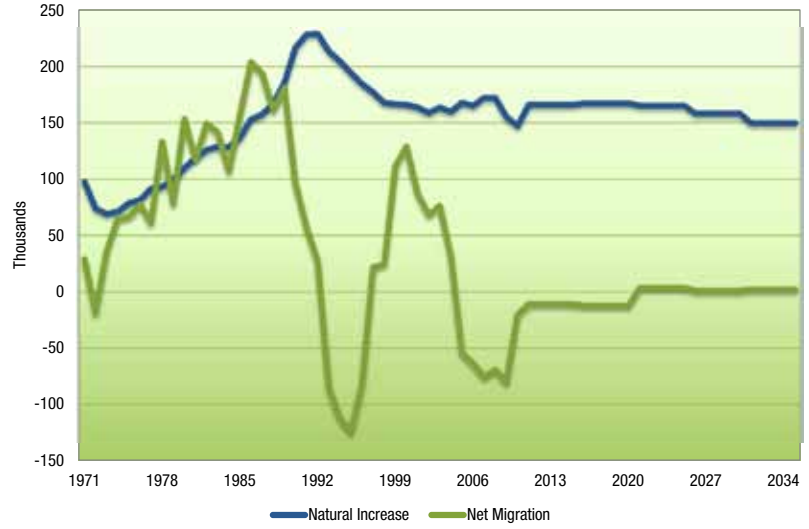


FIGURE 17 Births and Deaths, SCAG Region, 1970–2035

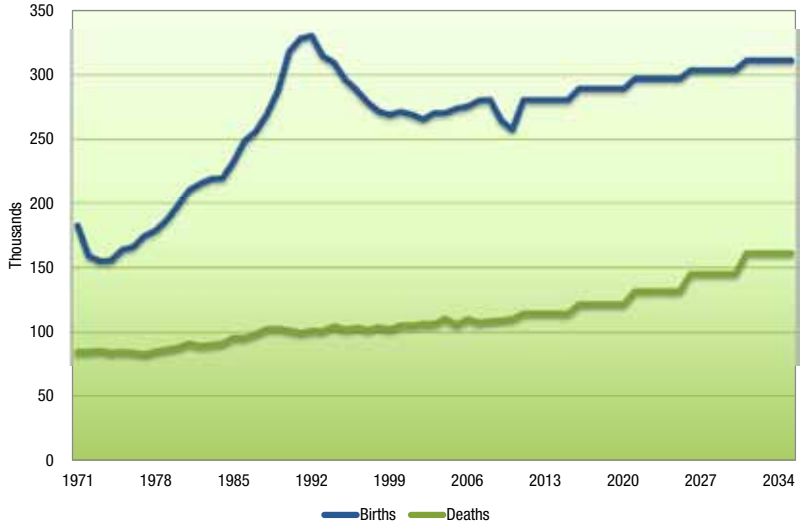
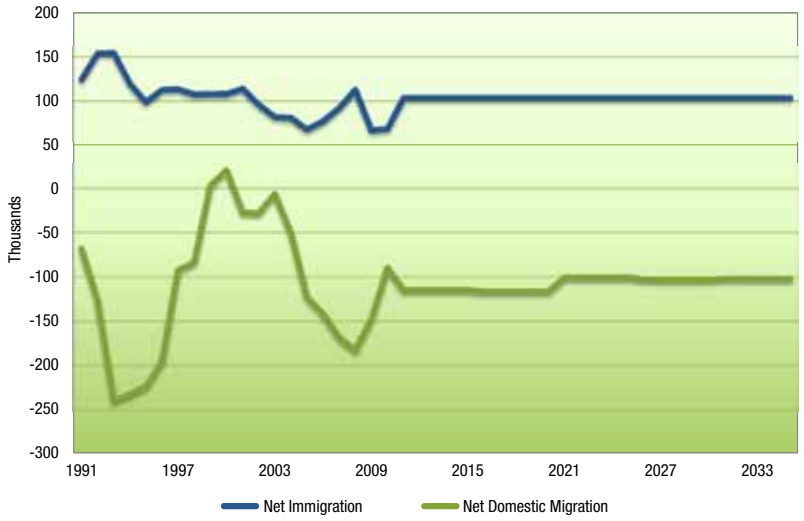


FIGURE 18 Net Immigration and Net Domestic Migration, SCAG Region, 1990–2035



HOUSEHOLDS

As the population ages and diversifies in the region during the projection period, householders follow the same path (see **TABLE 6**). The number of householders 65 years or older will reach more than 2 million in 2035 with the addition of one million households in the next 25 years. The growth of the senior householders will represent more than 70 percent of the projected household growth in the region. However, the share of householders in the younger age groups will decline. In particular, householders 45–54 years old will show an absolute decline.

The racial/ethnic distribution of householders will also change. The non-Hispanic White householders will decrease from 44 percent in 2010 to 29 percent in 2035, while Hispanic householders will increase from 35 percent in 2010 to 47 percent in 2035. The household size will also decline from 3.04 in 2010 to 2.97 in 2035 as a result of the dynamics of the changing age and racial/ethnic composition of the projected population and declining birth rates.

TABLE 6 Characteristics of Regional Households, 2010, 2020, and 2035

	2010	2020	2035	Difference (2010–35)	% Change (2010–35)
Total households ('000)	5,853	6,458	7,325	1,472	25.1
Age composition of householders					
15–24 (%)	3.9	3.4	3.4	-0.5	7.8
25–34 (%)	16.4	16.9	15.4	-1.0	17.8
35–44 (%)	21.3	18.5	18.4	-2.8	8.4
45–54 (%)	22.7	19.4	17.7	-5.0	-2.3
55–64 (%)	17.0	18.8	15.6	-1.4	14.8
65–74 (%)	10.1	13.4	14.9	4.8	84.7
75+ (%)	8.7	9.5	14.6	5.9	110.1
Total	100.0	100.0	100.0		
Ethnic composition of householders					
Non-Hispanic White householders (%)	43.7	37.3	28.8	-14.9	-17.6
Non-Hispanic Black householders (%)	8.0	7.9	7.5	-0.6	16.0
Non-Hispanic Asian & Other householders (%)	13.7	14.9	16.3	2.6	48.7
Hispanic householders (%)	34.5	39.9	47.4	12.9	72.0
Total	100.0	100.0	100.0		
Average household size					
Non-Hispanic White households	2.3	2.3	2.2	-0.1	
Non-Hispanic Black households	2.6	2.5	2.4	-0.2	
Non-Hispanic Asian & Other households	3.1	2.9	2.7	-0.4	
Hispanic households	4.0	3.8	3.5	-0.5	
Total	3.0	3.0	2.9	-0.1	

Source: SCAG

EMPLOYMENT

Two economic recessions and globalization were the major factors behind the slow growth in the region over the past 20 years. Although recessions and further globalization are expected, the region is still expected to add 2.2 million jobs, from 7.2 million in 2010 to 9.4 million in 2035. The annual average growth rate in jobs will be over 1 percent. The region will be recovered from the recent economic recession in the near future. In the long run, the regional economy will get back to normal with reasonable labor force participation rates and unemployment levels.

The region's industrial mix, however, will experience continuous change over time due to globalization (see **TABLE 7**). The region will transform its industrial structure from manufacturing oriented industries to the service oriented industries. The construction sector will regain its normal share by increasing from 4 percent in 2010 to 6.5 percent in 2035. Selected service sectors including professional and business services, education and health services will grow by more than one million and their share will increase from 37 percent in 2010 to 40 percent in 2035. The share of employment in the manufacturing sector will continue to decrease from 9 percent in 2010 to 8 percent in 2035 as a result of continued globalization.

There has been a concern about the economic performance of the region in recent years. SCAG initiated a discussion of an economic growth strategy among local and diverse stakeholders in the region. The economic growth strategy intends to improve the economic quality of life by maintaining the manufacturing sector and other traditional high income job sectors.

TABLE 7 Regional Employment Projections by Industry Sectors, 2010, 2020, and 2035

	2010	2020	2035	Difference (2010–35)	% Change (2010–35)
Total jobs ('000)	7,225	8,414	9,441	2,216	30.7
Jobs by NAICS					
Agriculture & Mining (%)	1.0	0.9	0.8	-0.2	5.5
Construction (%)	4.0	6.0	6.5	2.4	108.6
Manufacturing (%)	9.2	8.6	7.6	-1.6	8.0
Wholesale Trade (%)	5.1	4.9	4.8	-0.3	23.3
Retail Trade (%)	10.8	10.5	10.2	-0.6	23.1
Transportation and Warehousing, and Utilities (%)	4.8	4.6	4.6	-0.2	26.5
Information (%)	3.5	3.3	3.1	-0.4	16.2
Financial Activity (%)	5.8	5.7	5.5	-0.2	25.1
Professional and Business Services (%)	15.3	16.3	16.8	1.5	43.1
Education and Health Services (%)	22.0	22.0	23.1	1.1	37.2
Leisure and Hospitality (%)	10.6	9.7	9.6	-1.0	18.4
Other Services (%)	4.0	4.1	4.1	0.2	36.2
Public Administration (%)	4.0	3.3	3.3	-0.7	8.3
Total (%)	100.0	100.0	100.0	0.0	

Source: CA EDD and SCAG

COUNTY DISTRIBUTION OF POPULATION AND EMPLOYMENT

According to the SCAG growth forecast, Riverside and San Bernardino Counties will grow faster and increase their share of regional jobs while Los Angeles and Orange Counties decrease their share, between 2010 and 2035 (see **TABLE 8**). During the same period, in both Riverside and San Bernardino Counties the population to employment ratio will decline as relatively more jobs than population are added. Overall the population to employment ratio in each of the six counties will converge toward the regional average ratio.

TABLE 8 Regional Population and Employment Shares by County, 2010, 2020, and 2035

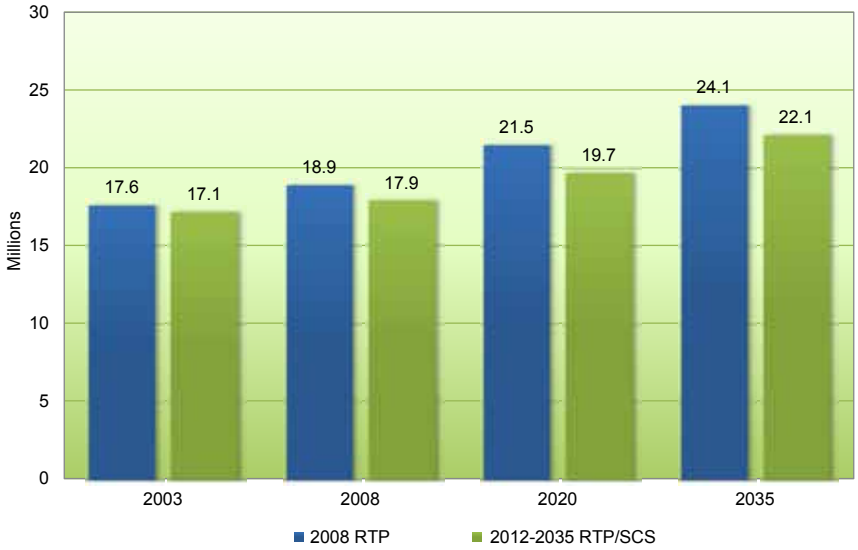
County	Share of Regional Population			Share of Regional Employment		
	2010	2020	2035	2010	2020	2035
Imperial	1%	1%	1%	1%	1%	1%
Los Angeles	54%	53%	51%	57%	54%	51%
Orange	17%	17%	15%	21%	19%	19%
Riverside	12%	13%	15%	8%	11%	13%
San Bernardino	11%	12%	12%	9%	10%	11%
Ventura	5%	5%	4%	5%	5%	4%
SCAG	100%	100%	100%	100%	100%	100%

Source: US Census Bureau and SCAG

COMPARISON OF 2008 RTP GROWTH FORECAST AND 2012–2035 RTP/SCS GROWTH FORECAST

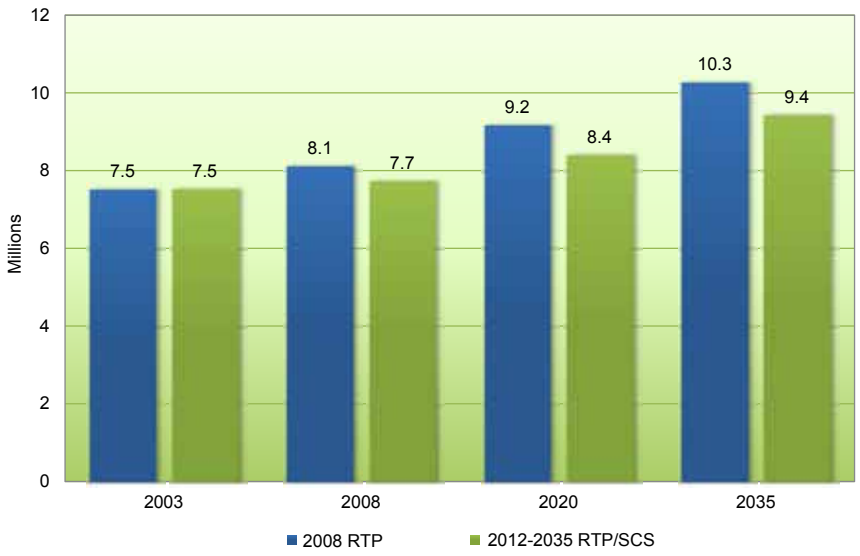
The growth forecast for the 2012–2035 RTP/SCS reflects the recent trends in components (e.g., births, deaths, domestic migration, international migration) of population growth and in job growth by sectors. The 2012–2035 RTP/SCS growth forecast for 2035 is lower than that of the 2008 RTP growth forecast (See **FIGURES 19–20**).

FIGURE 19 Population Growth, SCAG Region, 2003–2035: 2008 RTP vs. 2012–2035 RTP/SCS



Source: CA DOF and SCAG

FIGURE 20 Employment Growth, SCAG Region, 2003–2035: 2008 RTP vs. 2012–2035 RTP/SCS



Source: CA EDD and SCAG

Section III: Forecasting Framework, Methodology and Assumptions

Forecasting Framework

SCAG began developing the long term growth forecasts for the 2012–2035 RTP/SCS in the middle of the Great Recession (2007–2009). The traditional long term perspective, which might not reflect the on-going economic trends and the frequently updated short term economic forecast, might result in a serious bias in the short term population projections. The major sources of potential projection errors include: (1) the unstable/uncertain nature of the key economic-demographic assumptions, in particular, unemployment rate and migration in the short term framework; (2) the timing and reasonableness of population projections (and assumptions) by the US Census Bureau and CA DOF; (3) the lack of relevant statistical data in a timely manner; and 4) the significant gap in population estimates between the US Census Bureau and CA DOF.

SCAG uses the BULA (Balance, Uncertainty, Latest, and Adaptive) approach toward developing the regional growth forecasts. First, the regional forecasts should maintain the *Balance* between employment, population, and households due to their interrelationship, assuming that employment growth is a driving force of regional population and household growth. The employment-population-household (EPH) forecast framework has been the basis for developing the growth forecast for the SCAG region.

Second, the regional forecasts embrace the forecast *Uncertainty* as the recent population projections of US Census Bureau (2008) and California Department of Finance (2007) are quickly outdated in their consideration of the actual and projected international immigration. A range of regional growth forecasts are derived to reflect the different paths of national population growth with different immigration assumptions and their impact on national growth.

Third, SCAG makes an effort to use the *Latest* demographic and economic assumptions to ensure that the growth forecasts are current. The normative assumptions are also introduced into the forecast process as needed. For example, household formation behavior, measured in headship rates, is used to measure the housing needs of the projected population. The headship rates of minority ethnic populations did not show a convergence toward the headship rates of the White population. SCAG introduces the socially acceptable assimilation pattern into the assumption of the convergence of headship rates toward the White headship rates.

Finally, SCAG approaches development of growth forecasts in an *Adaptive* and flexible way. Many demographic and economic statistics are unstable and quickly outdated as the recession continued. SCAG collected those information materials and regularly went through the expert panel review (2009, 2010, 2011). Through the BULA approach, SCAG developed more realistic and accurate regional growth forecasts. SCAG annually updated the short term forecasts with the quickly changing demographic and economic conditions between 2009 and 2011 before adopting the growth forecast in April 2012.

UNCERTAINTY IN A REGIONAL GROWTH FORECAST AND EXPERT OPINION

In a rapidly changing and volatile economic environment, the usual economic and population projection models do not produce accurate projections. This is particularly true of the short term projections due to the unstable nature of the economic and demographic assumptions. The average approach (e.g., average of the newly available economic or demographic projections) might be a preferred approach for updating the new short term economic and demographic projections (Smith et al, 2001). Timely developed private sources of the near term or long term economic and demographic projections are available with a cost, although the demographic projections tend to rely on the most recent series of projections by the U.S. Census Bureau or the state statistical agency. The collective expert opinion could be a useful reference to reduce the short term and long term projection errors. The following is a brief summary of the expert opinion on critical factors and key economic and demographic assumptions collected through three panels of experts meetings between 2009 and 2011.

The Panel of Experts Meeting (2009)

A first panel of experts meeting was held on May 15, 2009. The panel was composed of fifteen experts in the field of regional and national economics and demography. These experts have developed economic or demographic forecasts for a long time or the agencies that they work for might have produced economic or demographic forecasts. They came from a variety of public or private organizations. Nearly 50 percent of the panel members come from universities in California (e.g., University of Southern California, University of California Los Angeles, University of California, Riverside, University of California, Santa Barbara, California State University, Long Beach, California State University, Fullerton). Other panel members come from state or local government agencies (e.g., Los Angeles Economic Development Corporation, South Coast Air Quality Management District, California Department of Finance), private consulting firms (e.g., Regional Economic Models, Inc., Beacon Economics, DB Consulting). Experts were provided with a list of questions regarding assumptions with background information (e.g., historical data and a preliminary range of forecasts by the moderator) a few days before the panel of experts meeting.

The survey questions focused on three major aspects of job and population projections: 1) short term economic outlook; 2) long term economic assumptions (e.g., regional share of the national job projections, retirement age of workers, labor force participation rate); and 3) long term demographic assumptions (e.g., fertility rate, life expectancy, and net international immigration). The survey questions included, but were not limited to: 1. How deep and long will the recession be? How will the recession affect the economy and prospects for housing in 2020?; 2. After the recession ends, will national job growth be equal to, greater than, or less than the U.S. job growth rate from the current U.S. BLS projection?; 3. Will workers retire at an older age in 2020/2035 than now?; 4. How will California's share of U.S. jobs change in the future?; 5. How will the SCAG region's share of California jobs change in the future?; 6. How does the panel evaluate the new Census Bureau U.S. population projections and related assumptions of fertility rates, life expectancy, and international immigration?; 7. Will labor force participation rates continue to increase for older workers?

First, the short term economic outlook is focused on understanding the timing of the bottom of the national and regional economic recession. According to the responses of the experts, the economic recession measured in job losses in the SCAG Region would most likely end in 2010 (2 respondents), 2011 (7 respondents), or 2012 (3 respondents). Once the economy is recovered from the recession, it might take several years for the unemployment rates to return to a normal range (5–8 percent). Five of seven responded that, after the recession ends, regional job growth would be equal to the annual average U.S. job growth rate (1.04 percent between 2006 and 2016) from the current 2007 US BLS job projection. Two respondents said that the regional job growth would be greater than the U.S. job growth rate from the current 2007 US BLS job projection.

Second, the regional share of the national job projections was surveyed through two different but related questions about 1) California's share of U.S. jobs for 2020 and 2035 and 2) the SCAG Region's share of California jobs for 2020 and 2035. Twelve experts responded to both questions above. The survey results imply that the regional share of the national job projection ranges from 4.3 percent (minimum) to 5.3 percent (maximum) in 2020 and 3.8 percent (minimum) to 5.5 percent (maximum) in 2035 (see **TABLE 2**). The gap between the minimum and maximum is much bigger in 2035 than in 2020. The median regional share remains constant at 5 percent for both 2020 and 2035, which is 0.2 percent lower than the most current regional share (5.2 percent). The overall survey

responses are not optimistic about the SCAG region's relative economic competitiveness in the national economy, although the survey questions did not directly touch on "the regional share of the national job growth". The labor force participation rate (retirement) trends in the SCAG region will be consistent with the national projection, and will support the assumption that workers in the region will tend to retire at an older age in the future.

Third, there is no or little concern about the national and regional assumptions of the future fertility rates and life expectancy. The current regional average total fertility rate of 2.1 is assumed to decline slightly to 2.0 and 1.9 in 2020 and 2035, respectively, during the projection period. The regional life expectancy will increase consistent with the national life expectancy's increase during the projection period. The national immigration assumptions are major concerns of the panel members. The US Census Bureau released one set of long-term population projections for the nation in August 2008. These baseline projections included higher immigration projections, which resulted in an increase in the projected population growth to 2050. The key question is whether SCAG will adjust the current international immigration upward in light of the higher Census Bureau projections. Ten of the thirteen panel members said No to the upward adjustment of the international immigration assumption.

The Panel of Experts Meeting (2010)

Two major projections from the US Census Bureau and US Bureau of Labor Statistics (BLS) were released since the previous year's panel of the expert meeting. In December 2009, the US Census Bureau released alternative sets of population projections with different immigration assumptions. The 2009 national population projections are a supplemental series to the 2008 national population projections released on August 14, 2008, and provide results for differing assumptions of net international migration (http://www.census.gov/population/www/projections/2009projections.html). All other methodology and assumptions of mortality and fertility rates, are the same as those used in the 2008 national population projections. The lower immigration assumption, which looks reasonable in light of the recent trends, results in lower national population. When compared with the baseline projections released in August 2008, the gap between the low migration alternative and the baseline is 4.5 million (1.3 percent of the baseline population) in 2020, 9.7 million (2.5 percent of the baseline population) in 2035. In December 2009, BLS released new job projections to 2018. These projections were based on the national population projections released by the US Census Bureau in August 2008. Since there is only 1.3 percent difference in 2020 population between the low migration alternative and the baseline, the potential impact of the new low immigration alternative on job projections would be negligible. International immigration, in particular, unauthorized immigrants show a rapid decline from 11.8 million in 2007 to 11.6 million in 2008, and to 10.8 million in 2009. The decline in just one year between 2008 and 2009 reaches 800,000, which would be the likely impact of the recent economic recession.

A second panel of experts meeting was held on May 28, 2010, just one year after the first meeting held in 2009. Panel members, who participated in the first panel of experts meeting, were invited to the second panel of experts meeting. Eleven members attended the meeting to: 1) revisit the potential impact of economic recession and recovery in the national economy on the regional economy; 2) provide input on the recent trends in immigration and U.S. population growth; and 3) review the recent trends in the region's share of the national jobs.

With those newly available data in mind, the panel members participating in the second panel of experts meeting provided input to SCAG staff. First, the panel thought that job losses in the region would end in 2010 or 2011 in the 2009 meeting. While panel members differed on the size and timing of the recovery, the panel did not think the recession would affect the size of the region in 2020 and 2035. Some panel members thought there could be a lingering impact on unemployment rates, income growth and housing markets.

Second, U.S. population growth affects the pool of people and jobs in the nation. For any given SCAG share of future growth, higher U.S. immigration and population growth will push the SCAG region growth higher and vice versa. U.S. immigration and population growth is likely to be maintained at the lower level for the next 5 to 10 years.

Third, job shares dropped in 2008 and 2009, and state and regional job losses were larger than in the U.S. The majority of panel members supported the downward revisions of the regional shares of the national jobs. We are not sure if these declines in the regional job shares are temporary, based on the sharp decline in construction. There is a possibility that these declines might be a permanent shift because of the result of the long term demographic trends toward the aging of population, or because of the lack of the timely development and implementation of economic growth policy and strategy

The Panel of Experts Meeting (2011)

A third panel of experts survey was conducted through email on May 2011. Most of the panel members, who participated in the first and second panel of expert meeting, were requested to answer survey questions on the demographic and economic trends and assumptions. Thirteen members responded to questions on: 1) economic recovery of the nation; 2) immigration assumptions at the national level; 3) the projected region's share of the national jobs; 3) household projections. There was an overall consensus on the following few issues: 1) panelists expect the nation to be fully recovered by 2020 from the recession; 2) panelists expect U.S. unemployment to be between 4.5 percent and 6.5 percent; 3) panelists see no need to change the immigration assumptions from last year; 4) while not all panelists gave clear answers, no panelist said the relationship between projected jobs, population and households was not reasonable. On whether the SCAG region would see job growth faster than the nation, six of ten respondents said yes, while only two said no. The housing questions are particularly hard for short email answers. The question on whether household projections should be based purely on demographics was not clear to panelists. Some panelists wanted to comment on changing demographics and the implications for housing. Most panelists think demographics are the major determinant in the long run but had some concerns about 2020. Seven of 10 respondents agreed that market conditions would prevent "enough" housing from being built by 2020.

A RANGE OF REGIONAL GROWTH FORECASTS AND LOCAL INPUT

SCAG assumes that any set of growth forecasts (population, employment, and households) within a range of growth forecasts might be a plausible choice set. The scenario was developed in the following way: First, international immigration, one of the major demographic assumptions in US population projections by the US Census Bureau (2008), is not consistent with the recent trends, and is adjusted downward to reflect the recent trends. This downward adjustment of international immigration and the resulting population reduces the baseline US job projections due to the reduced labor supply. A mid national employment forecast is developed as a result of expert panel review (2009), is used as a key guide to develop a range of regional growth forecasts.

Second, a range of the regional employment forecasts (low, mid, high) is derived using a range of the regional shares of the national jobs from the expert panel review. A range of regional employment forecasts is translated into a range of the regional population forecasts (low, mid, high) using a set of demographic assumptions. All related economic and demographic assumptions (e.g., unemployment rates, labor force participation rates, immigration level, fertility rates, and survival rates, etc) for three different employment levels remain unchanged during the conversion process.

Third, a range of the regional population forecasts are translated into a range of the regional household forecasts using six different methods (e.g., cohort method, assimilation method, 2008 headship rate method, trend method, mid-trend method, mid-assimilation). A trend method produces the fewest households, while the assimilation method produces the highest number of households, given the same population level. SCAG uses a mid-trend assumption as a baseline method to convert population into households. It is based on a combination of the extrapolation of headship rates by race/ethnicity and gender and assimilation assumptions of the Hispanic and Asian headship rates. The mid term household projection is used with the population and employment scenarios to generate three scenarios of regional growth. **TABLE 9** presents the three growth scenarios for population, households, and employment as well as the local input scenario. The local based scenario is consistent with the low scenario, and reflects the recent trends. All of these scenarios were derived before the 2010 Census redistricting data was available.

TABLE 9 Regional Growth Forecasts (in Thousands): Three Scenarios and Local Input

Scenario	EPH	7/1/2010	7/1/2020	7/1/2035	2010–2020
Low	EMP	7,458	8,526	9,423	1,068
	POP	19,020	20,692	23,039	1,673
	HHLD	5,925	6,569	7,341	644
Mid	EMP	7,458	8,735	9,783	1,277
	POP	19,020	21,111	23,790	2,091
	HHLD	5,925	6,692	7,581	767
High	EMP	7,458	9,172	10,426	1,714
	POP	19,020	22,000	25,128	2,981
	HHLD	5,925	6,969	8,020	1,044
Local Input (12/2010)	EMP	7,352	8,559	9,579	1,101
	POP	18,997	20,600	22,930	1,580
	HHLD	5,933	6,545	7,365	620

Source: SCAG

2010 DECENNIAL CENSUS AND RE-BENCHMARK OF REGIONAL GROWTH FORECASTS

City and County level demographic data (Redistricting Data [P.L. 94-171]) for the State of California was released by the US Census Bureau on March 8, 2011. **TABLES 10** and **11** show population and household counts from the 2000 and the 2010 Census (April 1st figures) for each county in the SCAG region. The tables also present SCAG's preliminary projections of population and households by county for July 2010. Highlights from the table include: (1) Redistricting data from the 2010 Census showed that the population in the SCAG region was 18.05 million as of April 1, 2010, which is 1.5 million higher (9.3 percent) than the regional population count for the 2000 Census (16.5 million). The 2010 Census population figure for the SCAG region was almost 1 million lower (4.9 percent) than SCAG's preliminary population projections for 2010, which were provided before the publication of 2010 Census and primarily resulted from population estimates from the California Department of Finance (DOF); and (2) The 2010 Census redistricting data also counts the number of households in the SCAG region at 5.8 million, which is 461,000 higher (8.6 percent) than the regional household count for the 2000 Census (5.4 million). The 2010 Census household figure for the SCAG region was about 85,000 lower (1.4 percent) than SCAG's preliminary household projections for 2010, which are based on household estimates from the CA DOF.

On March 4, 2011, EDD released state and county estimates of wage and salary jobs for 2010 and adjustments to its previously released 2008 and 2009 job estimates (see **TABLE 12**). Highlights from the table include: (1) The new job data indicates that employment in the region totaled 7.22 million in 2010, about 128,000 (1.7 percent) less than SCAG's preliminary employment projections of 7.35 million; (2) Among counties in the SCAG region, job losses were much more severe in Los Angeles, Orange and Ventura Counties than previously projected; and (3) The region lost almost 800,000 jobs (7.9 percent) from 2007 to 2010. During this period, for every 100 jobs lost in the United States, 17 were in California, and of those, 9 were lost in the SCAG region.

TABLE 10 Regional and County-Level Population Change, 2000-2010

County	Population		
	4/1/2000 Census	4/1/2010 Census	7/1/2010 SCAG*
Imperial	142,361	174,528	191,215
Los Angeles	9,519,338	9,818,605	10,451,374
Orange	2,846,289	3,010,232	3,181,814
Riverside	1,545,387	2,189,641	2,203,587
San Bernardino	1,709,434	2,035,210	2,123,624
Ventura	753,197	823,318	845,314
SCAG	16,516,006	18,051,534	18,996,928

Note: *Projected based on Local Input and California Department of Finance (DOF), and produced before the publication of 2010 Census. *Source: US Census Bureau and SCAG*

TABLE 11 Regional and County-Level Households, 2000 and 2010

County	Households		
	4/1/2000 Census	4/1/2010 Census	7/1/2010 SCAG*
Imperial	39,384	49,126	53,550
Los Angeles	3,133,774	3,241,204	3,270,353
Orange	935,287	992,781	1,012,627
Riverside	506,218	686,260	705,645
San Bernardino	528,594	611,618	621,772
Ventura	243,234	266,920	269,170
SCAG	5,386,491	5,847,909	5,933,117

Note: *Projected based on Local Input and California DOF, and produced before the publication of 2010 Census. *Source: US Census Bureau and SCAG*

TABLE 12 Regional and County-Level Employment Estimates, 2008–2010

County	Employment					
	SCAG Preliminary Projection*			EDD Revised		
	2008	2009	2010	2008	2009	2010
Imperial	61,504	56,033	50,561	62,449	58,668	58,687
Los Angeles	4,340,344	4,284,475	4,228,607	4,460,171	4,184,002	4,123,262
Orange	1,624,061	1,620,241	1,510,928	1,621,910	1,499,723	1,490,318
Riverside	663,950	618,986	574,023	651,662	600,250	586,234
San Bernardino	700,603	677,794	654,985	702,424	652,840	640,497
Ventura	347,720	340,492	333,264	348,380	329,159	325,672
SCAG	7,738,182	7,598,021	7,352,368	7,846,995	7,324,642	7,224,670

Note: * Projected based on Local Input and CA EDD. *Source: CA EDD and SCAG*

SCAG incorporated the 2010 Census (Redistricting Data [P.L. 94-171]) and 2011 Employment Development Department data into the 2012–2035 RTP/SCS and RHNA process. Local jurisdictions within the SCAG region participated in the 20-month review and input process for developing the growth forecast dataset. SCAG updated the base year 2008 estimates by backcasting new 2010 Census data and updated 2020 and 2035 growth forecast by using the growth increments for 2008–2020 and 2020–2035 from the most recent database (December 2010).

TABLE 13 Regional Growth Forecasts (in Thousands): Before and After Incorporation of 2010 Census and 2011 EDD Database

	RTP	2000	2010	2020	2035	2010–2020
EMP	Before Census	7,440	7,352	8,559	9,579	1,207
	After Census		7,225	8,431	9,451	
POP	Before Census	16,517	18,970	20,600	22,930	1,630
	After Census		18,052	19,681	22,012	
HHLD	Before Census	5,386	5,918	6,545	7,365	628
	After Census		5,848	6,476	7,296	
POP/ HHLD	Before Census	3.07	3.21	3.15	3.11	2.6
	After Census		3.09	3.04	3.02	
POP/ EMP	Before Census	2.22	2.58	2.41	2.39	1.35
	After Census		2.5	2.33	2.33	

Note: Population and household estimates for 2000 and 2010 are based on the Decennial Census and benchmarked to April 1st for both Census years. Employment estimates and projections are based on the annual average. *Source: US Census Bureau and SCAG*

Forecasting Methodology and Assumptions

The regional growth forecast for the 2012–2035 RTP/SCS was developed using the regional forecast methodology used in the development of the 2008 RTP growth forecast (see SCAG's growth forecast report for 2008 RTP: http://www.scag.ca.gov/rtp2008/pdfs/finalrtp/reports/fGrowthForecast.pdf). The following is an overall approach toward developing the regional growth forecast for the 2012–2035 RTP/SCS.

FORECASTING METHODOLOGY

SCAG projects regional population using the cohort-component model. The model computes population at a future point in time by adding to the existing population the number of group quarters population, births, and persons moving into the region during a projection period, and by subtracting the number of deaths and the number of persons moving out of the region. The patterns of migration into and out of the region are influenced by the availability of jobs. The preliminary regional and county growth forecast of population

and households for the 2012–2035 RTP/SCS was derived using the updated economic and demographic trends and perspectives.

The preliminary city population and household forecast was derived by multiplying the 2008 RTP jurisdiction's share of the county growth delta during the forecast horizon by the updated county household growth delta during the same period. The jurisdictions's relative growth pattern in the 2008 RTP growth forecast remained constant. The jurisdiction level household size and the group quarters population from the recent DOF estimates were incorporated into the new database.

Regional employment is projected using a shift-share model. The shift-share model computes employment at a future point in time using a regional share of the nation's employment. The preliminary regional and county growth forecast of employment for the 2012–2035 RTP/SCS was derived using updated economic and demographic trends and perspectives. The preliminary jurisdiction employment forecast was derived by using a constant-share method. The jurisdiction's share of county jobs for each sector for the base year is assumed to remain constant during the forecast years. By using the constant share method, the jurisdiction's job growth by sector will be determined by the different growth of the specific sector by county. If a city in Los Angeles County is specialized in a specific industry (e.g., manufacturing), its future job growth will be severely affected by a declining pattern of manufacturing sector in Los Angeles County. The initial job forecasts became a basis for the future local input process.

KEY REGIONAL ASSUMPTIONS

Demographic and economic assumptions play a decisive role in determining the size of population, households, and employment in the future. Population size is projected by identifying the demographic rates (e.g., fertility rate, survival rate, migration rate) of the population cohort. The region's total fertility rate remains at 2.2, which is slightly higher than the replacement level of 2.1, during the projection period. The total fertility rate of Hispanic women gradually declines from 2.64 in 2010 to 2.49 in 2035, while other racial/ethnic groups' rates tend to remain constant during the projection period. The total fertility rate of recent Asian and Hispanic immigrants is assumed to be at a higher level than the long-term residents of the same ethnic origin.

The region's life expectancy at birth improves at the same rate as that of the nation's life expectancy improvement as determined by the US Census Bureau's 2008 Projection during the projection horizon.

Domestic migration is fluctuating and is directly influenced by labor demand derived from regional employment projections. International net immigration is kept constant at 104,000, which is an annual average of international net immigration of the region during the 1990–2010 period. The share of racial/ethnic domestic (from within the nation) migrants changes along with the changing population size of the racial/ethnic group. For example, the share of Hispanic migrants increases while that of the non-Hispanic Whites decreases. In addition to demographic assumptions, three additional translation factors are needed to link employment projections to population projections. They are labor force participation rates, the implied unemployment rates, and double jobbing rates. First, labor force participation rates play an important role in translating the labor force demand into labor force supply or vice versa. The labor force participation rates projected in the latest U.S. Bureau of Labor Statistics (BLS) projections for 2016 were used as the starting point for projecting labor force participation rates for 2020 and 2035. The projected labor force participation rates for the population over 55 are especially important as a large share of labor force growth will be in this age group. SCAG kept the projected 2016 labor force participation rates for the population under 55 for the years 2020 and 2035. SCAG increased the projected labor force participation rates for population groups age 55 and above for 2020 and 2035. These increases reflect a continuation of the large increases seen in recent years and projected by BLS to 2016. They reflect the better health and life expectancy of the workforce and the tendency for people to work longer for financial reasons. As a result of the projected increases in age-related labor force participation rates, the overall labor force participation rate is projected to slightly decline from 60.4 percent in 2010 to 59.4 percent in 2035. Second, some workers might keep two or more jobs. The double jobbing rate is assumed to be around 4.5 percent, and remain constant during the projection period. Third, the implied unemployment rate is derived by matching labor supply estimated from population projections with workers estimated from job projections. The panel of experts suggested that the acceptable implied unemployment rate ranges from 5 percent to 8 percent. The current projection assumes a 5 percent unemployment rate during the projection period (2015–2035). Finally, the most important consideration is the reasonable regional share of national jobs. Currently the SCAG

region's share of the national jobs is assumed to be 5.2 percent, and remains constant during the projection period.

TABLE 14 Key Regional Assumptions

Race/Ethnicity	2005–10	2015–20	2030–35
Fertility Rate			
White (NH**)	1.7	1.7	1.7
Black (NH)	2.05	2.05	2.05
Asian & Other (NH)	1.50 (2.06*)	1.51 (2.06*)	1.51 (2.06*)
Hispanic	2.64 (2.88*)	2.58 (2.82*)	2.49 (2.72*)
Total	2.18	2.2	2.2
Crude Death Rate			
White (NH)	11.4	11.9	14
Black (NH)	9.1	9.4	10.4
Asian & Other (NH)	2.6	4	6.8
Hispanic	2.8	3.5	4.8
Total	6.2	6,4	7.5
Domestic In-Migration			
White (NH)	55%	46%	33%
Black (NH)	8%	8%	8%
Asian & Other (NH)	16%	18%	22%
Hispanic	21%	28%	38%
Total	100%	100%	100%
Domestic Out-Migration			
White (NH)	48%	46%	35%
Black (NH)	7%	7%	7%
Asian & Other (NH)	13%	14%	16%
Hispanic	31%	36%	43%
Total	100%	100%	100%
International Migration (annual average)	104,000	104,000	104,000
Labor Force Participation Rate			
White (NH)	62.4%	61.1%	60.9%
Black (NH)	57.8%	57.7%	57.1%
Asian & Other (NH)	59.1%	58.3%	56.4%
Hispanic	59.6%	61.3%	60.0%
Total	60.4%	60.5%	59.4%

Note: *Total Fertility Rates of Asian And Hispanic Immigrants. **NH refers to Non-Hispanic. *Source: CA DOF and SCAG*

The region's households are projected by using projected headship rate. The projected households at a future point in time are computed by multiplying the projected residential population by projected headship rates. Headship rate is the proportion of a population cohort that forms the household. Age-gender-racial/ethnic specific household formation level was applied to the projected population to estimate households. It is specified by age, gender, and race/ethnicity. Headship rate is projected in 5 year intervals for seven age groups (e.g., 15–24, 25–34, 35–44, 45–54, 55–64, 65–74, 75+), both genders (male and female), and four racial/ethnic groups.

The draft headship rate projections were developed using the extrapolation of the recent trends between 2005 and 2010 with different assumptions about the assimilation of Hispanic and Asian headship rates. The two plausible sets of headship rate assumptions were (1) age-sex-racial/ethnic specific household formation trends without assimilation and (2) age-sex-racial/ethnic specific household formation trends with assimilation.

In fact, there has been a gradual decline in the overall headship rates of the SCAG region from 43.7 percent in 1990 to 42.2 percent in 2010, with a sharp decrease by 3 percent from 46.7 percent in 1980 to 43.7 percent in 1990. The region's Hispanic headship rates generally did not converge toward the White headship rates between 1980 and 2000, but the gap of the White and Hispanic headship rates was growing over time and across generations, after controlling for socioeconomic factors. Although Hispanic immigrants

experience a linear assimilation toward the Non-Hispanic White headship rates over time, U.S. born Hispanic residents do not show a linear assimilation toward the Non-Hispanic White headship rates (Choi, 2008). There was generally a stronger effect of the economic recession on headship rates of the minorities or immigrants than that of the native-born White. As a result, the gap in headship rates between minorities or immigrants and the White group is larger (Min & Choi, 2011).

Since there is a potential overestimate of the projected households due to assimilation assumption, SCAG produces an acceptable range of the projected households by using headship rates with/without assimilation assumption. The final projected households will be within the acceptable range. **TABLE 15** shows the projected headship rates of the racial/ethnic groups between 2010 and 2035, which are the basis for deriving the household forecast.

TABLE 15 Headship Rates by Race/Ethnicity

	2010*	2020**	2035**
White (NH)	50.7%	51.6%	52.1%
Black (NH)	49.3%	51.6%	52.1%
Asian & Other (NH)	39.1%	39.6%–40.8%	39.4%–42.6%
Hispanic	34.8%	35.9%–36.5%	36.4%–37.8%
Total	42.2%	42.4%–42.8%	41.6%–42.9%

Note: *The base year (2010) headship rates were derived using ACS 05-07 3 year average and controlled for 2010 Census household estimates. **The 2020 and 2035 Asian and Hispanic headship rates include two assumptions of with/without assimilation. A headship rate assumption with assimilation is developed in the following way, Asian headship rates are reduced by 50 percent of the difference from 2010 White headship rates by 2050; Hispanic headship rates are reduced by 25 percent of the difference from 2010 White headship rates by 2050. *Source: SCAG*

SMALL AREA FORECAST AND ALLOCATION

The socioeconomic input data for the transportation model are processed at the transportation analysis zone (TAZ) level in two different formats: (1) the marginal total of person and household attributes and (2) the joint distributions of person and household attributes. TAZ is often referred to as TIER 2, are generally equivalent to Census block groups, and there are 11,267 TAZs in the region.

A marginal total of 54 independent socioeconomic attributes and 7 joint distributions of two or more attributes are developed as input for the transportation demand model (see **TABLES 16** and **17**). Those variables include population, households, school enrollment, household income, workers, employment, etc. Joint distributions of two or more attributes are now needed as required by the enhanced transportation demand model. One of those joint distributions is the number of households by household income, household size, the number of workers, and the type of dwelling units, at the TAZ level.

SCAG develops the marginal and joint distributions of socioeconomic attributes at the TAZ level using diverse public and private sources of data and advanced estimation methods. The major data sources include 2000 and 2010 Census, 2000 Census Transportation Planning Package (CTPP), American Community Survey (ACS), California Department of Finance (DOF), California Employment Development Department (EDD), InfoUSA, 2008 Existing Land Use, and 2008 County Assessor's Parcel Database.

The socioeconomic input data at the TAZ level is estimated using three major processes: 1) development of three major variables (population, households, employment; 2) development of secondary variables (socioeconomic attributes of persons and households, employment sectors); 3) development of joint distributions of selected attributes.

Development of Major Variables

The household estimates at the TAZ level are initially derived by summing the Minimum Planning Unit (MPU) level household estimates within the TAZ. The MPUs are generally equivalent to parcels. The MPU level household estimates are derived using the following process: (1) add the new residential construction between 2000 and 2008 to 2000 MPU level housing estimates from 2000 Census; and (2) convert housing units into households using the 2000 vacancy rate. The MPU level household estimates are controlled to the 2008 city level household estimates. The employment estimates at the MPU level are initially derived by using 2008 InfoUSA database. The MPU level employment estimates are controlled to the 2008 county level employment estimates from CA EDD. TAZ level household and employment estimates are derived by aggregating the MPU level estimates.

TAZ population and household forecasts are derived using the housing unit (HU) method, as used in the city forecasts. The first step of the housing unit method is to project housing units at the TAZ level. Since SCAG focuses on the household forecast, SCAG derives the initial TAZ household forecasts by reflecting growth patterns incorporated in the 2008 RTP forecasts, recent estimates and trends, and updated city household forecasts. The TAZ household forecast is converted into population by using the group quarters population plus the product of households and average persons per household (PPH). The average number of persons per household is projected using the recent estimates and trends, and is constrained by the updated city PPH. Group quarters population is projected using the TAZ's share of the city population from the 2000 Census and 2008 DOF, which is assumed to remain constant during the projection horizon.

TAZ jobs are initially projected using a constant-share method. The current TAZ's share to city jobs for each sector will remain constant during the forecast years. By using the constant share method, the TAZ's job growth by sector will be simply determined by the different growth of the specific sector by city. The initial TAZ population, household, and employment forecasts become a basis for the local review process.

Development of Secondary Variables

Three major variables are further disaggregated into necessary attributes (e.g., age, persons per households, industry sectors, etc), as required in the transportation demand model development process. The additional attribute variables are called secondary variables. These secondary variables at the TAZ level are estimated using the Large Area Secondary Variables Allocation Model (LASVAM) and Small Area Secondary Variables Allocation Model (SASVAM) (Cho, 2006; Choi & Ryu, 2011). SCAG uses LASVAM to develop the county level secondary variables using the trend extrapolation or the statistical method. SCAG uses SASVAM to develop the TAZ level secondary variables using the probabilistic choice model, which reflects the temporal change of the individual attribute and the changing relationship of the related attributes.

Development of Joint Distributions of Selected Secondary Variables

The marginal distribution of secondary variables at the TAZ level processed by SASVAM is developed into joint distribution of selected secondary variables using the Population Generator (PopGen) 1.1, developed by Arizona State University. PopGen 1.1 generates synthetic populations and households with attribute distributions, which become the basis for computing the joint distributions. SCAG uses the 2000 Census SF3 driven aggregate data at TAZ level and 2000 Census PUMS based individual data at the PUMA level as seed data to produce 2008 synthetic populations and households at the TAZ level.

INCORPORATION OF MAJOR DEVELOPMENT PROJECTS

SCAG incorporates major long range major development projects with regional significance into the TAZ population, household, and employment forecast to accurately assess their impacts on the long term regional transportation system. These projects are often collected through the Intergovernmental Review (IGR) program.

As required by the California Environmental Quality Act (CEQA), SCAG should review projects throughout its jurisdiction to monitor regional development as part of the IGR. Through the IGR, SCAG confirms that the regionally significant projects are consistent

with a range of adopted regional plans and policies. This IGR process allows SCAG to identify the regionally significant major development projects.

Once the small areas are identified as a major development project area through the IGR process, a set of preliminary population, household, and employment forecasts are processed using the information of proposed major development projects. The major development projects and related growth estimates generally do not influence the overall growth forecast of the local jurisdiction, but may influence the growth distribution within the local jurisdictional boundary.

TABLE 16 Description of Socioeconomic Variables

Variables	Description of Variables
Population (8 variables)	Total Population (1 variable): total number of people living within a zone. Total population is composed of residential population and group quarters population.
	Group Quarters (Non-Institutional) Population (1 variable): is primarily comprised of students residing in dormitories, military personnel living in barracks, and individuals staying in homeless shelters. Group quarters (non-institutional) population does NOT include persons residing in institutions.
	Residential Population (1 variable): the number of residents NOT living in "group quarters."
Population (8 variables)	Group Quarters Population living in student dormitories (1 variable): Population living in college dormitories (includes college quarters off campus).
	Population by Age (4 variables): the number of population for different age groups: 5–17, 18–24, 16–64, and 65+.
Households (26 variables)	Total Households (1 variable): Household refers to all of the people who occupy a housing unit. By definition there is only one household in an occupied housing unit.
	Households by Household Size (4 variables): the number of one-person households, two-person households, three-person households, and four or more person households.
	Households by Age of Householder (4 variables): the number of households with age of householder between 18 and 24 years old, 25 and 44, 45 and 64, and 65 or older.
Households (26 variables)	Households by Number of Workers (4 variables): the number of households with no worker, with one worker, with two workers, and with three workers or more.
	Households by Household Income (4 variables): the number of households with annual household income (in 1999 dollars) of less than $24,999, $25,000–$49,999, $50,000–$99,999, and $100,000 or more.
	Households by Type of Dwelling Unit (2 variables): the number of households living in single-family detached housing, and living in other housing.
	Households by Number of College Students (3 variables): the number of households with no college student, with one college student, with two college students or more.
	Households by Number of Children age 5–17 (4 variables): the number of households with no child, with one child, with two children, and three children or more.

Variables	Description of Variables
School Enrollment (2 variables)	K-12 School Enrollment (1 variable): the total number of K-12 (kindergarten through 12th grade) students enrolled in all public and private schools located within a zone. All elementary, middle (junior high), and high school students are included. This variable represents "students by place of attendance".
	College/University Enrollment (1 variable): the total number of students enrolled in any public or private post-secondary school (college or university) that grant an associate degree or higher, located within a zone. This variable also represents "students by place of attendance".
Workers (4 variables):	Total Workers (1 variable): total number of civilian workers residing in a zone. Workers are estimated by the place of residence.
	Workers by earning level (3 variables): the number of workers with earnings of less than $24,999, $25,000–$49,999, $50,000 or more.
Median Household Income (5 variables):	Median Household Income (1 variable): median household income is the median value of household income for all households within a zone. Household Income includes the income, from all sources, for all persons aged 15 years or older within a household.
	Median Household Income by Income Categories (4 variables): the median income is estimated for each of four different income categories: less than $24,999, $25,000–$49,999, $50,000–$99,999, and $100,000 or more.

Variables	Description of Variables
Employment (17 variables)	Total Employment (1 variable): total number of jobs within a zone. The employment variables represent all jobs located within a zone (i.e., employment by place of work). Jobs are composed of wage and salary jobs and self-employed jobs. Jobs are categorized into 13 sectors based on the North American Industry Classification System (NAICS) code definition.
	Employment by 13 Industries (13 variables): the number of total jobs for 1) agriculture & mining, 2) construction, 3) manufacturing, 4) wholesale trade, 5) retail trade, 6) transportation, warehousing, and utilities, 7) information, 8) financial activities, 9) professional and business services, 10) education and health services, 11) leisure and hospitality services, 12) other services, and 13) public administration.
	Employment by wage level (3 variables): total number of jobs by three wage levels: of less than $24,999, $25,000–$49,999, $50,000 or more.

TABLE 17 Joint Distributions of Population, Households, and Workers by Selected Demographic Attributes.

Major Variables	Demographic Attributes
Households	Household income (less than $24,999, $25,000 to $49,999, $50,000 to $99,999, $100,000+)
	Household size (1,2,3,4+ persons in household)
	Number of workers (0,1,2,3+ workers in household)
	Type of dwelling unit (single-family detached, other)
Households	Household income (less than $24,999, $25,000 to $49,999, $50,000 to $99,999, $100,000+)
	Number of workers (0,1,2,3+ workers in household)
	Age of head of household (18–24, 25–44, 45–66, 65+ years old).
Households	Household income (less than $24,999, $25,000 to $49,999, $50,000 to $99,999, $100,000+)
	Household size (1,2,3,4+ persons in household)
Households	Number of college students (0, 1, 2+)
	Household income (less than $24,999, $25,000 to $49,999, $50,000 to $99,999, $100,000+)
Households	Number of children age 5–17 (0,1,2,3+)
	Household income (less than $24,999, $25,000 to $49,999, $50,000 to $99,999, $100,000+)
Population	Age (0–4, 5–17, 18–24, 25+)
	Household income (less than $24,999, $25,000 to $49,999, $50,000 to $99,999, $100,000+)
Workers	Worker's earnings (less than $24,999, $25,000–$49,999, $50,000+)
	Household income (less than $24,999, $25,000 to $49,999, $50,000 to $99,999, $100,000+)

LOCAL INPUT

Local input plays an important role in developing an accurate growth forecast for 2012–2035 RTP/SCS. Although the local input is an on-going process, SCAG sought local input from local jurisdictions for at least three times during the development of the growth forecast. The first and preliminary local input process was conducted between September 2008 and January 2009 in anticipation of 2012–2035 RTP/SCS growth forecast, data and tool requirements under SB 375. SCAG collected the 2008 existing land use, 2008 zoning, and the current general plan land use through the local input process.

The second and major local input process was conducted between July 2009 and February 2010 to collect and update land use information and the preliminary growth forecast. The preliminary projection of population, household and employment growth at the jurisdictional and TAZ level was provided to all local jurisdictions for comments and inputs. SCAG conducted a series of one-on-one meetings with local jurisdictions. Over 90 percent of 195 local jurisdictions provided SCAG with input on growth forecast, existing land use, zoning, and general plan land use. The local input result presented an imbalance of population and employment for the year 2035. The number of jobs in 2035 is larger than that of available labor supply. SCAG eventually adjusted the 2035 employment downward to achieve a balance of population and employment.

The third and final local input process was conducted at the jurisdictional level between May 2011 and August 2011. With the availability of demographic data from the 2010 Census (Redistricting Data [(P.L. 94-171]) and employment data from CA EDD in March 2011, SCAG rebenchmarked the growth forecast's base year demographic and employment figures. SCAG updated the base year (2008) data with the growth delta of the preliminary forecast unchanged. SCAG made an appropriate adjustment of growth forecast as needed.

TABLE 18 presents a proposed growth forecast of population, households, and employment for years 2008, 2020, and 2035 at the local jurisdictional level in the SCAG region. The proposed local growth forecast was primarily derived using the bottom-up local input process.

TABLE 18 Proposed 2012–2035 RTP/SCS Growth Forecast

County	City	Population			Households			Employment		
		2008	2020	2035	2008	2020	2035	2008	2020	2035
Imperial	Brawley	24,200	36,200	46,800	7,500	11,500	15,800	7,500	12,300	14,600
Imperial	Calexico	37,800	50,800	62,800	10,100	14,100	18,800	9,000	15,300	18,500
Imperial	Calipatria	7,400	9,000	9,900	1,000	1,200	1,500	2,300	4,000	5,000
Imperial	El Centro	41,300	50,300	61,300	12,900	15,700	19,300	18,600	31,400	38,000
Imperial	Holtville	5,800	6,600	7,300	1,800	2,100	2,400	1,600	2,600	3,000
Imperial	Imperial	14,200	19,900	22,900	4,300	6,200	7,600	2,800	4,800	5,800
Imperial	Westmorland	2,200	3,000	3,800	600	900	1,200	600	1,000	1,200
Imperial	Unincorporated	36,900	67,900	73,400	10,400	19,900	24,000	18,900	30,300	35,100
	County Total	**170,000**	**244,000**	**288,000**	**49,000**	**72,000**	**91,000**	**62,000**	**102,000**	**121,000**
Los Angeles	Agoura Hills	20,300	20,400	21,400	7,300	7,500	7,900	11,600	12,100	12,700
Los Angeles	Alhambra	83,000	87,000	92,400	29,200	31,300	33,300	29,600	31,000	32,500
Los Angeles	Arcadia	56,200	59,600	64,300	19,500	21,000	22,700	26,700	28,100	29,500
Los Angeles	Artesia	16,500	16,700	17,000	4,500	4,700	4,800	5,900	6,200	6,500
Los Angeles	Avalon	3,600	4,300	5,100	1,400	1,700	1,900	4,400	4,600	4,800
Los Angeles	Azusa	46,300	49,500	53,800	12,700	13,800	14,800	18,200	18,500	19,200
Los Angeles	Baldwin Park	75,400	78,200	82,200	17,200	17,900	18,600	17,600	18,300	19,200
Los Angeles	Bell	35,500	35,900	36,400	8,900	8,900	9,000	9,000	9,300	9,700
Los Angeles	Bellflower	76,600	76,600	81,300	23,600	23,700	25,100	16,000	16,900	17,900
Los Angeles	Bell Gardens	41,900	43,000	44,500	9,600	9,700	9,700	8,000	8,400	8,800
Los Angeles	Beverly Hills	34,100	35,000	36,300	14,900	15,200	15,600	58,000	61,400	64,800
Los Angeles	Bradbury	1,000	1,100	1,100	300	400	400	200	300	300
Los Angeles	Burbank	103,300	112,400	115,300	41,900	46,000	47,000	90,300	102,300	114,700
Los Angeles	Calabasas	23,000	23,800	24,400	8,500	9,000	9,200	14,800	15,400	16,200
Los Angeles	Carson	91,700	97,500	106,000	25,500	27,400	29,600	51,900	52,500	54,000
Los Angeles	Cerritos	49,000	49,400	49,800	15,500	15,600	15,800	35,900	37,100	38,600
Los Angeles	Claremont	34,800	36,100	37,900	11,600	12,100	12,600	18,100	19,400	20,600

County	City	Population			Households			Employment		
		2008	2020	2035	2008	2020	2035	2008	2020	2035
Los Angeles	Commerce	12,800	12,900	13,000	3,400	3,400	3,500	48,100	47,800	48,600
Los Angeles	Compton	95,900	96,900	97,600	22,900	23,100	23,100	30,600	31,200	32,200
Los Angeles	Covina	47,800	48,700	50,200	15,900	16,200	16,700	12,900	13,100	13,600
Los Angeles	Cudahy	23,600	25,200	27,200	5,600	6,000	6,400	3,400	3,500	3,700
Los Angeles	Culver City	38,900	39,300	40,000	16,800	17,000	17,300	45,400	47,900	50,400
Los Angeles	Diamond Bar	55,300	58,700	63,300	17,800	19,300	20,800	15,500	16,200	17,000
Los Angeles	Downey	111,800	116,200	122,700	33,900	35,000	36,200	40,200	42,200	44,200
Los Angeles	Duarte	21,200	22,100	23,400	7,000	7,400	7,900	6,700	7,000	7,300
Los Angeles	El Monte	113,400	124,300	140,100	27,800	30,400	33,300	36,300	37,100	38,400
Los Angeles	El Segundo	16,700	16,900	17,000	7,100	7,200	7,200	53,800	54,000	55,400
Los Angeles	Gardena	58,800	59,700	66,200	20,500	21,000	23,200	30,500	28,900	30,700
Los Angeles	Glendale	191,600	198,900	209,300	72,200	75,200	78,600	93,600	98,200	103,000
Los Angeles	Glendora	49,700	52,900	56,700	17,000	18,000	18,400	12,300	12,900	13,500
Los Angeles	Hawaiian Gardens	14,300	14,800	15,600	3,600	3,700	3,900	2,900	3,000	3,200
Los Angeles	Hawthorne	84,300	89,600	96,300	28,500	29,500	30,600	20,600	21,100	21,800
Los Angeles	Hermosa Beach	19,400	19,600	19,700	9,500	9,600	9,600	7,000	7,300	7,700
Los Angeles	Hidden Hills	1,800	1,900	1,900	600	600	600	30	30	30
Los Angeles	Huntington Park	58,100	62,000	67,700	15,000	15,700	16,900	16,400	16,800	17,400
Los Angeles	Industry	200	200	200	100	100	100	84,100	83,900	85,600
Los Angeles	Inglewood	109,700	111,900	113,500	36,400	37,900	38,800	33,400	35,000	36,700
Los Angeles	Irwindale	1,400	1,600	2,000	400	400	500	13,400	11,500	12,300
Los Angeles	La Cañada Flintridge	20,200	20,400	20,600	6,800	7,000	7,100	9,500	10,200	10,300
Los Angeles	La Habra Heights	5,300	5,700	6,500	1,800	1,900	2,200	800	800	900
Los Angeles	Lakewood	80,000	80,500	80,600	26,600	27,100	27,400	15,700	16,800	17,800
Los Angeles	La Mirada	48,500	50,300	52,800	14,700	15,000	15,300	19,400	19,100	19,300
Los Angeles	Lancaster	154,500	174,800	201,300	46,300	52,200	58,800	49,700	51,900	54,200
Los Angeles	La Puente	39,800	45,000	52,500	9,500	10,700	11,900	8,000	8,400	8,800
Los Angeles	La Verne	31,100	33,000	35,600	11,300	12,000	12,900	9,400	10,100	10,800

County	City	Population			Households			Employment		
		2008	2020	2035	2008	2020	2035	2008	2020	2035
Los Angeles	Lawndale	32,700	34,600	37,400	9,700	10,100	10,700	5,700	6,000	6,300
Los Angeles	Lomita	20,300	21,000	21,900	8,100	8,100	8,200	4,700	5,000	5,200
Los Angeles	Long Beach	462,200	491,000	534,100	163,500	175,600	188,900	168,100	176,000	184,800
Los Angeles	Los Angeles	3,770,500	3,991,700	4,320,600	1,309,900	1,455,700	1,626,600	1,735,200	1,817,700	1,906,800
Los Angeles	Lynwood	69,300	72,300	74,300	14,600	15,300	15,700	13,200	13,800	14,500
Los Angeles	Malibu	12,600	13,800	14,800	5,300	5,400	6,100	8,900	8,900	9,900
Los Angeles	Manhattan Beach	35,100	35,500	36,000	14,100	14,100	14,100	15,100	16,100	17,200
Los Angeles	Maywood	27,400	27,600	28,000	6,600	6,600	6,700	3,700	3,900	4,000
Los Angeles	Monrovia	36,300	37,700	39,400	13,600	14,300	14,800	17,700	18,300	19,100
Los Angeles	Montebello	62,500	66,400	66,400	19,000	20,500	20,500	25,700	26,400	27,400
Los Angeles	Monterey Park	60,100	67,900	77,700	19,900	20,900	21,700	30,400	32,000	33,700
Los Angeles	Norwalk	105,500	109,100	114,200	27,100	27,400	27,700	24,600	25,700	27,000
Los Angeles	Palmdale	149,200	179,300	206,100	41,900	51,300	58,800	32,700	38,900	47,200
Los Angeles	Palos Verdes Estates	13,400	13,500	13,500	5,100	5,100	5,100	3,500	3,400	3,400
Los Angeles	Paramount	54,100	57,100	62,600	13,900	14,100	14,400	18,300	18,500	19,100
Los Angeles	Pasadena	135,300	143,400	152,500	54,500	58,400	61,400	117,300	124,400	131,300
Los Angeles	Pico Rivera	62,900	65,900	70,100	16,600	17,600	18,700	16,100	16,400	16,900
Los Angeles	Pomona	149,100	168,500	197,400	38,500	43,400	48,900	54,700	57,000	59,600
Los Angeles	Rancho Palos Verdes	41,600	41,700	41,700	15,500	15,600	15,600	6,300	6,700	7,100
Los Angeles	Redondo Beach	66,500	69,700	73,000	28,900	30,700	32,000	30,100	30,600	31,600
Los Angeles	Rolling Hills	1,900	1,900	1,900	700	700	700	40	40	40
Los Angeles	Rolling Hills Estates	8,100	8,100	8,200	3,000	3,000	3,000	3,800	4,000	4,200
Los Angeles	Rosemead	53,600	55,500	58,100	14,200	15,000	15,800	16,400	16,900	17,600
Los Angeles	San Dimas	33,400	35,000	35,600	12,000	12,600	12,900	13,100	13,600	14,100
Los Angeles	San Fernando	23,600	24,400	25,500	5,900	6,200	6,600	15,000	15,300	15,900
Los Angeles	San Gabriel	39,700	42,800	46,100	12,500	13,800	14,800	14,200	15,000	15,700
Los Angeles	San Marino	13,100	13,200	13,300	4,300	4,300	4,300	4,800	5,000	5,300
Los Angeles	Santa Clarita	175,900	201,100	237,100	59,300	70,100	81,900	92,900	108,700	122,600

County	City	Population			Households			Employment		
		2008	2020	2035	2008	2020	2035	2008	2020	2035
Los Angeles	Santa Fe Springs	16,200	17,900	20,300	4,800	5,200	5,800	49,600	49,600	50,500
Los Angeles	Santa Monica	89,100	92,400	94,700	46,600	49,200	51,400	99,500	101,600	104,200
Los Angeles	Sierra Madre	10,900	10,900	11,000	4,800	4,900	5,000	3,400	3,400	3,400
Los Angeles	Signal Hill	11,000	11,800	12,900	4,100	4,400	4,700	11,700	12,300	12,700
Los Angeles	South El Monte	20,100	20,800	21,800	4,600	4,800	5,000	15,700	15,300	15,400
Los Angeles	South Gate	94,400	101,200	110,000	23,400	24,800	26,100	19,700	20,000	20,600
Los Angeles	South Pasadena	25,600	25,900	26,300	10,500	10,600	10,800	9,000	9,500	10,000
Los Angeles	Temple City	35,400	36,900	39,000	11,600	12,300	13,000	6,700	7,000	7,300
Los Angeles	Torrance	145,000	150,800	158,500	55,800	57,800	59,800	105,800	109,100	113,300
Los Angeles	Vernon	100	100	100	30	30	30	44,600	45,700	47,300
Los Angeles	Walnut	29,000	32,600	33,200	8,500	9,800	10,000	9,000	9,500	10,000
Los Angeles	West Covina	106,100	112,200	120,200	31,600	32,600	33,900	27,700	29,300	30,900
Los Angeles	West Hollywood	34,400	35,100	36,100	22,700	23,100	23,800	32,300	34,500	36,600
Los Angeles	Westlake Village	8,300	8,600	9,000	3,300	3,300	3,400	9,300	9,600	10,000
Los Angeles	Whittier	85,300	87,600	90,500	28,300	29,400	30,500	31,300	33,000	34,800
Los Angeles	Unincorporated	1,052,800	1,159,100	1,399,500	298,100	336,100	405,500	237,000	266,100	318,100
	County Total	**9,778,000**	**10,404,000**	**11,353,000**	**3,228,000**	**3,513,000**	**3,852,000**	**4,340,000**	**4,558,000**	**4,827,000**
Orange	Aliso Viejo	47,200	51,500	51,000	18,000	19,000	19,000	17,200	19,600	19,700
Orange	Anaheim	333,900	369,100	405,800	97,700	107,600	124,700	192,200	193,700	224,200
Orange	Brea	39,200	48,300	49,800	14,300	17,000	17,800	48,900	49,100	49,500
Orange	Buena Park	80,000	83,500	83,200	23,600	24,200	24,500	33,900	35,500	35,700
Orange	Costa Mesa	109,100	113,700	114,000	39,700	40,100	40,900	94,200	88,300	88,800
Orange	Cypress	47,800	50,300	51,400	15,700	16,000	16,500	26,900	27,500	28,200
Orange	Dana Point	33,400	35,900	36,200	14,200	14,800	15,200	13,600	13,500	13,700
Orange	Fountain Valley	54,900	58,300	59,500	18,500	19,100	19,700	34,400	32,900	33,000
Orange	Fullerton	134,700	145,500	164,500	45,300	47,400	54,800	65,300	63,400	91,600
Orange	Garden Grove	170,400	179,400	180,300	46,000	47,000	47,800	50,900	49,700	49,800
Orange	Huntington Beach	189,700	199,800	205,500	74,300	75,800	79,200	82,900	80,100	80,600

County	City	Population			Households			Employment		
		2008	2020	2035	2008	2020	2035	2008	2020	2035
Orange	Irvine	203,600	265,600	304,200	75,800	98,000	114,700	223,500	242,000	291,800
Orange	Laguna Beach	22,700	23,500	23,400	10,900	10,900	10,900	14,000	14,000	14,100
Orange	Laguna Hills	30,300	32,100	32,000	10,500	10,600	10,700	19,900	20,400	20,500
Orange	Laguna Niguel	62,700	65,700	65,200	24,100	24,500	24,600	20,000	20,100	21,000
Orange	Laguna Woods	16,200	17,000	16,900	11,300	11,500	11,600	5,500	6,200	6,700
Orange	La Habra	60,100	62,800	62,300	19,000	19,200	19,300	17,700	17,500	17,600
Orange	Lake Forest	77,200	88,100	87,400	26,200	30,000	30,100	44,500	40,600	45,800
Orange	La Palma	15,500	15,600	15,600	5,100	5,100	5,100	7,800	7,300	7,400
Orange	Los Alamitos	11,400	12,000	12,000	4,200	4,300	4,300	15,300	14,300	14,300
Orange	Mission Viejo	93,200	96,600	97,000	33,200	33,400	33,900	37,200	38,000	38,800
Orange	Newport Beach	84,200	88,700	90,300	38,400	39,500	40,700	82,500	77,000	77,700
Orange	Orange	135,500	141,500	156,300	43,100	43,700	49,400	99,900	104,900	108,600
Orange	Placentia	50,200	53,600	57,000	16,300	16,900	18,700	19,200	21,200	21,200
Orange	Rancho Santa Margarita	47,800	49,500	49,000	16,700	16,700	16,700	17,700	16,300	16,600
Orange	San Clemente	63,200	68,100	68,300	23,800	24,800	25,200	25,600	26,300	26,600
Orange	San Juan Capistrano	34,400	38,100	37,800	11,300	12,300	12,300	15,700	15,700	15,800
Orange	Santa Ana	323,900	337,600	336,700	73,100	73,900	74,800	168,400	146,000	149,400
Orange	Seal Beach	24,100	25,000	24,800	13,000	13,100	13,100	10,600	11,500	11,800
Orange	Stanton	38,100	40,800	43,400	10,800	11,200	11,900	8,400	8,100	8,300
Orange	Tustin	74,700	81,300	82,900	24,900	26,600	27,800	42,100	51,900	66,800
Orange	Villa Park	5,800	6,000	6,100	2,000	2,000	2,000	1,900	1,800	1,800
Orange	Westminster	89,700	92,900	92,600	26,200	26,300	26,500	23,800	24,800	24,900
Orange	Yorba Linda	63,500	69,700	69,400	21,400	22,600	22,800	19,000	17,200	17,300
Orange	Unincorporated	121,200	159,100	189,300	38,500	44,000	57,600	23,800	29,700	39,500
	County Total	**2,989,000**	**3,266,000**	**3,421,000**	**987,000**	**1,049,000**	**1,125,000**	**1,624,000**	**1,626,000**	**1,779,000**
Riverside	Banning	28,900	42,200	61,900	10,800	15,600	22,900	7,800	11,300	15,900
Riverside	Beaumont	33,600	56,500	79,400	11,000	18,800	26,200	5,100	8,600	13,400
Riverside	Blythe	20,300	22,700	24,300	4,500	5,200	5,800	5,500	7,800	10,400

County	City	Population			Households			Employment		
		2008	2020	2035	2008	2020	2035	2008	2020	2035
Riverside	Calimesa	7,700	14,800	25,800	3,300	6,300	11,000	1,900	2,800	4,300
Riverside	Canyon Lake	10,300	11,000	11,700	3,900	4,100	4,300	1,200	1,300	1,400
Riverside	Cathedral	50,200	57,000	64,600	17,100	19,600	23,900	13,800	18,900	23,900
Riverside	Coachella	38,200	70,200	128,700	8,600	17,300	34,000	6,400	12,800	27,900
Riverside	Corona	148,000	155,800	164,600	44,600	46,100	48,800	71,200	88,300	105,000
Riverside	Desert Hot Springs	25,200	43,500	58,100	8,600	15,400	20,900	3,500	5,100	6,900
Riverside	Eastvale	53,200	61,500	68,300	13,500	15,700	17,700	3,700	5,400	10,100
Riverside	Hemet	76,400	83,400	110,300	29,900	33,700	45,900	26,200	39,800	52,500
Riverside	Indian Wells	4,800	5,500	5,800	2,700	3,100	3,600	3,900	4,900	6,000
Riverside	Indio	73,300	91,500	111,800	23,000	28,600	34,600	21,000	30,100	40,000
Riverside	Jurupa Valley	94,400	103,700	126,000	24,500	27,100	33,300	28,100	34,400	53,500
Riverside	Lake Elsinore	50,200	70,500	93,800	14,600	21,000	28,700	10,300	15,000	20,100
Riverside	La Quinta	36,100	41,600	46,300	14,600	16,600	17,900	9,200	10,600	11,900
Riverside	Menifee	74,800	93,100	119,400	27,100	35,900	45,900	8,800	10,500	12,600
Riverside	Moreno Valley	187,400	213,700	255,200	51,100	60,000	72,800	32,300	48,000	64,400
Riverside	Murrieta	101,200	109,300	121,100	32,700	35,100	39,200	17,400	50,100	86,500
Riverside	Norco	26,500	30,300	32,700	7,000	8,000	8,700	12,400	17,000	21,600
Riverside	Palm Desert	47,100	52,100	56,800	23,000	25,800	28,000	37,700	41,600	44,500
Riverside	Palm Springs	43,400	48,900	56,100	22,700	25,700	30,400	36,300	44,400	52,300
Riverside	Perris	65,900	82,000	114,000	16,100	22,000	30,900	14,400	21,700	26,700
Riverside	Rancho Mirage	16,900	18,800	22,900	8,900	9,600	11,800	10,800	12,700	17,400
Riverside	Riverside	295,500	339,000	382,700	91,400	104,000	117,800	151,500	198,300	217,800
Riverside	San Jacinto	42,600	50,300	99,100	13,000	15,900	33,200	5,700	8,100	10,900
Riverside	Temecula	95,100	109,800	118,900	30,900	34,300	37,200	46,600	59,800	72,800
Riverside	Wildomar	31,500	42,100	53,700	10,000	13,100	16,800	3,400	5,900	9,300
Riverside	Unincorporated	349,100	471,500	710,600	109,600	150,800	240,000	68,000	123,700	203,200
	County Total	**2,128,000**	**2,592,000**	**3,324,000**	**679,000**	**834,000**	**1,092,000**	**664,000**	**939,000**	**1,243,000**
San Bernardino	Adelanto	31,200	46,100	68,400	7,700	11,900	17,700	5,400	7,300	10,600

County	City	Population			Households			Employment		
		2008	2020	2035	2008	2020	2035	2008	2020	2035
San Bernardino	Apple Valley	69,000	82,900	109,000	23,500	28,500	37,100	15,500	17,000	22,500
San Bernardino	Barstow	22,500	27,300	36,200	8,000	9,900	13,000	13,300	14,900	19,100
San Bernardino	Big Bear Lake	5,000	5,600	7,000	2,200	2,400	3,000	6,200	6,400	7,400
San Bernardino	Chino	75,600	88,800	107,200	20,100	24,600	29,200	48,500	53,500	67,700
San Bernardino	Chino Hills	74,600	76,600	78,400	22,900	24,000	25,600	9,300	10,500	12,900
San Bernardino	Colton	52,100	60,700	71,700	15,000	17,800	21,100	24,000	25,500	29,600
San Bernardino	Fontana	193,900	222,700	259,100	48,600	57,500	66,700	47,600	53,700	69,000
San Bernardino	Grand Terrace	11,800	11,600	13,000	4,300	4,600	5,400	3,000	3,200	4,000
San Bernardino	Hesperia	89,600	98,200	132,500	26,300	28,900	39,300	15,500	20,400	28,700
San Bernardino	Highland	53,000	58,600	67,300	15,400	17,700	20,300	6,000	7,800	9,100
San Bernardino	Loma Linda	23,000	26,700	31,700	8,700	10,500	12,600	17,600	23,300	32,600
San Bernardino	Montclair	36,000	39,700	43,900	9,300	10,400	11,600	16,500	17,000	18,400
San Bernardino	Needles	4,800	6,000	8,000	1,900	2,400	3,100	3,300	3,800	4,700
San Bernardino	Ontario	162,900	203,800	307,600	44,600	57,700	87,300	114,300	142,900	214,400
San Bernardino	Rancho Cucamonga	162,800	167,100	167,100	53,600	56,300	57,600	62,500	63,900	68,300
San Bernardino	Redlands	68,600	75,500	87,900	24,700	28,300	32,500	41,400	46,700	60,100
San Bernardino	Rialto	98,900	110,000	125,200	25,100	29,400	34,700	22,900	26,400	32,800
San Bernardino	San Bernardino	209,900	231,200	261,400	59,300	66,900	76,800	101,300	113,400	145,300
San Bernardino	Twentynine Palms	24,900	26,300	36,300	8,000	8,600	11,800	3,200	3,200	4,500
San Bernardino	Upland	72,600	76,700	80,200	25,400	28,300	31,300	27,900	29,700	33,400
San Bernardino	Victorville	111,900	145,300	190,100	31,400	43,700	56,900	33,700	45,900	66,400
San Bernardino	Yucaipa	51,200	55,800	61,900	18,200	20,700	23,600	9,800	10,900	14,000
San Bernardino	Yucca Valley	20,700	23,000	26,200	8,300	9,900	11,800	4,600	5,100	6,000
San Bernardino	Unincorporated	289,400	301,600	372,600	93,300	97,700	117,500	47,200	58,300	77,700
	County Total	**2,016,000**	**2,268,000**	**2,750,000**	**606,000**	**698,000**	**847,000**	**701,000**	**810,000**	**1,059,000**
Ventura	Camarillo	64,500	72,200	76,700	24,400	27,500	29,700	32,200	37,800	40,600
Ventura	Fillmore	14,900	18,000	20,800	4,100	5,100	5,900	3,200	3,500	3,900
Ventura	Moorpark	33,900	39,300	41,500	10,400	12,000	12,700	12,000	14,200	15,700

County	City	Population			Households			Employment		
		2008	2020	2035	2008	2020	2035	2008	2020	2035
Ventura	Ojai	7,400	8,400	9,400	3,100	3,600	4,100	6,300	7,100	7,800
Ventura	Oxnard	193,900	216,700	244,500	49,100	58,800	70,600	59,000	64,000	69,800
Ventura	Port Hueneme	21,600	22,100	22,500	7,100	7,200	7,400	10,900	10,500	10,800
Ventura	San Buenaventura (Ventura)	105,300	116,900	128,800	40,300	45,200	50,100	63,100	70,500	77,400
Ventura	Santa Paula	29,000	35,400	38,800	8,300	10,000	11,100	8,800	9,700	10,500
Ventura	Simi Valley	123,200	129,700	133,200	41,200	42,800	44,000	41,400	46,200	50,700
Ventura	Thousand Oaks	125,200	129,700	130,900	45,600	46,100	46,600	67,600	72,700	78,700
Ventura	Unincorporated	94,200	100,500	107,200	31,900	33,700	35,300	43,400	42,800	44,900
	County Total	**813,000**	**889,000**	**954,000**	**266,000**	**292,000**	**318,000**	**348,000**	**379,000**	**411,000**
	Region Total	**17,895,000**	**19,663,000**	**22,091,000**	**5,814,000**	**6,458,000**	**7,325,000**	**7,738,000**	**8,414,000**	**9,441,000**

Note: * The City numbers may not sum to the County total due to rounding. City numbers were rounded to the nearest 10 for jurisdictions with small numbers or to the nearest 100 for all others, while county numbers were rounded to the nearest 1,000. ** The proposed growth forecasts of Eastvale and Jurupa Valley are subject to further revisions due to the recent incorporation, pending final approval from cities/county. Source: SCAG.

Section IV: SCAG PECAS Land Use Model

Introduction

SCAG made its initial step in developing an integrated, comprehensive transportation and land use model in early 2009. The model is based on the PECAS (Production –Exchange – Consumption Allocation System) framework. The model has not been officially peer-reviewed and is not fully operational. The model is used only as an internal scenario testing tool for the 2012–2035 RTP/SCS. However, the model will be the main tool to design and develop RTP scenarios in the near future when it is ready. This chapter introduces the related effort and summarizes a selected scenario test.

The following section briefly summarizes the status of consulting project for development of the model. Then the model is introduced in terms of its structure, SCAG specifications, and calibration. An analysis of the impact of the implementation of a 5 cents VMT fee is provided as an example scenario. A brief conclusion remark is provided at the end of the section.

Consulting Projects

The model was commissioned by SCAG and built by SCAG staff together with the Urban Land Use and Transportation (ULTRANS) Center at the University of California, Davis, and HBA Specto Incorporated in Calgary, Alberta. Over the 25 month contract period from February 2009 to March 2011, the staff tried to achieve two purposes. The first was to develop a working draft model and its related data within the given period of time. To achieve this objective, the development started with the statewide PECAS model, which was developed by ULTRANS and HBA for CalTrans to demonstrate the model. Once the model and the data was delivered, it was modified to make it more specific to the SCAG region through an iterative development approach. The draft model developed from this process represented the SCAG region in geographic sense, but its behavioral parameters and economic data represented the state of California. The second was to acquire knowledge to develop an integrated land use model. This involved staff work in processing raw data, development of the database, model setup and adjustment (calibration) and operation. After twenty-three 2 or 4 day workshops held at SCAG or UC Davis, model has been scrutinized down to the individual source code lines.

Another portion of the consulting project was to establish the economic data and parameters for the SCAG region with MJ Consulting. Based on the transferred knowledge, regional economic data was processed to set up the AA (Activity Allocation) module of the PECAS model. The work was performed from September 2009 to May 2010. As a result of this project, staff was able to develop a more streamlined process to prepare regional economic data, and a calibrated set of the AA module for the region. In addition, this project allowed staff to have time and resource to produce the first SCAG parcel-level land use database.

PECAS Overview

PECAS is a generalized approach for simulating spatial economic systems. It is designed to provide a simulation of the land use component of land use transport interactive modeling systems.

PECAS uses an aggregate, equilibrium structure with separate flows of exchanges (including goods, services, labor and space) going from the production site to the consumption location, based on variable technical coefficients and a market clearing mechanism with exchange prices. It provides an integrated representation of spatially distinct markets for the full range of exchanges, with the transport system and the development of space represented in more detail with specific treatments.

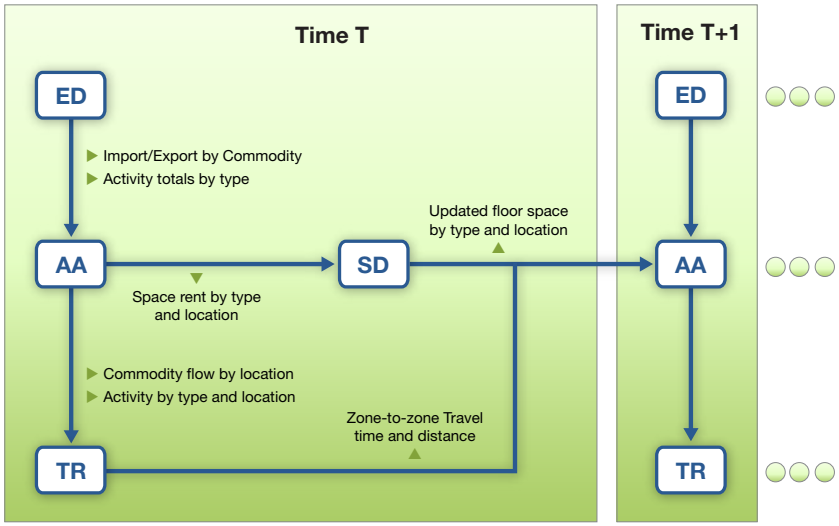
Flows of exchanges from production to exchange zones and from exchange zones to consumption are allocated using the nested logit models, according to exchange prices and transport generalized costs (expressed as transport utilities with negative signs). These flows are converted to transport demands that are loaded to networks in order to determine congested travel utilities. Exchange prices determined for space inform the calculation of changes in space thereby simulating developer actions. Developer actions are represented at the level of land use zones using an aggregate flow treatment. The system is run for each year being simulated, with the travel utilities and changes in space for one year influencing the flows of exchanges in the next year.

PECAS includes two basic modules that are linked together with two other modules to provide a representation of the complete spatial economic system. **FIGURE 21** shows the relationship between modules.

The set of four basic modules includes:

- **Activity Allocation Module (AA Module):** This is one of the two PECAS modules. It represents how the production, exchange and consumption activities locate within the space provided by developers and how these activities interact with each other at a given point in time. For SCAG application, economic activities from 42 industrial sectors and 14 types of households consist of individual markets in each of 302 CSA (Community Statistical Area) zones.
- **Space Development Module (SD Module):** This is another of the two PECAS modules. It represents the actions of developers in the provision of different types of developed space where activities can locate, including the new development, demolition and re-development that occurs from one point in time to the next. This developed space is typically floor space of various types and is called 'space' in the PECAS framework. 9 residential types and 14 non-vacant land use types are represented in the SCAG SD module.
- **Transport Model (TR Module):** This is one of the 'non-PECAS' modules. It represents the transport system connecting locations, including at a minimum a transport network, the transport demands that load onto this network (as a result of the economic interactions represented in the AA Module) and the congested times and costs for interactions between locations arising with the loading of these demands. For SCAG application, two sub-modules are employed to simulate the traditional 4-step model. The first sub-module of trip generation converts the activity flow estimated by AA Module into Origin-Destination matrices between the CSA zones, and another sub-module performs a Frank-Wolfe style traffic assignment to estimate link traffic volume, zone-to-zone travel time, and VMT.
- **Economic Demographic Aggregate Forecasting Model (ED Module):** This is the other of the 'non-PECAS' modules: It is a form of model or approach used to develop aggregate economic forecasts for the study area being modeled. In the SCAG application, this is a regional control total of households by 14 types and employment by 42 industrial sectors.

FIGURE 21 Pecas Module Structure



Scenario Test

As stated above, the PECAS land use model produced as-is based, preliminary impact analysis results for various what-if scenarios. Therefore any measurements presented in this section are not necessarily intended to support any implementation of the plan. The purpose of this section is to demonstrate the functionality of the developing land use model based on the PECAS framework.

As depicted in **FIGURE 21**, each module in PECAS produces intermediate outputs, which are input to the subsequent processes. The AA module primarily estimates the spatial price of commodities, and allocates activities, which consists of households by types and employment by sector. The AA module also estimates commodity flows, between the sectors and locations of production and consumption, in dollars. The main output from the SD module is changes in land use and amount of floor space at parcel level. The presentation of this detail output would prevent finding regionally meaningful implications. It could also cause unnecessary misunderstanding as if that market-driven forecast was

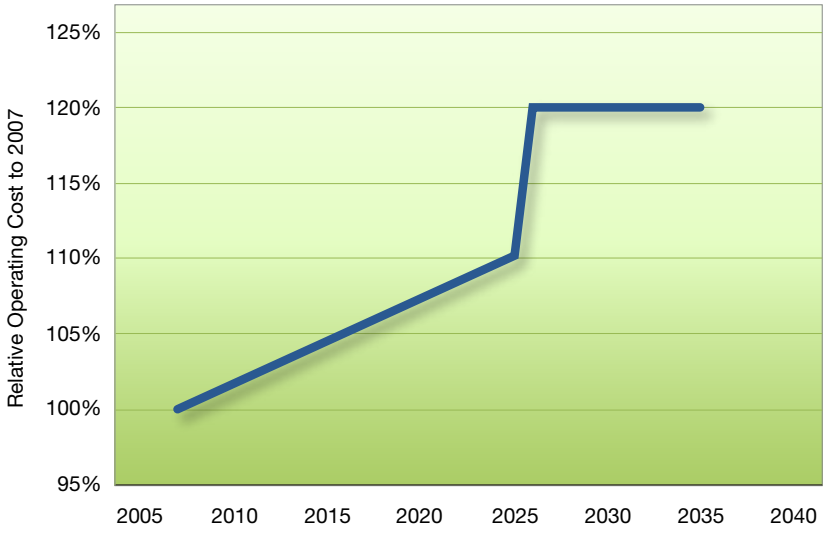
intended for the local land use plan. For SCAG's planning purpose, microscopic outputs are aggregated over sectors and statistical zones.

A what-if scenario was selected to present the comprehensiveness of PECAS. Note that this scenario is independent of and does not reflect the assumptions underlying the financial plan as documented in the Transportation Finance Appendix and Chapter 3 of the 2012–2035 RTC/SCS. Under the test, the following assumptions are applied.

- The current gasoline tax, 36.4 cents per gallon, would gradually increase until 2025 to 50 cents per gallon due to nominal inflation.
- After that, a 5 cents per mile VMT fee would replace the gasoline tax in year 2026.
- The auto operating cost would be 50 cents per mile, and 10 percent is fuel cost.
- The increase of the gasoline tax up to year 2026 would be the equivalent of about a 10 percent increase in operating costs, and the new VMT fee would result in an additional 10 percent surcharge.

FIGURE 22 shows the scenario of auto operating costs over the planning horizon. When evaluating (dis-)utility of locations, importance of travel cost is high with the increase in auto operating costs. In responding to the relatively increased travel cost, economic actors (households and firms) would change their behavior, including relocating the operation location, or job site according to their preference. Such a change would cause shorter travel distance on average, at a given transportation network capacity.

FIGURE 22 Scenario of Auto Operating Cost



Average travel distances are calculated by three categories; Worker Compensation Distance (WCD) is the distance between a worker's residence to work place, which is equivalent to Home-to-Work trip distance. In PECAS flow is reported with the value of the commodity, times the distance between where it originated (produced) to where it is destined (consumed). To calculate the average for WCD, the estimated wage at the place of work is used. Intermediate Goods movement Distance (IGD) is the delivery distance of commodity to the other industries for their production activities. Consumer Goods movement Distance (CGD) is the distance of the same commodities but its destination is to households, and it is equivalent to the distance of Home-to-Shop trips. For IGD and CGD, commodity price at production site is used to calculate average distance.

PECAS estimates the flow of commodities including goods, services, and labor by using the value of commodities multiplied by the movement distance of commodities from where they are produced to where they are consumed. The total transported commodities in the SCAG region were estimated to be 41.98 trillion dollar•miles in year 2007, and 53.19 trillion dollar•miles in year 2035, if no additional auto operating cost is charged.

This 26.7 percent increase is caused by regional economic growth and continuing sprawl. With the VMT fee replacing the current gasoline tax, the estimation is 3.55 percent less than the base case at year 2035. Given that economic growth remains constant in both cases, this reduction is due to the additional travel cost and subsequent reallocation of activity. **FIGURE 23** shows the variation over time that is caused by the changed travel cost.

FIGURE 23 Scenario Test Result: Travel Distance of Commodities in Value * Mile Transported

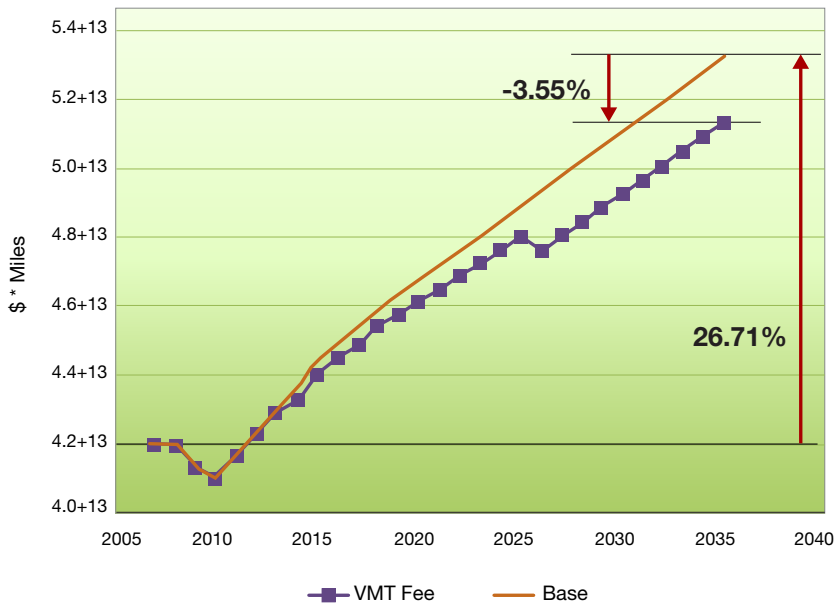


TABLE 19 summarizes the average travel distance by category. In the base case, the average travel distance of working trip (WCD) would increase 10.3 percent in year 2035, while intermediate goods delivery (IGD) and shopping trips (CGD) would increase 7.5 percent and 3.2 percent, respectively. The overall increase is 5 percent. With the new 5 cents per mile VMT fee, overall travel distance would increase 1.3 percent from year 2007.

TABLE 19 Scenario Test Result: Average Travel Distance In Miles

Scenario	Type	2007	2020		2035	
		(A)	(B)	(B)/(A)	(C)	(C)/(A)
Base	WCD	12.858	13.543	1.053	14.176	1.103
	IGD	42.784	44.284	1.035	46.006	1.075
	CGD	25.515	25.846	1.013	26.341	1.032
	Sum	32.517	33.257	1.023	34.157	1.050
VMT Fee	WCD	12.858	12.948	1.007	12.668	0.985
	IGD	42.784	43.819	1.024	44.815	1.047
	CGD	25.515	25.390	0.995	25.182	0.987
	Sum	32.517	32.776	1.008	32.928	1.013

Coda

This section introduces the SCAG PECAS land use model, as an available tool to be used in the future RTP. After a 2-year development consulting project, SCAG commissioned a draft version of the PECAS model, and applied it to cursory test of various scenarios internally. At the current stage, the model produced reasonable sensitivity to the what-if scenario with increased auto operating cost.

With refined modeling parameters and input data, the model will be involved more actively in the scenario development process, by supporting region-wide impact measures. Also, with a mature model, its activity reallocation estimation could be the basis of scenario-sensitivity socioeconomic data development.

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