

GROWTH FORECAST



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

Southern California Association of Governments
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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 area level is the basis for developing the Regional Transportation Plan (RTP), Sustainable Communities Strategy (SCS), Environmental Impact Report (EIR), 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. 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 Committee (CEHD) provided direction to the 2012 RTP Growth Forecast Update Process for the 2012 RTP/SCS/EIR/RHNA. SCAG's Plans & Programs Technical Advisory Committee (P&P TAC) assisted in the forecasting process by providing technical input.

The Growth Forecast Appendix is comprised of four major sections. Section I introduces the major source of challenges in producing the 2012 RTP/SCS growth forecast, and summarizes the eighteen 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

New state law requirements (e.g., SB 375) and the Great Recession (2007-2009) posed new challenges in the development of the 2012 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 RTP/SCS growth forecast is required to be consistent.

SCAG began developing the long term growth forecasts for the 2012 RTP 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 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 developed their own methods in generating population estimates and produced population estimates for this period. The gap in population estimates in the late 2000s was extremely high. 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 growth forecast for the 2012 RTP/SCS.

Forecasting Timeline and Milestones

SCAG began its forecast update process by conducting subregional workshops throughout the region in September 2008 (See Table 1). If 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 the future dialogue between the 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 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 RTP/SCS. In fact, this SED data was used for developing the SCAG suggested emission reductions 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 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 RTP/SCS between July 2011 and November 2011, SCAG released it in December 2011 and the Regional Council will be adopting the 2012 RTP/SCS and the draft RHNA in April 2012. The regional growth forecast is adopted as part of the 2012 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 RTP growth forecast, data and tool requirements under the SB 375	September 2008–January 2009
3	Developed an initial range of preliminary 2012 RTP 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 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

	Milestone	Date/Period
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 RTP/SCS. The dataset was used for regional transportation model calibration and validation.	July 2011–November 2011
18	Released the draft 2012 RTP/SCS	December 2011
19	Will adopt the 2012 RTP/SCS and the draft RHNA	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% of the US population of 308,745,538, and nearly 49% 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%, 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%, 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% 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 has been 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%, 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%, 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%, 1.5%, 1.3%, and 0.9%, 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 1980's. 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% in 1990 to 4% in 2010. At one point in 2005, its share reached 6% of all industry sectors and immediately declined to 4% in 2010 due to the economic recession. The manufacturing sector has consistently decreased its share from 17% in 1990 to 9% by 2000 and 8% 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% in 1990 to 22% in 2010, and leisure and hospitality sector jobs increased its share from 8% in 1990 to 11% in 2010.

TABLE 3 SCAG Region's Employment Trend, 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, (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% in 1990 to 23.4% in 2010, while Los Angeles County decreased its share from 60.5% in 1990 to 54.4% 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 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% in 1990 to 9.7% 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 1.95% in 1990-1991 to 0.46% 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% 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 (0.42%) 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 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%, which is much lower than the 23.4% 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, 1990-2010

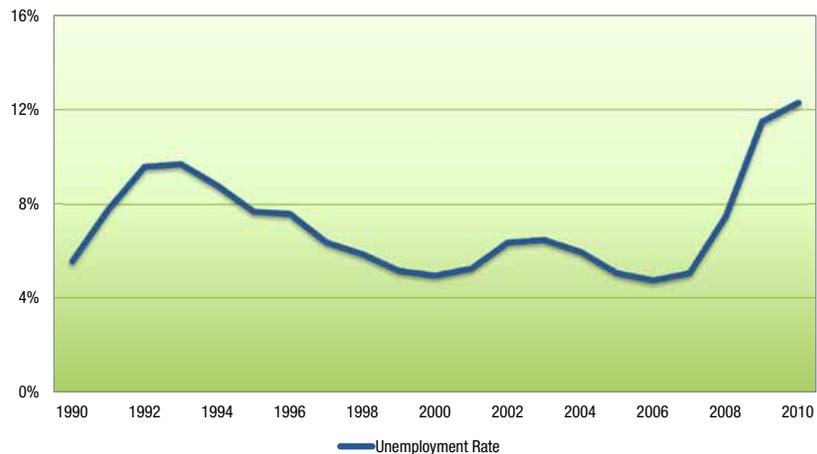


FIGURE 2 SCAG Region Job Growth, 1990-2010

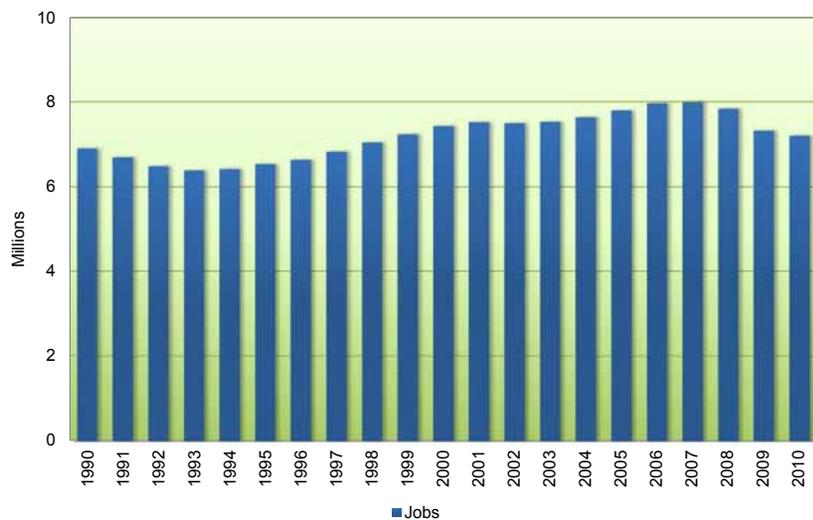


FIGURE 3 Percent Change of Jobs, 1990-2010

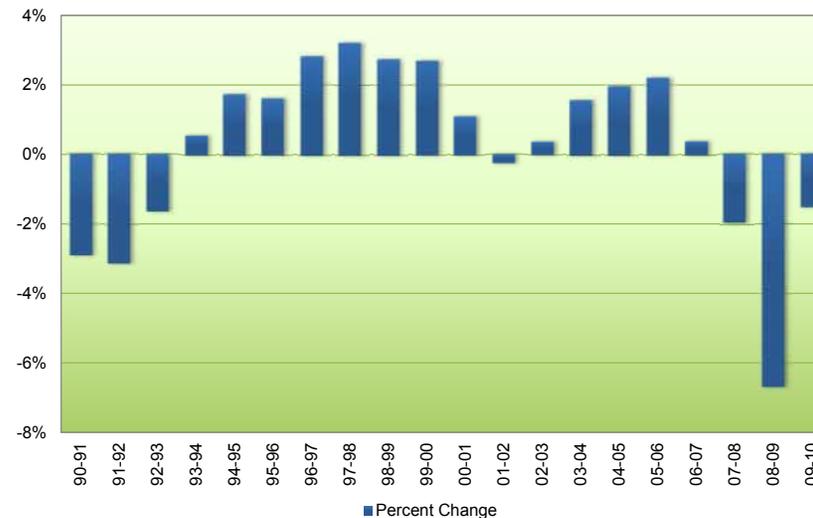


FIGURE 4 SCAG Region Population Growth, 1990-2010

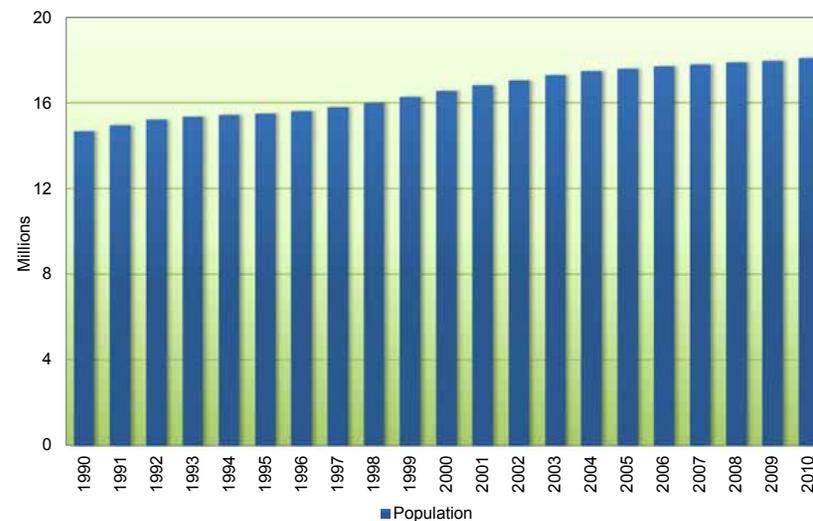


FIGURE 5 Percent Change of Population, 1990-2010

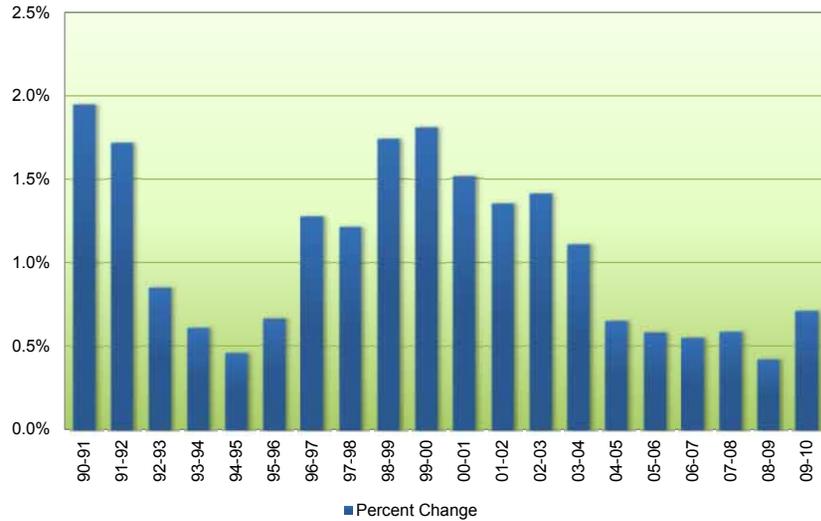


FIGURE 7 Net Domestic Migration, 1990-2010

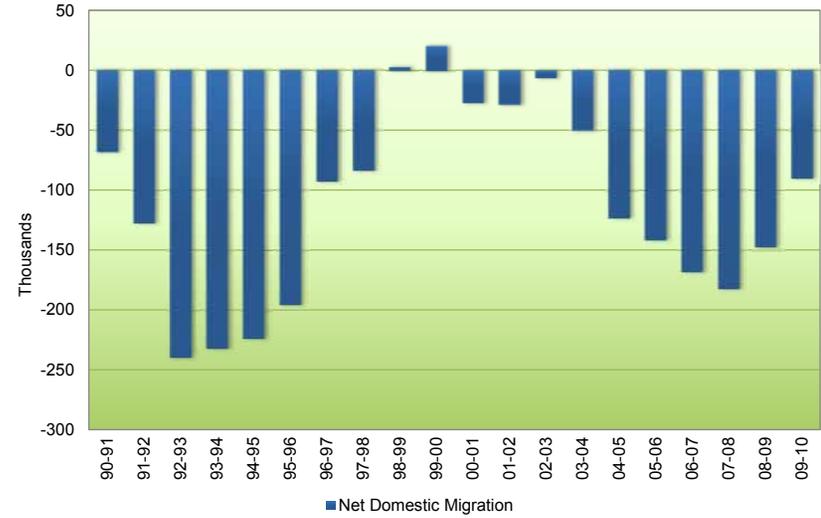


FIGURE 6 Components of Population Change, 1990-2010

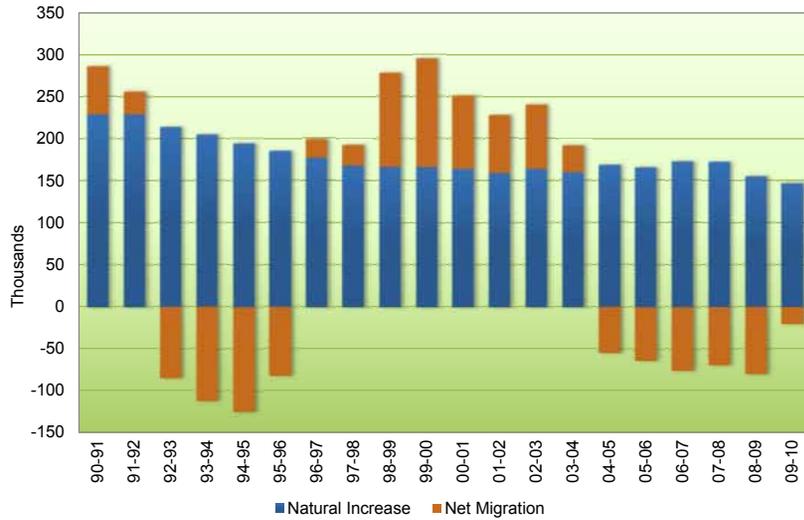


FIGURE 8 Net Immigration, 1990-2010

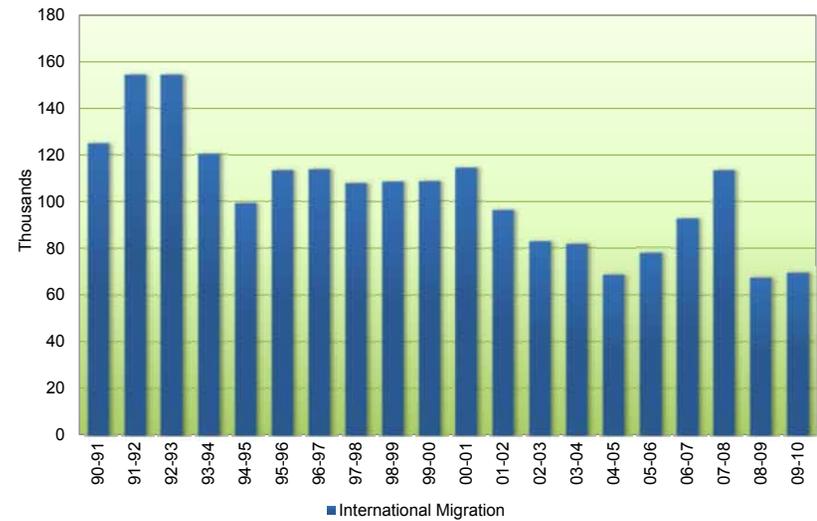


FIGURE 9 Births, 1990-2010

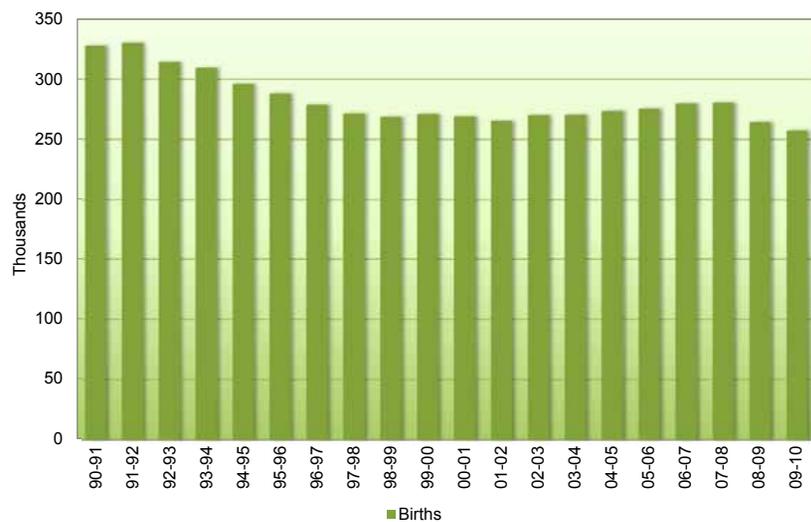
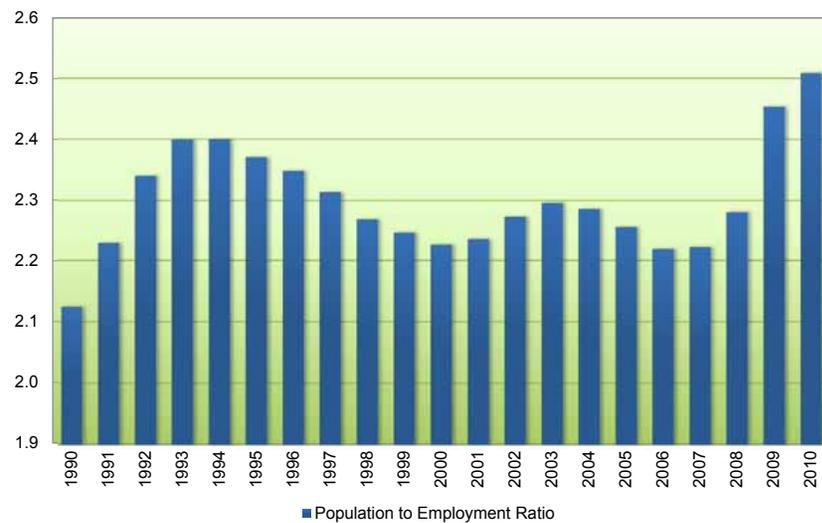


FIGURE 10 Population to Employment Ratio, 1990-2010



Growth Forecast

The regional growth forecast is used as a key guide for future transportation investments in the SCAG region. SCAG began developing the long term growth forecasts for the 2012 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 serious bias in the short term population projections. The 2012 RTP/SCS growth forecast was developed reflecting both the short term and long term perspectives.

The latest 2010 Census data indicates 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 4.3 million new residents, 1.5 million new households, and 1.7 million new jobs by 2035 (See Figures 11 and 12).

FIGURE 11 Projections of Regional Population, Employment, and Households, 2008–2035

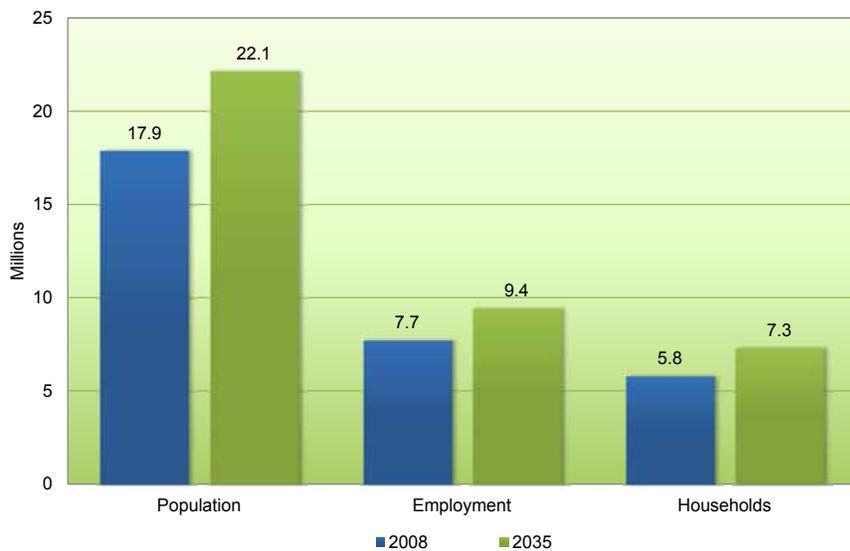


FIGURE 12 Projections of Regional Population, Employment, and Households 1970–2035

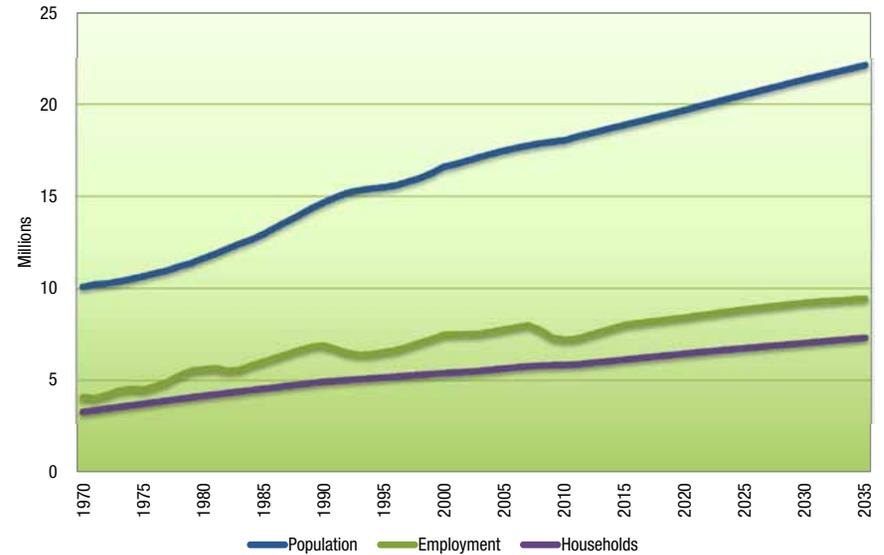
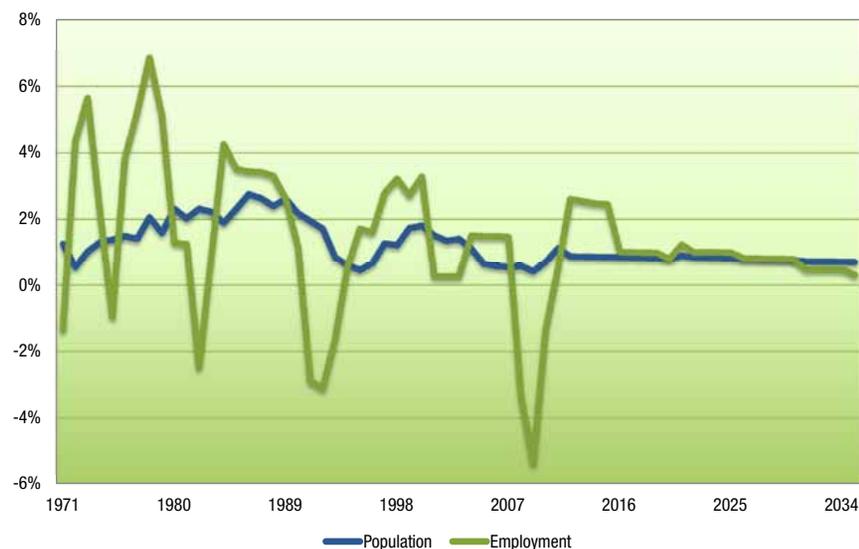


FIGURE 13 Percent Change of Regional Population and Employment 1970–2035



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%, 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 36.6 in 2035. The share of the population 65 years old and over is projected to increase from 11% in 2010 to 18% in 2035, while the share of the population less than 16 years old decreases from 89% in 2010 to 82% in 2035. In particular, the share of the population of the working age 16-64 has its share decline sharply from 65% to 60% 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 old-age dependency ratio is projected to increase from 17% in 2010 to 30% in 2035 (an increase of 13% 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%, a non-Hispanic White population of 34%, a non-Hispanic Asian population and others of 14%, and a non-Hispanic Black population of 7%. The region's racial/ethnic composition is projected to exhibit a rapid change toward a majority Hispanic population of 56% in 2035, while the share of the non-Hispanic White population is projected to drop sharply to 22%.

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

	2010	2020	2035	Difference (2010–2035)	% Change (2010–2035)
Population ** ('000)	18,104	19,692	22,148	4,044	22.3
Births per 1,000 population	15.4	15.3	15.0	-0.4	
Total fertility rate (per woman)	2.2	2.2	2.2	0.02	
Deaths per 1,000 population	6.2	6.4	6.7	0.5	
Natural increase (%) (05–10, 15-20, 30–35)	143.9	107.4	101.7		
Net migration (%) (05-10, 15-20, 30-35)	-43.9	-7.4	-1.7		
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	36.6	2.4	
Total dependency ratio*					
Child dependency Ratio	35.2	35.5	36.5	1.3	
Old-Age dependency Ratio	16.6	21.6	29.9	13.3	
Ethnic composition of population					
Non-Hispanic White persons (%)	33.8	28.9	22.4	-11.4	-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: * a measure showing the number of dependents (aged 0-15 & over 65) to the working age population (aged 16-64). Dependents per 100 working age population. ** Total population. *Source: SCAG*

FIGURE 14 Population Pyramid, SCAG Region 2010 and 2020

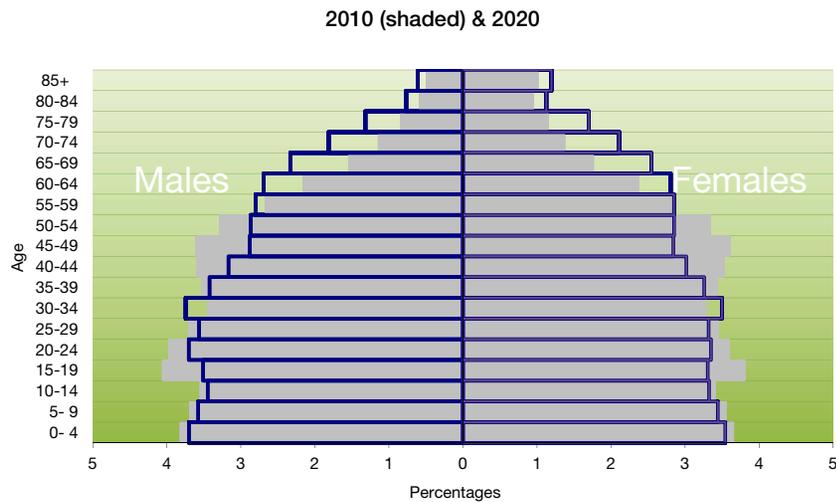


FIGURE 15 Population Pyramid, SCAG Region 2010 and 2035

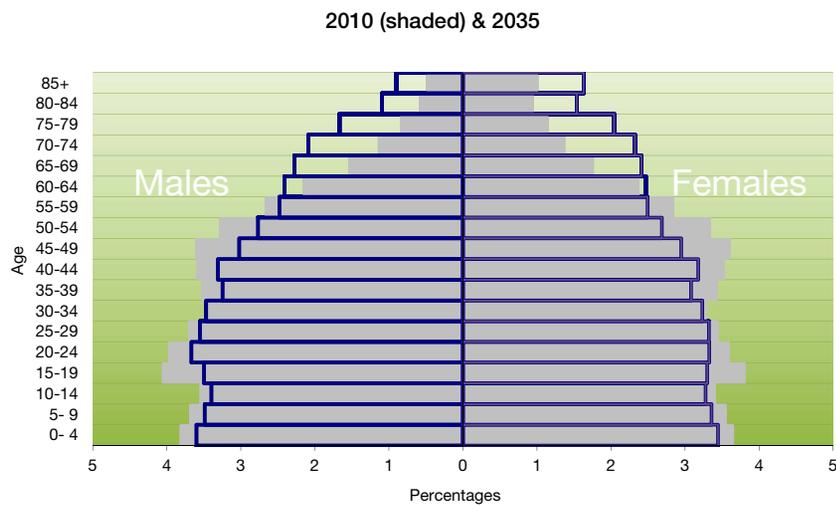


FIGURE 16 Components of Population Change, SCAG Region 1970–2035

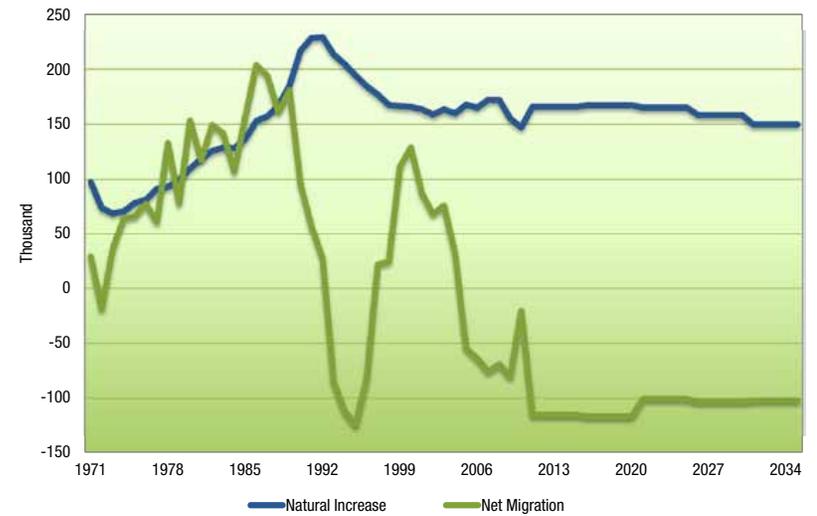


FIGURE 17 Births and Deaths, SCAG Region 1970-2035

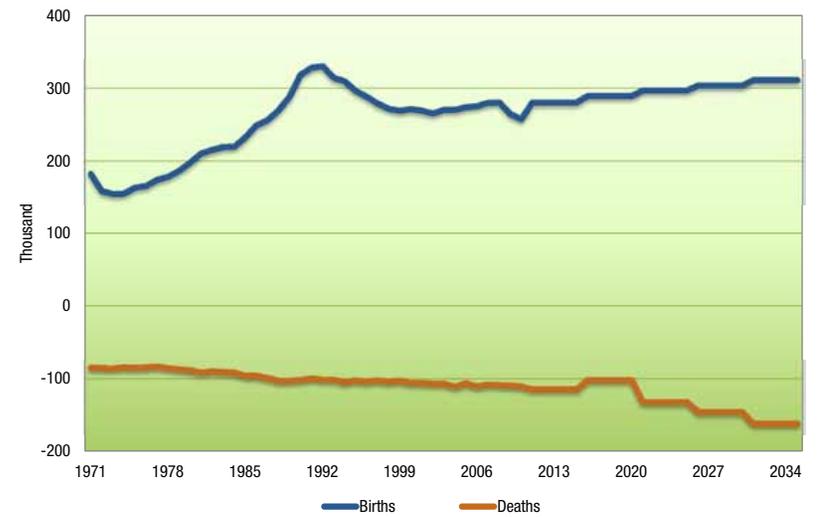
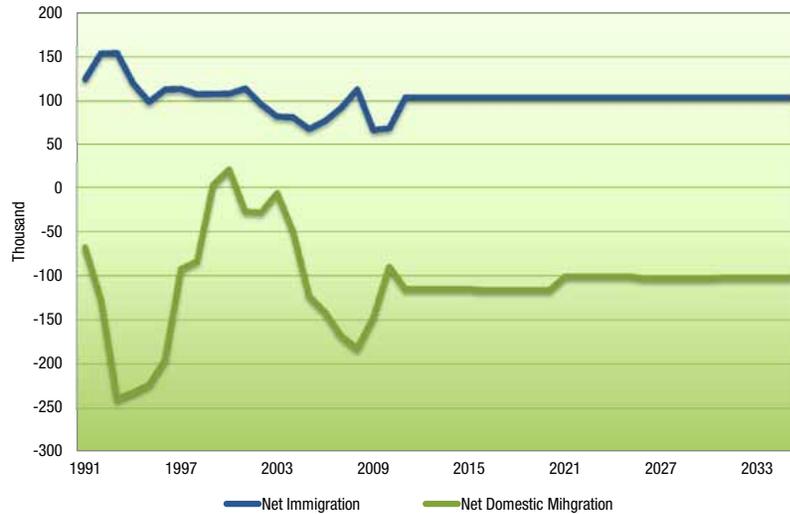


FIGURE 18 Net Immigration and Net Domestic Migration, SCAG Region, 1990–2035



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% 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% in 2010 to 29% in 2035, while Hispanic householders will increase from 35% in 2010 to 47% 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)
Households ('000)	5,853	6,462	7,323	1,470	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	2.33	2.29	2.26	-0.07	
Non-Hispanic Black households	2.59	2.47	2.41	-0.18	
Non-Hispanic Asian & Other households	3.10	2.93	2.77	-0.33	
Hispanic households	4.02	3.78	3.56	-0.46	

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%. 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% in 2010 to 6.5% 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% in 2010 to 40% in 2035. The share of employment in the manufacturing sector will continue to decrease from 9% in 2010 to 8% 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)
Jobs ('000)	7,225	8,417	9,436	2,211	30.6
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 draft 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 by County, 2010, 2020, and 2035

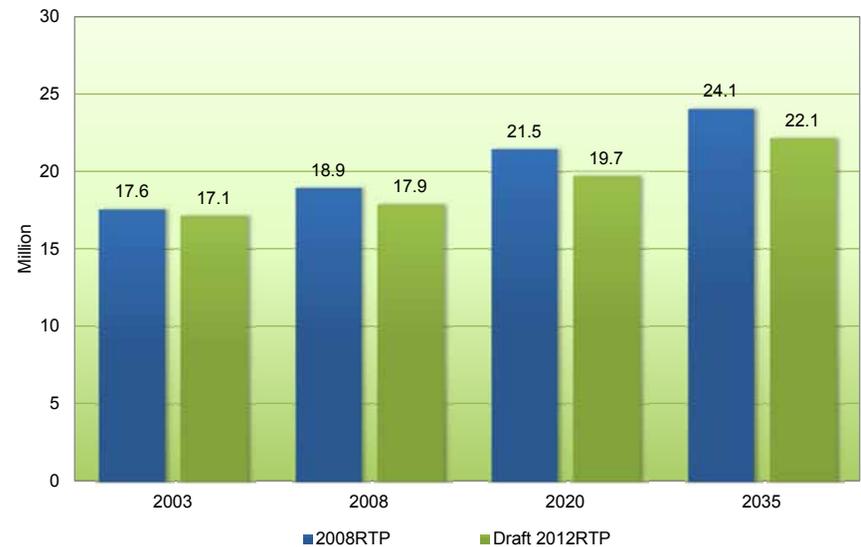
County	Share of Regional Population			Share of Regional Employment		
	2010	2020	2035	2010	2020	2035
Imperial	1%	1%	1%	1%	1%	1%
Los Angeles	54%	53%	51%	57%	54%	51%
Orange	17%	17%	15%	21%	19%	19%
Riverside	12%	13%	15%	8%	11%	13%
San Bernardino	11%	12%	12%	9%	10%	11%
Ventura	5%	5%	4%	5%	5%	4%
SCAG	100%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

Source: US Census Bureau and SCAG

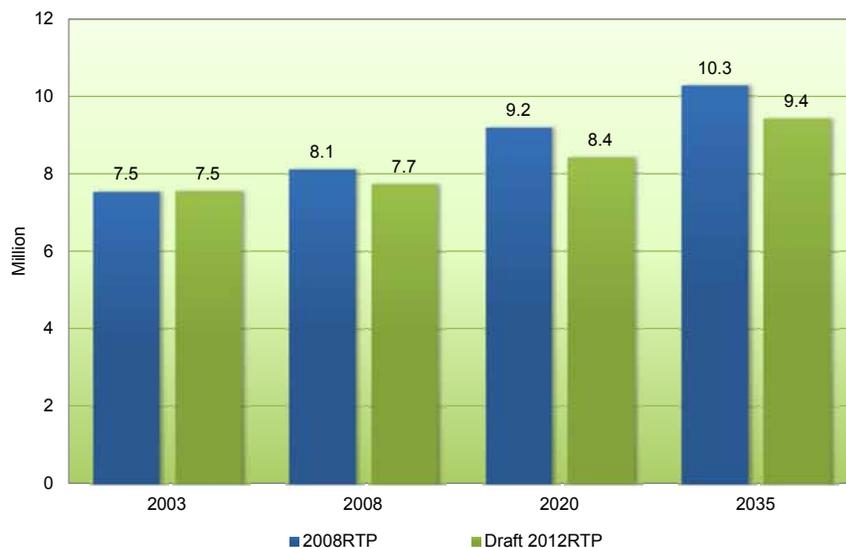
COMPARISON OF 2008 RTP GROWTH FORECAST AND DRAFT 2012 RTP/SCS GROWTH FORECAST

The growth forecast for the 2012 RTP was developed reflecting the recent trends in components (e.g., births, deaths, domestic migration, international migration) of population growth and in job growth by sectors. The 2012 RTP growth forecast for 2035 is lower than that of the 2008 RTP growth forecast (See Figures 19-20).

FIGURE 19 Regional Population: 2008 RTP vs. Draft 2012 RTP



Source: CA DOF and SCAG

FIGURE 20 Regional Employment: 2008 RTP vs. Draft 2012 RTP

Source: CA EDD and SCAG

Section III: Forecasting Framework, Methodology and Assumptions

Forecasting Framework

The regional growth forecast is used as a key guide for the future transportation investments in the SCAG region. SCAG began developing the long term growth forecasts for the 2012 RTP 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. If the recent statistics are not socially acceptable, then the normative assumptions are partly introduced into the forecast process. 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 or immigrant populations did not show a convergence toward the headship rates of White populations. 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 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 reasonable 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% 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%). 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% 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% (minimum) to 5.3% (maximum) in 2020 and 3.8% (minimum) to 5.5% (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% for both 2020 and 2035, which is 0.2% lower than the most current regional share (5.2%). 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, including mortality and fertility, 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%) in 2020, 9.7 million (2.5%) 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% 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% and 6.5%; 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 trend, 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 3 scenarios of regional growth. The 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 trend. All of these scenarios were derived before the 2010 Census redistricting data was available.

TABLE 9 Regional Growth Forecasts (in Thousands): Three Scenarios & 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
	HHL D	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
	HHL D	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
	HHL D	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
	HHL D	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 1.53 million higher (9.3%) 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%) than SCAG's preliminary population projections for 2010, which primarily resulted from population estimates from the California Department of Finance (DOF).; (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%) 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%) 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%) 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%) 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 between 2000 and 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). Source: US Census Bureau and SCAG

TABLE 11 Regional and County-Level Household Change between 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 CA DOF. 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 RTP/SCS and RHNA processes.

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 by backcasting new 2010 Census data and 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 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/fin-alrtp/reports/fGrowthForecast.pdf>). The following is an overall approach toward developing the regional growth forecast for the 2012 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 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' 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 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 base year jurisdiction's share of county jobs for each sector is assumed to remain constant during the forecast years. By using the constant share method, the city'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, survival, migration) 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 are 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 national 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. 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 participation rates for 2020 and 2035. The projected 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 participation rates for the population under 55 for the years 2020 and 2035. SCAG increased the projected participation rates for population groups 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 participation rates, the overall labor force participation rate is projected to slightly decline from 60.4% in 2010 to 59.4% in 2035. Second, some workers might keep two or more jobs. The double jobbing rate is assumed to be around 4.5%, 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% to 8%. The current projection assumes a 5% 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%, 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

Race/Ethnicity	2005-10	2015-20	2030-35
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

Regional 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+), each gender (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% in 1990 to 42.2% in 2010, with a sharp decrease by 3% from 46.7% in 1980 to 43.7% 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%	52.0%
Asian & Other (NH)	39.1%	39.6%-40.7%	39.4%-42.5%
Hispanic	34.8%	35.9%-36.5%	36.4%-37.8%
Total	42.2%	42.4%-42.8%	41.6%-42.8%

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% of the difference from 2010 White headship rates by 2050; Hispanic headship rates are reduced by 25% 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 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 trend, 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.

TABLE 16 Description of Socioeconomic Variables

Variables	Description of Variables
Population (8 variables)	<p>Total Population (1 variable): total number of people living within a zone. Total population is composed of residential population and group quarters population.</p> <p>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.</p> <p>Residential Population (1 variable): the number of residents NOT living in “group quarters.”</p>
Population (8 variables)	<p>Group Quarters Population living in student dormitories (1 variable): Population living in college dormitories (includes college quarters off campus).</p> <p>Population by Age (4 variables): the number of population for different age groups: 5-17, 18-24, 16-64, and 65+.</p>
Households (26 variables)	<p>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.</p> <p>Households by Household Size (4 variables): the number of one-person households, two-person households, three-person households, and four or more person households.</p> <p>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.</p>

Variables	Description of Variables
Households (26 variables)	<p>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.</p> <p>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.</p> <p>Households by Type of Dwelling Unit (2 variables): the number of households living in single-family detached housing, and living in other housing.</p> <p>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.</p> <p>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.</p>
School Enrollment (2 variables)	<p>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.”</p> <p>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.”</p>
Workers (4 variables):	<p>Total Workers (1 variable): total number of civilian workers residing in a zone. Workers are estimated by the place of residence.</p> <p>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.</p>

Variables	Description of Variables
Median Household Income (5 variables):	<p>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.</p> <p>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.</p>
Employment (17 variables)	<p>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.</p> <p>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.</p> <p>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.</p>

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 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 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% 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.

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 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 of 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.

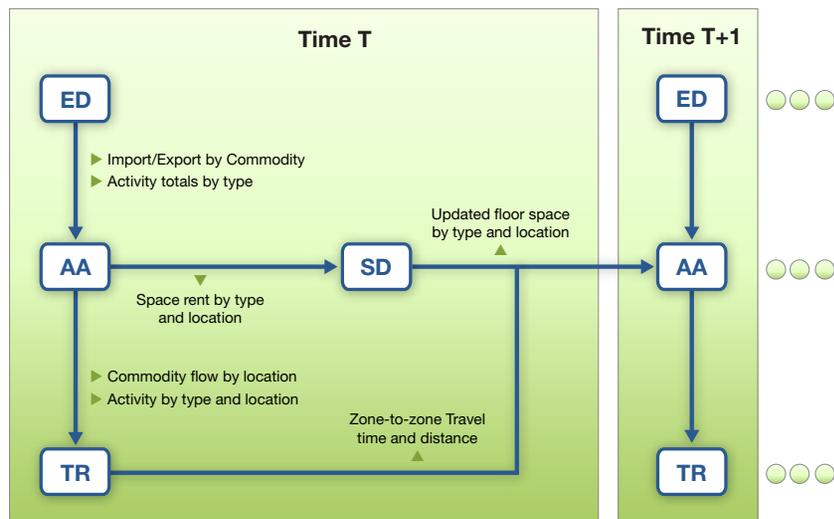
Flows of exchanges from production to exchange zones and from exchange zones to consumption are allocated using the nested logit models, according to exchange prices and transport generalized costs (expressed as transport utilities with negative signs). These flows are converted to transport demands 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 a total 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 14 households 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.

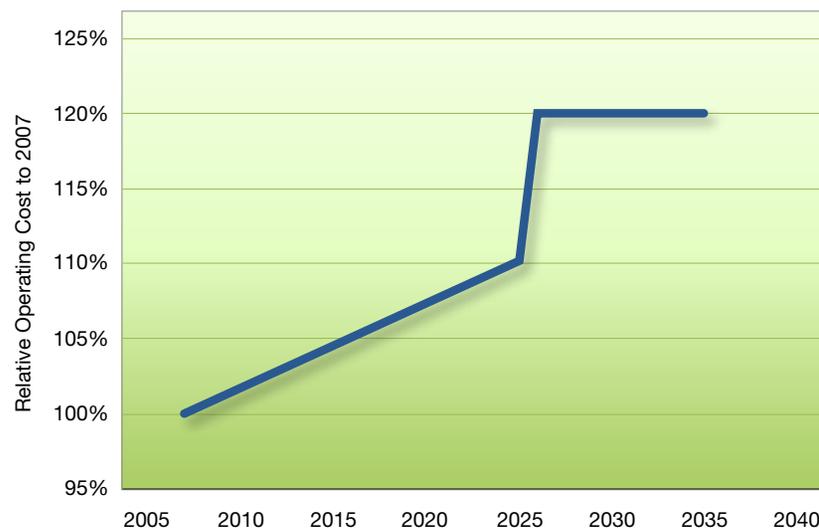
As depicted in Figure 21, each module in PECAS produces intermediate outputs, which are input to the subsequent processes. The AA module primarily estimates the spatial price of commodities, and allocates activities, which consists of households by types and employment by sector. The AA module also estimates 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. 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% is fuel cost.
- The increase of the gasoline tax up to year 2026 would be the equivalent of about a 10% increase in operating costs, and the new VMT fee would result in an additional 10% 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 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.

The total transported commodities in the SCAG region was estimated to be 41.98 trillion dollar * mile in year 2007, and 53.19 trillion dollar * mile in year 2035, if no additional auto operating cost is charged. This 26.7 % increase is caused by regional economic growth and continuing sprawl. With the VMT fee replacing the current gasoline tax, the estimation is 3.55% less than the base case at year 2035. Given economic growth is 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 due to the changed travel cost.

FIGURE 23 Scenario Test Result: Travel Distance Of Commodities In Value * Mile Transported

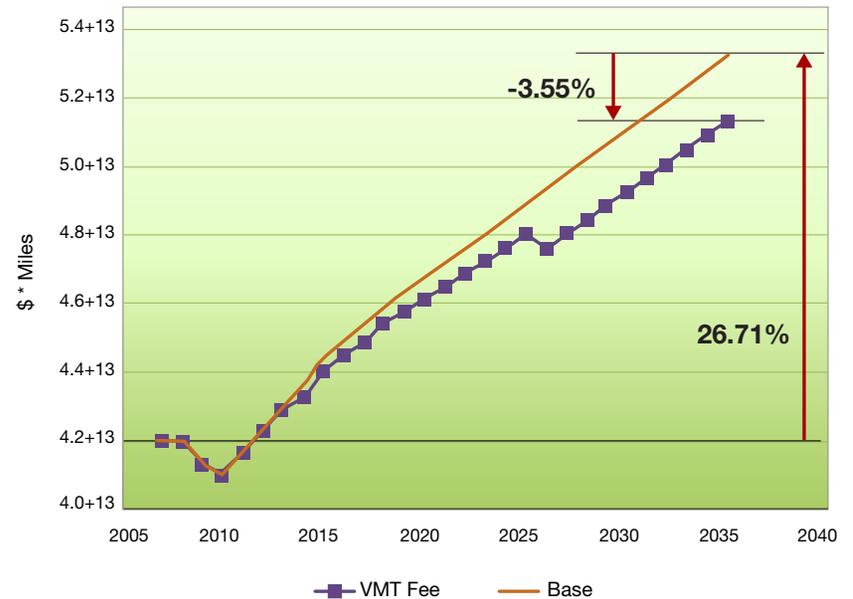


Table 18 summarizes the average travel distance by category. In the base case, the average travel distance of working trip (WCD) would increase 10.3% in year 2035, while intermediate goods delivery (IGD) and shopping trips (CGD) would increase 7.5% and 3.2 % respectively. The overall increase is 5%. With the new 5 cents per mile VMT fee, overall travel distance would increase 1.3% from year 2007.

TABLE 18 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.

References

- Cho, Kyuyoung. 2006. Small Area Forecasting Model and Results: 106 Variables. SCAG Workbook. pp. 89-304..
- Choi, Simon. 2008. Testing the Convergence of Hispanic Headship Rates: The Case of Southern California, Paper presented at the 47th Annual Meeting of the Western Regional Science Association (WRSA), The Big Island, Hawaii, February 17-20, 2008.
- Choi, Simon. 2010. Projecting Regional Population in the Middle of an Economic Recession: Case of Southern California, Paper presented at the 57th Annual North American Meetings of the Regional Science Association International, 2010, Denver, Colorado, November 10-12, 2010.
- Choi, Simon, S. Ryu. 2011. Linking the Regional Demographic Processes and the Small Area Housing Growth: Implications for the Small Area Demographic Projections, Paper presented at the 52nd Association of Collegiate Schools of Planning (ACSP) Conference, Salt Lake, Utah, October 13-15, 2011.
- Hunt, J.D., J.E. Abraham. 2009. PECAS - for Spatial Economic Modelling: Theoretical Formulation. System Documentation Technical Memorandum 1. HBA Spectro Incorporated, Calgary Alberta.
- Min, SeongHee, S. Choi. 2011. The Great Recession, Household Formation, and Homeownership Rate: Implications for Minorities and Immigrants, Paper presented at the 42nd Annual Conference of Mid-Continent Regional Science Association (MCRSA), Detroit, Michigan, June 8-10, 2011.
- Myers, Dowell and J. Pitkin, S. Mawhorter, J. Goldberg, and S. Min. 2010. The New Place of Birth Profile of Los Angeles and California Residents in 2010. Special Report, Population Dynamics Research Group, March 2010.
- Park, Heonsoo. 2009. Advanced Programming Support for Developing Traffic Analysis Zone (TAZ)/Grid Cell Socioeconomic Data and Assessing Selected Small Area Allocation Models for Southern California Association of Governments.
- Smith, Stanley K., J. Tayman, D. A. Swanson. 2001. State and Local Population Projections: Methodology and Analysis. New York: Kluwer Academic/Plenum Publishers.

Southern California Association of Governments (SCAG). 2008. 2008 Regional Transportation Plan: Making the Connection, Growth Forecast Report. <http://www.scag.ca.gov/rtp2008/pdfs/finalrtp/reports/fGrowthForecast.pdf>

U.S. Census Bureau. 2008. United States Population Projections by Age, Sex, Race, and Hispanic Origin: July 1, 2000-2050.

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