ECONOMIC AND JOB CREATION ANALYSIS

PLAN PERFORMANCE

SOUTHERN CALIFORNIA ASSOCIATION OF GOVERNMENTS

2016 2040 RTPSCS

APPENDIX

DRAFT DECEMBER 2015

INTRODUCTION 1

ECONOMIC BENEFITS OF TRANSPORTATION INVESTMENTS AND CONGESTION REDUCTION 1

BACKGROUND 2

METHODOLOGY: THE REMI MODEL 4

RESULTS 6

CONCLUSION 11

REFERENCES 12

ACKNOWLEDGMENTS 12

2016 2040 RTPSCS

APPENDIX

PLAN PERFORMANCE | ECONOMIC AND JOB CREATION ANALYSIS

DRAFT DECEMBER 2015

ECONOMIC AND JOB CREATION ANALYSIS

INTRODUCTION

This technical appendix documents an analysis of the economic impacts of the Southern California Association of Governments (SCAG) 2016-2040 Regional Transportation Plan/ Sustainable Communities Strategy (2016 RTP/SCS). SCAG's 2012 RTP/SCS included, for the first time, an analysis of that prior plan's economic impacts – one of the first formal economic impact analyses of a major metropolitan area's RTP.

The previous 2012 RTP/SCS economic impact work included a significant consideration of the opportunities provided by the transportation infrastructure plan set forth in the Plan, considering not only the economic and job creation impacts of the direct investment in transportation infrastructure, but also the efficiency gains from the coordination of transportation and land use patterns in terms of economic competitiveness, business productivity and goods movement. This technical appendix continues and builds on that previous analysis by analyzing the potential economic impacts of the SCAG 2016 RTP/SCS, primarily in the form of prospective job creation impacts of the Plan.

ECONOMIC BENEFITS OF TRANSPORTATION INVESTMENTS AND CONGESTION REDUCTION

Public investment in transportation can boost employment in at least two ways:

1. Providing jobs for people in highway and rail construction, transportation and transit operations, and maintenance; and
2. Enhancing the economic competitiveness of the SCAG region by making it a more attractive place to do business. Those two impacts are summarized below.

DIRECT JOB CREATION AND THE MULTIPLIER EFFECT:

The 2016 RTP/SCS will employ people to build, operate and maintain transportation projects as a result of the regional infrastructure investment outlined in the 2016 RTP/ SCS Financial Plan. Those jobs are called the direct effect, in the jargon of economic impact modeling. Direct effects – new jobs in entities that construct and operate rail lines or that build and maintain highways, for example – ripple through the economy, creating additional jobs in two ways.

- **Indirect Effects:** Indirect effects are the jobs in companies that supply inputs for the direct jobs created by the RTP/SCS spending. The firms and agencies that build and maintain the transportation system with RTP/SCS funding buy materials, office supplies and business services. All of those supply purchases that are necessitated by the RTP/SCS spending are indirect effects – the jobs required to supply inputs (both goods and services) to support the direct investment in the RTP/SCS.
- **Induced Effect:** Additionally, employees of the firms and agencies that build, operate and maintain the Southern California regional transportation system use their wages to buy all manner of goods – housing, food, clothing, entertainment and the like – and that supports additional jobs. That ripple effect is called the induced effect; the employees who build, operate and maintain the RTP/SCS will have wage income to buy goods and services associated with daily living.

Funding from SCAG's RTP/SCS will therefore directly generate new jobs that would not otherwise exist in the region, and those direct jobs create additional jobs as firms and agencies purchase inputs (indirect effect) and as workers spend their wages on goods and services in the SCAG region (induced effect.) Academic scholars have long understood that public infrastructure investment creates direct jobs and additional multiplier effects from those jobs. But recently, the literature has illuminated how transportation spending also improves the viability and productivity of firms in geographic regions by increasing economic competitiveness through transportation system network efficiency – a second source of additional job growth layered on top of the direct construction/investment effects.

JOB CREATION FROM ENHANCED ECONOMIC COMPETITIVENESS:

A well-planned, well-functioning transportation system with land use strategies that complement transportation investments can allow firms to communicate and conduct business with each other more quickly and readily, draw workers from larger labor market pools, and obtain inputs and ship outputs at lower costs. All of these effects can contribute to enhanced regional economic competitiveness, and therefore raise the productivity of firms in the region. This leads to job creation that goes beyond the jobs required to build, operate and maintain the RTP/SCS. Think of this as a second source of RTP/SCS economic benefits – higher firm productivity that enhances the business and economic competitiveness of the Southern California metropolitan area.

Transportation projects can increase long-term economic prospects beyond the jobs needed for construction and maintenance, an increasing body of evidence shows. Note, as an aside, that an older literature (circa the 1960s) argued that, under most conditions, economic competitiveness benefits were likely shifts from one location to another and so ought not be considered in economic impact analyses for transportation projects (e.g. Mohring and Harwitz, 1962; Mohring, 1993).

Circumstances and research findings have changed. First, as congestion has increased and economies shifted to more knowledge-intensive industries, production is often characterized by increasing returns to scale, and economists have long-known that under conditions of increasing returns transportation can produce long-term economic competitiveness gains (Jara-Diaz, 1986). Second, while new jobs in the SCAG region might be, in part, jobs that would have located outside the region if the RTP/SCS projects were not built, those new jobs would still benefit the SCAG region (for an early example of this effect, see, e.g., Boarnet, 1997). Advanced economic impact software tools, including REMI (discussed below), can model the migration of people and firms across metropolitan areas, allowing SCAG to understand changes in population and employment related to economic competitiveness due to the RTP/SCS plan investment. While in some cases those benefits flow from the migration of people and jobs from outside of the region into the region, those are real economic and employment benefits to SCAG region residents, and therefore matters of policy importance. Whether it is a commuter, a truck driver, a tourist or a firm awaiting crucial goods, lost time due to congestion is a cost to the economy. Reducing congestion therefore adds economic activity and jobs.

This suggests that research and analysis on economic impacts of transportation investments should account for both effects: (1) the direct effect of construction, maintenance and operations spending, as has been more traditionally modeled using, for example, input-output multiplier methods and (2) the longer-term beneficial effects of transportation infrastructure on productivity and economic competitiveness. The economic impact analysis of the 2012 RTP/SCS was an early and innovative effort that examined the spending-related job creation impacts (direct, indirect and induced) as well as the network efficiency/economic competitiveness effects. Both effects – construction, operations and maintenance jobs and their respective multipliers, and long-term network efficiency and economic competitiveness-related effects – are further discussed below.

BACKGROUND

Two economic transformations have occurred over the past two to three decades that make transportation access an increasingly important element of regional economies. First, metropolitan economies are increasingly reliant on the value of proximity – what urban economists call "agglomeration economies", or the propensity of successful local economies to cluster. Second, congestion has risen to levels that, academic research indicates, tends to limit economic growth.

AGGLOMERATION ECONOMIES AND THE NEED FOR ACCESS:

Firms benefit from being near other firms. Santa Monica's "Silicon Beach" is a location where technology firms have easy access to other nearby peer firms, creating an environment of shared ideas, talent and interaction. Yet the access is not always as easy as it might sound. A video gaming company in Santa Monica might benefit from access to talent at Caltech in Pasadena or access to movie studios in Burbank – both easily an hour away during much of the day because of congestion. Hence the benefit of agglomeration – nearby access to business partners, customers and ideas – is diminished because of a congested transportation system.

The benefits of local concentrations of firms are increasingly based on face-to-face communication (Storper and Venables, 2004). Research has shown that firms have higher productivity when locating near other firms, and those productivity benefits are often short-distance phenomena. Rosenthal and Strange (2003) document agglomeration benefits (productivity advantages from locating near other firms) that operate over distances of five to ten miles. Yet physical distance must be coupled with travel time. Good transportation access "shrinks distance" by allowing businesses to more quickly access knowledge, suppliers and customers. Well-performing transportation systems, by contributing to dense, lively, walkable neighborhoods, can also create communities that are conducive to serendipitous meetings and face-to-face communication that is particularly important in knowledge intensive or creative industries.

CONGESTION AND EMPLOYMENT:

Traffic congestion has been increasing in virtually all U.S. metropolitan areas. Research indicates that what was once just a nuisance for drivers – traffic delays – now inhibits job growth. Hymel (2009) used a regression analysis to estimate the effect of congestion reduction on new job creation. Hymel expressed those results as an elasticity of job creation with respect to congestion reduction – the percentage change in employment growth that would result from a percentage change in congestion.

Hymel concluded that from 1990 to 2003, a ten percent congestion reduction in the Los Angeles-Long Beach-Santa Ana metropolitan area would have resulted in a 4.67 percent increase in employment growth. For the Los Angeles metropolitan area, actual employment growth from 1990 to 2003 was 567,983 new jobs, and Hymel estimates that with 50 percent congestion reduction, the metropolitan area's employment growth, 1990 to 2003, would have been 700,235 new jobs, implying an elasticity of -0.467. Compare that to Hymel's results for the San Diego-Carlsbad-San Marcos metropolitan area, which had lower congestion levels in 1990 than did the Los Angeles metro area.

The elasticity of employment growth with respect to traffic congestion in the San Diego area was -0.248, implying that a 10 percent congestion reduction in the San Diego region would increase employment growth by 2.48 percent.

Importantly, this suggests that the employment enhancing effect of congestion reduction (e.g. the RTP/SCS investment) is larger in more congested urban areas. This is intuitive; the "distance shrinking" effect of managing congestion is more important in more congested urban areas. This is also a non-linear effect; congestion relief grows more important for the economy as congestion levels rise, implying that the economic competitiveness job creation and economic growth effects from the SCAG RTP/SCS are, quite likely, larger now than in past decades.

This sets the background and context for the economic impact study of the 2016 SCAG RTP/SCS. Metropolitan economies increasingly rely on agglomeration benefits, as knowledge-based firms desire to locate near other similar firms to benefit from the surrounding milieu. Such a phenomenon has long been familiar in Silicon Valley, and evidence suggests that the need to locate near similar firms is becoming pervasive in many segments of modern economies - therefore the increasing importance of industry clusters to regional economic success. At the same time, congestion has increased the "effective distance" within metropolitan areas, and the evidence suggests that the negative economic effects of congestion are largest (and growing) in our most congested cities. Creating better access and mobility – a key goal of SCAG's RTP/SCS – can be a clear pathway toward stimulating economic growth. There are five possible paths through which transportation improvements can increase regional economic competitiveness, and each is described below.

1. Improved labor market matching: Reducing travel time allows firms to hire from a larger geographic catchment area. This effectively increases the firm's labor market – particularly so in a large urban area like the SCAG region, where reductions in commuting time can yield access to many more potential employees. Increasing the size of the labor pool allows firms to find a better employee match for its needs. By hiring employees who better suit their needs, the firm can produce more (employees are more productive) for the same cost, allowing the firm to be more competitive and capture a larger market share. That, in turn, can lead to increased hiring if the increase in market share countervails the fact that the firm can produce more with fewer employees due to the improved employer-employee job match. (See, e.g., Finney and Kohlhase, 2008).
2. Firms move into the SCAG region in response to enhanced economic competitiveness: This effect flows in part from the first effect. If the SCAG region's transportation system allows for more efficient commutes and hence a larger labor market pool, and if that larger employee pool allows firms to hire better employees, eventually firms, especially those that rely on a skilled workforce, will move into the region in response to those improved hiring prospects. Therefore the increases in firm productivity that initially come from improved labor market matching will result in firms moving into the SCAG region from other locations over longer time horizons.
3. Reduced Congestion Increases Labor Supply: Metropolitan areas compete for mobile labor, and metropolitan regions with lower traffic congestion will, all else equal, lure more migrants into the region due to the amenity value of lower traffic congestion. This increases the supply of available labor. In metropolitan areas subject to high traffic congestion and longer commutes, the labor pool will have to be compensated either in the form of higher wages, lower house prices, or both (e.g. Roback, 1982). These two related effects are, in fact, one and the same – the higher wages in high congestion metropolitan areas reflect the need to lure in a labor pool that otherwise might choose to locate in lower congestion locales. Reduced congestion can attract more workers to a region, allowing a firm to hire quality workers at reasonable wages.
4. Increased market for firms' products: Reductions in travel time can allow firms to supply a larger market area. In some cases, that larger market area can be supplied by larger firms, or more firms of the same size, and there are not net economic competitiveness gains from the larger market area. In the jargon of economics, such a case is production that is constant returns to scale. For many locally serving products – eating establishments, consumer products, services – production is likely to be constant returns to scale, and larger firms likely have no particular cost advantage over smaller firms. There are, however, important exceptions – cases where larger market areas lead to increased economic competitiveness and hence regional job growth. One example is the goods movement/freight traffic that moves through the Ports of Los Angeles and Long Beach. Larger ports can build infrastructure that allow faster and hence lower cost processing of freight movements. Supply chain managers favor Southern California because of the speed and reliability at which goods can be moved around the region and from it to the rest of the U.S. As the economy expands, congestion robs the area of this competitive advantage. Increasing the efficiency of throughput would maintain and enhance these advantages and create extra economic activity and jobs. Reductions in landside freight shipping times from the ports to points within and beyond the SCAG region can contribute to shipping volumes that could allow lower costs and hence lead to higher productivity, making the SCAG ports more cost effective than other competitive points of entry.
5. Learning: In a progressively more knowledge-based economy, cities are increasingly engines of economic innovation. Virtually all economic advances – in consumer products, technology, medicine, consumer services, retailing and logistics, entertainment and fine arts – are created in metropolitan areas. A large and growing literature argues that much of the economic advantage of cities is the learning that is possible when persons and firms are in close proximity (e.g.

Puga, 2010, Glaeser, 2011, Storper and Venables, 2004). The engineers in Silicon Valley interact regularly, within and across different firms, creating a world-class hub of knowledge and innovation that is unrivaled in the computing, advanced electronics and software industries. The movie industry in Los Angeles provides the same center for knowledge and learning in the entertainment industry. Such learning effects are central to many industries, including manufacturing processes and services that increasingly rely on innovations to remain competitive. (For empirical evidence on productivity gains that accrue to firms that locate in very close proximity to concentrations of employment in their own industry, see, e.g., Rosenthal and Strange, 2003.) Transportation investments that reduce traffic congestion can allow people to interact more readily with a larger pool of like-minded experts, increasing the learning and innovation in a regional economy. That can allow local firms to innovate in ways that lowers costs, improves products and leads to larger market share. Over time, that improved innovation environment will attract mobile labor and capital (workers and firms) from other regions, further boosting economic activity.

METHODOLOGY: THE REMI MODEL

To quantify the economic impact of the plan's implementation, the SCAG economic team used data and software from Regional Economic Models, Inc. (REMI). The REMI TranSight model is an advanced economic analysis model that combines input-output approaches coupled with a model of resident and firm migration into and out of the SCAG region to model the direct, indirect and induced effects of the RTP/SCS spending. REMI also includes a general equilibrium model combined with New Economic Geography approaches to model changes in economic competitiveness. REMI TranSight is the most advanced tool commercially available for analysis that forecasts the total economic effects of changes to transportation systems. All of the economic analysis of the plan was conducted using REMI models.

COMPETITIVENESS AND NEW JOBS: RESULTS FROM REMI MODEL

SCAG's regional travel forecasting model was used to generate inputs for the REMI TranSight model. The forecasting model from REMI includes historical data from public, government sources like the Bureau of Economic Analysis (BEA), the Bureau of Labor Statistics (BLS), the Energy Information Administration (EIA), and the United States Census Bureau.

The model relies on four different quantitative methodologies of regional analysis: input-output tabulation (which captures inter-industry relationships); econometrics (which estimates behavioral responses); computable general equilibrium (which will estimate long-term effects); and New Economic Geography (which relates economic growth to market areas as measured based on travel times and shipping or travel costs).

Using vehicle miles traveled (VMT), vehicle hours traveled (VHT), and number of trips from the SCAG 2016 RTP/SCS travel demand model, REMI TranSight calculated how consumer, household and business behavior responds to changes within a travel network. This allowed forecasts of future economic impacts. The model inputs were from SCAG's travel model and analysis. REMI TranSight models economic competitiveness in five categories, listed below, which collectively can account for the paths of economic competitiveness effects. Inputs included reductions in commuting costs, accessibility costs, transportation costs, and operations costs and improvements in amenities or reductions in externalities. Each is defined below:

COMMUTING COSTS

Reductions in commuting costs increase the ability of firms to draw from larger labor pools, while better commuting leads to higher productivity due to improved quality of the employer-employee match and general stability throughout the network. REMI TranSight quantifies changes to commuting patterns from the travel demand data as a change in "commuting costs." The primary interaction is VHT/trips – that is, the average trip time for personal automobiles. Shorter trips assume a greater ease of commute throughout the region and between different regions. From there, TranSight quantifies an increase in labor productivity as an increase in "labor pooling" and a better match between employees and employers. This leads to expanded labor productivity throughout the SCAG region creating a competitive advantage for the Southern California region, which leads to expanded market shares and increased output for local businesses. From there, employers continue to expand and hire more workers into the future, which forms a large bulk of the economic gains in the SCAG region.

ACCESSIBILITY COSTS

Accessibility, in the REMI TranSight model, is the concept of the availability of intermediate inputs for businesses. That is, increased access means a better match for businesses in terms of their intermediate suppliers, which leads to increased productivity, larger market shares and a greater clustering effect within a region. In REMI, this effect models and quantifies how reductions in the cost of transport for business-to-business inputs within the region allows firms to produce at lower cost, or more productively, due to the ease of movement of intermediate goods between regions and the associated strength of local supply chains. The travel demand interaction in this case is number of trips/VHT – again, this being the "average number of deliveries per hour" via truck. The model assumes that a

faster rate of delivery means a greater ease of access in a region or between regions, which means better and cheaper access to the intermediate goods that businesses need.

TRANSPORTATION COSTS

Transportation costs are a similar concept to accessibility, but these quantify the expenses involved in the delivery of finished goods, rather than the movement of intermediate inputs amid different businesses and industries. The travel interaction is VMT/VHT, or the average system speed, for trucks, assuming that a higher system speed means a higher ease of transportation from sellers to buyers between regions. This effect, in REMI TranSight, models how reduced costs for transporting outputs allow firms to access larger markets and quantifies the cost of transportation between points of final production and final sale/consumption. This builds on the gravity concepts of trade flows in the model, and also the concept of "relative delivered prices." That is, the model includes both a "relative cost of production" (RCP, which access lowers) and a "relative delivered price" (which is the RCP plus the cost of transporting a good to the shelf). The differences are transportation costs, which a higher speed for the system makes cheaper for the region inside of the TranSight model.

AMENITY/EXTERNALITY

Under normal circumstances, TranSight automatically quantifies the user- and agency-costs of transportation from travel demand data. REMI models how improvements in amenities, e.g. reduced congestion or improved air quality, will draw in-migrants to a region and hence improve competitiveness through, e.g., labor market pooling effects. However, in this case, as SCAG had an internal estimate of the same, REMI used the same information as the estimation of amenity benefits inside of the model. The variable in question, which is a non-pecuniary amenity, goes into the model as an increase in the attractiveness of a region to migrants. For instance, people are willing to locate themselves in Florida for lower wages, given the high overall attractiveness of the area's culture and climate. Similarly for the SCAG region, we can enter a calculated value for externality benefits. This will move migrants into the region, lower wages and create a bigger cluster of labor for businesses to choose from. This is important to the industrial competitiveness of the region, as employers can charge less money for the same (or better) work from employees. SCAG's estimates included the cost of emissions, lost travel time due to congestion, and safety benefits. These all, in sum, add to the attractiveness of a region, and are the basis for the amenity impacts in REMI TranSight.

OPERATIONS COSTS

Transportation improvements can have a big influence on business/household economies in terms of their fuel and vehicular repair purchases. REMI models how reductions in expenditures on fuel or vehicles, for example, frees up income for residents to spend elsewhere, and the associated impacts on the regional economy. TranSight normally quantifies this, but SCAG had an external estimate. To illustrate the influence of fuel savings on the economy, this goes into the model as reduced consumer or business spending on gasoline and oil. As an extension, saving an entity $50/year on fuel "frees up" $50 to spend on other priorities. For households, this means an increase in consumer spending and a decrease in the cost of living. For a business, this would mean increased competitiveness, as enterprises in SCAG counties no longer have to pay as much for fuel in the future. This allows them to expand their market shares and eventually have more output and hire more workers in the out years.

The basis of the 2016 RTP/SCS economic analysis model is described below in two parts:

JOBS RESULTING FROM THE DIRECT EFFECT OF RTP/SCS SPENDING ON CONSTRUCTION AND OPERATION AND MAINTENANCE, PLUS MULTIPLIER EFFECTS:

The RTP/SCS includes more than $500 billion in anticipated spending on transportation construction, operation and maintenance over the 25-year period from 2016-2040. That magnitude of investment will result in a large number of jobs from the direct effect of the spending plus indirect and induced effects. The REMI model is structured on input-output relationships that can forecast the impact of spending on direct job creation and on indirect and/or induced effects as the spending requires new input purchases and as the economy expands when employees have more money to spend. The REMI TranSight model also contains a "New Economic Geography" component, which models how transportation affects in- and out-migration of residents and firms. Impacts from those effects, when linked to investment plan spending, are also modeled.

JOBS RESULTING FROM ENHANCED ECONOMIC COMPETITIVENESS:

The results of the model effort yielded network benefits (flowing from reduced commuting, accessibility, and transport costs as defined above) and amenity and operations benefits (from the changes in amenities and the reductions in operations costs). The network benefits collectively illustrate the economic benefit of "closing the distance" between economic actors on the travel network. The network benefits summarize the bulk of the economic competitiveness impacts from improvements to the transportation system that result from the plan, while the amenity/operations benefits are largely the impact of measurable non-economic quality of life benefits of a project (such as air quality, travel times or safety) and increased consumer spending power that results from lower transportation costs due to direct savings on fuel costs and "wear and tear" to vehicles arising from more efficient network operations.

As outlined previously, the academic and research literature highlights five possible paths through which transportation improvements can increase regional economic competitiveness, and each is repeated briefly below:

- Improved labor market matching
- Firms move into the SCAG region in response to enhanced economic competitiveness
- Reduced congestion increases labor supply
- Increased market for firms' products
- Learning

Of the five paths for competitiveness benefits, REMI can provide some insight into all but learning. Learning across firms is still difficult to model formally in predictive economic impact tools, and so we note that such effects are not present in the competitiveness effects modeled here.

To summarize, REMI TranSight models competitiveness effects from (1) changes in commuting costs that allow firms to hire from larger labor market pools (transportation shrinks distance), finding better employee-firm matches, and hence higher productivity, (2) obtaining inputs at lower transportation costs within the region, (3) accessing larger output markets within the region, and (4) hiring employees who migrate into the region in response to lower traffic congestion and/or improved air quality. Additionally, residents who spend less on transportation will have more income to make purchases in other sectors, which is also included in the REMI model calculations. All of these effects can make the region a more productive location, and firms will, at the margin, locate in the Southern California metropolitan region rather than other alternative metropolitan areas in response to transportation improvements in the SCAG region.

RESULTS

This analysis reports SCAG 2016 RTP/SCS economic results from the REMI analysis in two parts: first jobs that result from the RTP/SCS investment spending (direct, indirect and induced effects), and then additional jobs that flow from the improvements to the transportation network, resulting in network efficiencies and related increases in regional economic and business competitiveness.

TABLE 1 2016-2040 SCAG RTP/SCS plan, employment impact from construction, operations, and maintenance spending, annual average jobs (relative to baseline), thousands

FY	2016-2020	2021-2025	2026-2030	2031-2035	2036-2040	AVERAGE PER YEAR
Imperial	1.68	2.14	4.54	4.55	4.55	3.49
Los Angeles	110.74	112.71	99.16	86.01	93.78	100.48
Orange	52.99	21.17	16.75	17.41	20.05	25.67
Riverside	31.99	19.33	25.09	28.84	24.90	26.03
San Bernardino	32.53	26.41	26.98	27.11	25.13	27.63
Ventura	7.13	6.00	6.02	3.71	4.04	5.38
SCAG Region	237.06	187.76	178.53	167.63	172.45	188.69

Source: SCAG calculations from 2016 RTP/SCS financial plan input into REMI model. Note that the REMI model reports full and part-time jobs, and the job numbers include both full-time and part-time jobs.

JOBS RESULTING FROM THE DIRECT EFFECT OF THE 2016 RTP/SCS PLAN INVESTMENT SPENDING ON CONSTRUCTION, OPERATION AND MAINTENANCE, PLUS MULTIPLIER EFFECTS

TABLE 1 shows the annual average jobs from the 2016 SCAG RTP/SCS Financial Plan spending. This is a traditional economic analysis, modeling the stimulus from new spending in the form of direct jobs and multiplier effects (indirect and induced effects). The job impact is reported as annual average jobs in five-year periods (starting with 2016-2020), for each county and for the entire SCAG region. The last column in Table 1 shows jobs, averaged over all plan years, from RTP/SCS construction, operations and maintenance spending.

We note that REMI's output is expressed in terms of job-years – a new job that lasts for five years is five job-years in REMI. Jobs are created and lost in an economy on an ongoing basis, and the job-year concept allows the REMI TranSight model to track jobs over time. When we express annual average jobs in the five-year period, that annual average would be equal to the number of new jobs in the five-year period if those jobs lasted, on average, five years. We note that REMI TranSight has an advanced ability to model economic dynamics, including year-to-year variations in job creation and destruction. The job-year concept reflects that advanced capability. To keep the language simpler, we refer to job impacts as averages over either five-year periods or the entire plan.

The results reported in **TABLE 1** reflect a post-model adjustment to the REMI model. The scale of the expansion of the SCAG region's transit system, and hence the scale of the increase in transit operations and maintenance spending, is without precedent and poses complications for models, like REMI, that are built based on existing conditions and experience.

REMI TranSight model outputs predicted that jobs from transit operations and maintenance (O&M) expenditures in the SCAG region grow from an annual average of 119,000 in 2016-2020 to 173,000 in the last five years of the plan, 2036-2040. As a fraction of the total jobs from the plan's spending (construction and O&M), transit O&M jobs grow from half of the jobs in 2016-2020 to nearly two thirds of all jobs in 2036-2040 according to REMI results. Transit O&M spending, as a fraction of the total plan spending, was virtually constant across those two time periods – moving from 37 percent of total plan spending in 2016-2020 to 39 percent of plan spending in 2036-2040. The large increase in the share of plan jobs from transit O&M while the share of plan spending from transit O&M stays constant is not consistent.

Upon examination, the research team concluded that the size of the SCAG region's transit spending is outside of what REMI can accurately model in the later years of the plan. In the years 2036-2040, the SCAG region will spend $7.5 billion per year on transit O&M, while REMI's baseline forecast of the size of the transit industry in the SCAG region during that same time period is about $2 billion per year. The large difference is not due to any fault of the REMI model, but rather is due to the fact that the SCAG region is building the largest transit public works project in the history of the U.S. – an investment at a scale well beyond what has been experienced in other similar metropolitan areas during recent decades, and even of a magnitude unprecedented compared to prior SCAG RTPs. The scale of the transit investment, and the resulting magnitude of the increase in transit O&M, are beyond what the research team believes the REMI TranSight model can reliably forecast at this point in time, so therefore the growth in jobs from transit O&M spending was adjusted downward.

TABLE 1 reflects an adjustment to the REMI model's output. The adjustment had two steps:

1. The research team assumed that the share of jobs from transit O&M spending in the first five-year time period, 2016-2020, reflects an accurate split between jobs from transit O&M and jobs from all other plan spending. The conditions in the early years of the plan more closely reflect the current conditions that are the basis for the REMI model's baseline and internal forecasts, and hence the early year transit O&M jobs, which are substantially lower than REMI's estimate of transit-related O&M jobs in later years, are more reliable.
2. The research team adjusted the share of transit O&M jobs moving forward to reflect the share of transit O&M spending as a fraction of total plan spending.

The ratio of jobs from transit O&M relative to jobs from all other plan spending in 2016-2020 is 1.0055. Transit O&M spending, in 2016-2020, is 37 percent of total plan spending. This analysis assumed that REMI's estimate of job from sources other than transit O&M are accurate in each time period, to 2040, and assumed that the ratio of jobs from transit O&M spending relative to jobs from all other sources in 2016-2020 will only change in proportion to changes in transit O&M spending relative to the total spending in the plan in time periods after 2020.

Jobs from transit O&M spending are thus calculated as shown below.

$$\text{Transit Jobs}_t = \text{Non Transit Jobs}_t * \left(\frac{\text{Transit Jobs}_{16-20}}{\text{Non Transit Jobs}_{16-20}}\right) * \left(\frac{\text{Transit Spend}_t}{\text{Plan Spend}_t} \Big/ \frac{\text{Transit Spend}_{16-20}}{\text{Plan Spend}_{16-20}}\right)$$

Where:
TransitJobs = Final estimate of jobs from transit O&M spending;
NonTransitJobs = REMI estimate of jobs from plan spending in categories other than transit O&M;
TransitSpend = Plan spending, in dollars, on transit O&M;
PlanSpend = Plan spending, in dollars, total;
Subscript "16-20" indicates the average for the years 2016-2020;
Subscript "t" indicates one of the five-year periods, 2016-2020, 2021-2025, 2026-2030, 2031-2035, 2036-2040.

For comparison, **TABLE 2** shows the annual average jobs from the construction, operation and maintenance spending in the 2012 RTP/SCS. Note that the overall SCAG region job impact from the 2016 RTP/SCS (Table 1) is eight percent larger than the same impact from the 2012 RTP/SCS, reflecting the larger size of the 2016 RTP/SCS investment plan. The 2016 plan results in nine percent more jobs (relative to the 2012 RTP/SCS) in Los Angeles County, 27 percent fewer jobs in Orange County, and an increase in jobs in the other SCAG counties, all relative to 2012. Note that the change in jobs generated in Orange County results from a substantial front-loading of the transportation investment. In Orange County, annual average new jobs from RTP/SCS construction, operations and maintenance is 52,990 per year in 2016-2020, while for the first two five-year periods of the 2012 plan Orange County was projected to see 36,100 and 34,000 new jobs (in 2011-2015 and 2016-2020, respectively). That same front-loading effect of economic impacts is evident in Riverside and San Bernardino Counties, from comparisons of **TABLES 1 AND 2**.

TABLE 2 2012 plan, employment impact from construction, operations, and maintenance spending, annual average new jobs (relative to baseline), thousands

FY	2011-2015	2016-2020	2021-2025	2026-2030	2031-2035	AVERAGE PER YEAR
Imperial	0.7	0.7	1.1	1.6	0.9	1.0
Los Angeles	112.2	89.1	90.1	93.4	76.4	92.2
Orange	36.1	34.0	35.5	37.8	32.3	35.1
Riverside	23.5	22.0	25.0	28.0	23.7	24.4
San Bernardino	18.0	15.5	18.5	21.4	18.0	18.3
Ventura	3.8	3.4	3.0	3.6	3.2	3.4
SCAG Region	194.3	164.7	173.2	185.8	154.5	174.5

Source: SCAG calculations from 2012 RTP/SCS financial plan input into REMI TranSight model.

TABLE 3 2016 plan, jobs from enhanced economic competitiveness, REMI estimates of jobs from network efficiency annual average jobs (relative to baseline), thousands

FY	2016-2020	2021-2025	2026-2030	2031-2035	2036-2040	AVERAGE PER YEAR
Imperial	0.0	0.4	0.7	1.2	1.8	0.8
Los Angeles	37.9	135.7	235.1	309.3	336.7	211.0
Orange	11.8	36.3	53.3	76.2	106.8	56.9
Riverside	10.2	34.0	51.6	70.7	91.7	51.6
San Bernardino	7.1	27.6	49.9	70.5	89.1	48.8
Ventura	0.4	2.7	6.7	9.5	9.9	5.8
SCAG Region	67.4	236.8	397.3	537.4	636.0	375.0

Source: SCAG calculations from 2016 RTP/SCS travel model results input into REMI TranSight model.

TABLE 4 2012 plan, jobs from enhanced economic competitiveness, REMI estimates of jobs from network efficiency, annual average jobs (relative to baseline), thousands

FY	2011-2015	2016-2020	201-2025	2026-2030	2031-2035	AVERAGE PER YEAR
SCAG Region	21	71	264	543	852	354

Source: SCAG calculations from 2012 RTP/SCS travel model results input into REMI TranSight model, post-model adjusted network efficiency results as described in 2012 RTP/SCS.

JOBS RESULTING FROM ENHANCED NETWORK EFFICIENCY AND ECONOMIC COMPETITIVENESS

Network efficiency in the form of improved transportation access is a second source of job growth. **TABLE 3** shows the jobs from improved economic competitiveness that result from decreases in travel times and less costly trip-making relative to the baseline. Note that the economic competitiveness jobs grow over time, as the effect of the RTP/SCS relative to baseline results in increasingly larger transportation improvements, and resulting cumulative network efficiencies, over the course of the Plan.

For comparison purposes, the economic competitiveness jobs from the 2012 RTP/SCS are shown in **TABLE 4**. The economic competitiveness jobs from the 2016 plan are larger than those from the 2012 Plan in the first fifteen plan years (compare 2016-2030 in Table 3 to 2011-2025 in **TABLE 4**), but after the first fifteen Plan years the economic competitiveness jobs from the 2012 RTP/SCS are larger. This likely is the result of the more front-loaded spending structure in the 2016 Plan.

FULL RESULTS

The full economic results of the 2016 RTP/SCS investment are summarized below, with thousands of new jobs (annual average) resulting from the Plan in five year time periods and an annual average for 2016–2040 shown. The total combined jobs from the two effects, Plan investment (construction, operations and maintenance spending) and network efficiency/economic competitiveness, are shown summed together in **TABLE 5** to highlight the total economic impact of the SCAG 2016 RTP/SCS. For comparison, **TABLE 5** also shows the combined impact of the 2012 RTP/SCS.

Additionally, REMI TranSight can model new jobs from increases in amenities in the region that flow from the Plan, such as improved air quality, and from improvements in system operations because people can travel at lower dollar cost with the plan in place. SCAG had their own measures of the improvements in amenities and reduction in user travel costs, and those were entered into the REMI TranSight model. The net result is an additional annual average of 47,000 jobs from amenities and system operation improvements.

TABLE 5 Total Jobs, all sources, construction, operations and maintenance, network benefits, from 2016 RTP/SCS, with 2012 shown for comparison, annual average jobs (relative to baseline), thousands

FY	2016-2020	2021-2025	2026-2030	2031-2035	2036-2040	AVERAGE PER YEAR
Imperial	1.7	2.5	5.3	5.8	6.3	4.3
Los Angeles	148.7	248.4	334.3	395.3	430.5	311.4
Orange	64.8	57.5	70.0	93.7	126.9	82.6
Riverside	42.2	53.4	76.7	99.5	116.6	77.7
San Bernardino	39.6	54.0	76.9	97.6	114.3	76.5
Ventura	7.6	8.7	12.7	13.2	13.9	11.2
SCAG Region	304.5	424.5	575.8	705.0	808.5	563.7
	2011-2015	2016-2020	2021-2025	2026-2030	2031-2035	
2012 RTP/SCS SCAG Region	215	236	437	729	1,006	528.5

Source: SCAG calculations

CONCLUSION

The economic analysis shows that the 2016 SCAG RTP will result in:

- Job growth from building, operating and maintaining the RTP infrastructure projects, averaging over 188,000 jobs per year;
- Increases in economic competitiveness and efficiency from completion of the projects and operations, averaging 375,000 jobs per year; and
- Amenities and infrastructure system operations that contribute to employment, averaging an additional 47,000 jobs per year.

Southern California is a huge geographic area. The friction of distance means employers in one sub-area cannot easily access workers living in another. A more efficient transportation system, with increased mass transit systems, will create a more efficient and competitive labor market and add economic activity and jobs into the economy.

The 2016 SCAG RTP/SCS outlines a transportation infrastructure investment strategy that will beneficially impact Southern California, the state, and the nation in terms of economic development, job creation and economic growth, and overall business and economic competitive advantage in the global economy in terms of job creation and economic growth throughout the Southern California region. Over the 2016–2040 period, the RTP/SCS calls for the spending of more than $500 billion on transportation improvement projects. The findings show that over the 25-year period and six-county SCAG region, the plan will generate significant employment gains. The RTP/SCS boosts employment in two ways: providing jobs for persons in highway and rail construction, operation and maintenance; and boosting the economic competitiveness of the SCAG region by making it a more attractive place to do business.

The economic analysis shows that across SCAG's six county region, an annual average of more than 188,000 new jobs will be generated by the construction, maintenance and operations expenditures that are specified in the RTP/SCS program, and the indirect and induced jobs that flow from those expenditures.

When investments are made in the transportation system, the economic benefits go far beyond the jobs created building it, operating it and maintaining it. Unlike spending to satisfy current needs, infrastructure delivers benefits for decades. The infrastructure, once built, can enhance the economic competitiveness of a region. Projects that reduce congestion may help firms produce at lower cost, or allow those firms to reach larger markets or hire more capable employees. An economy with a well-functioning transportation system can be a more attractive place for firms to do business, enhancing the economic competitiveness of the SCAG region. An additional 375,000 annual jobs will be created by the SCAG region's increased competitiveness and improved economic performance that will result from congestion reduction and improvements in regional amenities due to implementation of the 2016 RTP/SCS.

Additionally, as investments are made in an enhanced Southern California transportation system and the infrastructure system becomes increasingly completed, including its sustainable community provisions, transit, pollution reduction, amenities and operations savings such as lower health costs from improved air quality represent about 47,000 jobs per year, on average.

REFERENCES

Boarnet, Marlon G. (1997). Infrastructure Services and the Productivity of Public Capital: The Case of Streets and Highways. National Tax Journal, 50(1): 39-57.

Finney, Miles M., and Kohlhase, Janet E. (2008). The Effect of Urbanization on Labor Turnover. Journal of Regional Science, 48(2): 311-328.

Glaeser, Edward L. (2011). The Triumph of the City: How Our Greatest Invention Makes Us Richer, Smarter, Greener, Healthier, and Happier. New York, NY: Penguin Press.

Hymel, Kent. (2009). Does traffic congestion reduce employment growth? Journal of Urban Economics, 65(2): 127-135.

Jara-Diaz, Sergio R. (1986). On the Relation Between Users' Benefits and the Economic Effects of Transportation Activities. Journal of Regional Science, 26(2): 379-391.

Mohring, Herbert. (1993). Maximizing, measuring, and not double counting transportation-improvement benefits: A primer on closed- and open-economy cost-benefit analysis. Transportation Research Part B: Methodological, 27(6): 413-424.

Mohring, Herbert and Harwitz, Mitchell. (1962). Highway Benefits: An Analytical Framework. Evanston, IL: Northwestern University Press.

Puga, Diego. (2010). The Magnitude and Causes of Agglomeration Economies. Journal of Regional Science, 50(1): 203-220.

Roback, Jennifer. (1982). Wages, Rents, and the Quality of Life. Journal of Political Economy, 90(6): 1257-1278.

Rosenthal, Stuart S., and Strange, William C. (2003). Geography, Industrial Organization, and Agglomeration. Review of Economics and Statistics, 85(2): 377-393.

Storper, Michael, and Venables, Anthony J. (2004). Buzz: Face-to-Face Contact and the Urban Economy. Journal of Economic Geography, 4(4): 351-370.

ACKNOWLEDGMENTS

Regional Economic Models, Inc.

Chris Brown, Managing Economic Associate

Billy Leung, Vice President

SOUTHERN CALIFORNIA
ASSOCIATION of GOVERNMENTS

MAIN OFFICE

818 West 7th Street, 12th Floor
Los Angeles, CA 90017
(213) 236-1800

www.scag.ca.gov

REGIONAL OFFICES

Imperial County
1405 North Imperial Avenue, Suite 1
El Centro, CA 92243
Phone: (760) 353-7800
Fax: (760) 353-1877

Orange County
OCTA Building
600 South Main Street, Suite 906
Orange, CA 92868
Phone: (714) 542-3687
Fax: (714) 560-5089

Riverside County
3403 10th Street, Suite 805
Riverside, CA 92501
Phone: (951) 784-1513
Fax: (951) 784-3925

San Bernardino County
Santa Fe Depot
1170 West 3rd Street, Suite 140
San Bernardino, CA 92410
Phone: (909) 806-3556
Fax: (909) 806-3572

Ventura County
950 County Square Drive, Suite 101
Ventura, CA 93003
Phone: (805) 642-2800
Fax: (805) 642-2260

2016 2040 RTPSCS

APPENDIX

PLAN PERFORMANCE | ECONOMIC AND JOB CREATION ANALYSIS

DRAFT DECEMBER 2015

WWW.SCAGRTPSCS.NET

please recycle 2347 2015.11.24