

PLAN PERFORMANCE

# PERFORMANCE MEASURES

SOUTHERN CALIFORNIA ASSOCIATION OF GOVERNMENTS



TECHNICAL REPORT

ADOPTED ON SEPTEMBER 3, 2020

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## TECHNICAL REPORT

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# PLAN PERFORMANCE

## Performance Measures

### EXECUTIVE SUMMARY

#### OVERVIEW OF PERFORMANCE MONITORING

The setting of goals and the subsequent monitoring of performance toward achieving those goals is a critical ingredient for success in any endeavor. As the Metropolitan Planning Organization (MPO) for a six county region in Southern California with a population now exceeding 19 million inhabitants, SCAG is required to develop a Regional Transportation Plan and Sustainable Communities Strategy (RTP/SCS) every four years to set a guiding vision for what the region will look like and how it will function over the next 20-25 years. The RTP/SCS establishes regional priorities for the coordinated planning efforts and allocation of resources that will be needed to achieve that vision. These resources most notably include the financial support available to fund much needed regional transportation system improvements.

The performance monitoring of our regional transportation system investments has always been an important means for evaluating progress being made toward meeting our regional goals and the efficiency of the various projects and policies that have been implemented to help achieve them. However, with limited funding options available to support the maintenance and operation of our existing transportation infrastructure, as well as to fund the numerous other transportation related projects needed to help make our communities more sustainable and energy efficient, the role of performance monitoring in the regional planning process has become even more critical.

The objective of the Connect SoCal performance measures is to provide a quantitative mechanism to effectively link the regional goals identified in the Plan with actual performance at the implementation level. Performance monitoring is key to understanding which projects, programs, and strategies are proving successful in meeting specific regional goals and which ones may require modification or reconsideration. Ultimately, progress toward achieving SCAG's regional objectives is made through implementation of the RTP/SCS at the local level. The implementation of a carefully calibrated monitoring program, able to provide a quantitative assessment of how our programs and strategies are performing toward achievement of the regional goals identified in Connect SoCal, will serve to guide and support future regional and local planning efforts and transportation system investment options.

As our region continually evolves, so does our collective vision of what the SCAG region should look like, what its priorities should be, and what course should be set for its future. While the specific outcomes and measures may change over subsequent RTP/SCS cycles, the primary objective of the regional performance monitoring program of informing the task of defining the future of our region, will remain unchanged.

## THE CONNECT SOCIAL PERFORMANCE MEASURES TECHNICAL REPORT

The investments identified in Connect SoCal are expected to result in significant benefits to our region, not only in regard to regional mobility and accessibility improvements, but also to air quality, economic activity and job creation, community sustainability, climate amelioration and environmental justice. Once fully implemented, Connect SoCal is expected to achieve specific performance outcomes reflective of these desired benefits. These outcomes, and the associated metrics that will be used to gauge our region's progress toward achieving them, are the focus of this Technical Report.

This Technical Report will present the specific performance metrics that were used to evaluate the various planning scenarios employed in the development

of Connect SoCal. It will also introduce the set of performance measures used to assess the Connect SoCal Environmental Justice element. Finally, this report will include a third set of metrics which will be used to support the on-going regional monitoring program to evaluate implementation of Connect SoCal over time. These three sets of performance measures will be presented in tabular format, including a description of what is being measured and the sources being enlisted to provide the necessary data.

The results of the Connect SoCal performance analyses will be presented in either graphical or tabular format, depending on the nature of the variable involved. This Technical Report will also provide a summary table comparing the results of all of the Connect SoCal performance metrics for the 2045 Baseline (without implementation of the Plan), and the 2045 Plan (full implementation of the investments, plans and strategies included in Connect SoCal).

To facilitate our regional performance monitoring efforts and to maximize the inter-jurisdictional compatibility of collected performance data, SCAG encourages, but does not require, local agencies to maintain a level of consistency with the performance measures included in Connect SoCal, to such an extent as is feasible, in their sub-regional and project-level planning studies and reports.

## INTRODUCTION

### REPORT ORGANIZATION

The purpose of this Technical Report is to provide information regarding the performance assessment and monitoring processes that are integral to the success of Connect SoCal. The content of the report is organized to first present the specific measures being used by SCAG to evaluate Connect SoCal, the metrics used in support of the Environmental Justice program, and the measures to be used for on-going regional monitoring of the implementation of the Plan. Descriptions will be provided for each of the metrics and the associated outcome it is being used to assess. Finally, the results of the Connect SoCal performance evaluation will be presented. The detailed results

of the Environmental Justice performance assessment are featured in a separate Technical Report.

In addition to discussion of the results of the performance analyses conducted in support of Connect SoCal, additional state and federal performance monitoring requirements are presented in the 'Regulatory Framework' section of this report, including the federally required MAP-21 'System Performance Report'.

### CONNECT SOCIAL PERFORMANCE GOALS

The Connect SoCal performance assessment process provides an important means for determining how well the program of investments included in the Plan correspond to its overall goals and to its vision for the future of the SCAG region. As part of the development of Connect SoCal, a set of ten high level goals were adopted, as presented below in **TABLE 1**. The RTP/SCS goals are intentionally general in nature, and the Connect SoCal performance measures are not intended to specifically match them. However, they are complementary, with most of the performance measures supporting multiple goals.

### CONNECT SOCIAL OUTCOMES AND PERFORMANCE MEASURES

SCAG has been incorporating performance measurement in its RTP development since the 1998 Plan. For the 2004 RTP, SCAG developed a set of measurable goals and performance outcomes that were based upon the principle of sustainability, which is not limited only to the environment and the transportation-land use connection, but also has important implications for how the region meets its critical system preservation needs. Connect SoCal builds upon the sustainability goals established in previous RTP cycles, reflecting the ever-evolving needs and priorities of our region.

With passage of the 'Moving Ahead for Progress in the 21st Century' (MAP-21) federal transportation authorization legislation in 2012, transportation system performance monitoring became a federal mandate. This commitment to a national performance management and reporting system was further solidified with the passage of the subsequent federal transportation authorization package (the 'FAST Act') in 2015. However, SCAG has been a pioneer in the development and use of performance metrics long before MAP-21 became law,

**TABLE 1** Connect SoCal Goals

1	Encourage regional economic prosperity and global competitiveness.
2	Improve mobility, accessibility, reliability, and travel safety for people and goods.
3	Enhance the preservation, security, and resilience of the regional transportation system.
4	Increase person and goods throughput and travel choices within the transportation system.
5	Reduce greenhouse gas emissions and improve air quality.
6	Support healthy and equitable communities.
7	Adapt to a changing climate and support an integrated regional development pattern and transportation network.
8	Leverage new transportation technologies and data-driven solutions that result in more efficient travel.
9	Encourage development of diverse housing types in areas well supported by multiple transportation options.
10	Promote conservation of natural and agricultural lands and restoration of critical habitats.

**TABLE 2 Connect SoCal Performance Measures**

Outcome	Performance Measure	Description	RTP Goals*	Data Source(s)
Location Efficiency	Share of regional household growth occurring in HQTAs	Percent of the region's total household growth occurring within HQTAs	7, 9	SCAG Integrated Growth Forecast
	Share of regional employment growth occurring in HQTAs	Percent of the region's total employment growth occurring within HQTAs	1, 7	SCAG Integrated Growth Forecast
	Land consumption	Total square miles of greenfield or otherwise rural land uses converted to urban use	7, 10	Scenario Planning Model
	Vehicle Miles Traveled (VMT) per capita	Daily vehicle miles driven per person (automobiles and light trucks)	2, 5	Travel Demand Model
	Average distance traveled	Average distance (in miles) traveled for work and non-work trips	2, 5	Travel Demand Model
	Percent of trips less than 3 miles	Share of work and non-work trips which are less than 3 miles in length	2, 5	Travel Demand Model
	Work trip length distribution	Share of work trip lengths that are 10 miles or less and 25 miles or less	2, 5	Travel Demand Model
Mobility and Accessibility	Person delay per capita	Daily amount of delay experienced per capita due to traffic congestion	2, 4	Travel Demand Model
	Person hours of delay by facility type (mixed flow/ HOV/ arterials)	Excess travel time resulting from the difference between a reference speed and actual speed	2, 4	Travel Demand Model
	Truck delay by facility type (highways/arterials)	Excess heavy duty truck travel time resulting from the difference between a reference speed and actual speed	1, 4	Travel Demand Model
	Travel time distribution by mode	Travel time distribution for transit, SOV, and HOV modes	2, 8	Travel Demand Model
	Transit mode share	Percentage of total trips that use transit (work and non-work trips)	4, 7	Travel Demand Model
	Mean commute time	Average travel time to work	2, 8	Travel Demand Model

**TABLE 2 Connect SoCal Performance Measures – Continued**

Outcome	Performance Measure	Description	RTP Goals*	Data Source(s)
Safety and Public Health	Collision fatality rate	Rate of collisions involving fatalities per 100 million vehicle miles traveled	2, 6	Statewide Integrated Traffic Records System (SWITRS)
	Collision serious injury rate	Rate of collisions involving serious injuries per 100 million vehicle miles traveled	2, 6	SWITRS
	Air pollution-related health measures	Pollution-related respiratory disease incidence and cost	5, 6	Scenario Planning Model
	Physical activity-related health measures	Physical activity/weight related health issues and cost	6, 7	Scenario Planning Model
	Mode share for walking and biking	Percentage of trips using walking or biking (work and non-work trips)	6, 7	Travel Demand Model
Environmental Quality	Greenhouse gas (GHG) emissions reduction	Percent reduction in GHG emissions per capita (from 2005 levels)	5, 6	Travel Demand Model/ ARB EMFAC Model
	Criteria pollutant emissions	ROG, CO, NOx, PM10, and PM2.5 emissions (tons per day)	5, 6	Travel Demand Model/ ARB EMFAC Model
	Non-SOV mode share	Percentage of total trips using a travel mode other than driving alone	2, 4	Travel Demand Model
Economic Opportunity	New jobs supported by improved economic competitiveness	Number of new jobs added to the regional economy as a result of improved transportation conditions	1, 4	Regional Economic Model (REMI)
	New jobs supported by transportation system investments	Number of new jobs added to the regional economy as a result of transportation expenditures	1, 3	REMI
Investment Effectiveness	Transportation system investment benefit/cost ratio	Ratio of monetized user and social benefits to transportation system investment costs	1, 3	California Benefit/Cost Model

**TABLE 2 Connect SoCal Performance Measures – Continued**

Outcome	Performance Measure	Description	RTP Goals*	Data Source(s)
Transportation System Sustainability	Cost per capita to preserve the regional multimodal transportation system in current state of good repair	Annual cost per capita required to preserve the regional multimodal transportation system to current conditions	1, 3	SHOPP Plan/California Transportation Commission Needs Assessment
	State Highway System pavement condition	Share of State Highway System pavement in 'Good' or 'Poor' condition	1, 3	Caltrans Pavement Management System
	Local roadways pavement condition	Pavement Condition Index (PCI) rating for local roads	1, 3	Local Arterial Survey Database
Environmental Justice	See Table 3: Environmental Justice Performance Measures		6, 9	Various Sources

Source: SCAG

\* RTP Goals correspond to Table 1

Acronyms:

ARB: California Air Resources Board

EMFAC: Emissions Factors Model (ARB)

GHG: Greenhouse Gas

HOV: High Occupancy Vehicle

SHOPP: State Highway Operations & Protection Program (Caltrans)

SOV: Single Occupancy Vehicle

a practice that has only gained momentum over subsequent years. Starting with the 1998 Regional Transportation Plan, SCAG has been using quantitative performance measures to evaluate how well the RTP performs toward achieving the regional goals established in the Plan.

California Senate Bill 375 (SB 375), the ‘Sustainable Communities and Climate Protection Act of 2008’, provided a robust statewide plan of action for addressing the daunting challenges presented by climate change. The ambitious greenhouse gas (GHG) reduction goals and associated sustainability planning requirements introduced by SB 375 served to further fortify SCAG’s already firm commitment to the monitoring of regional performance in regard to GHG reduction and community sustainability objectives, as well as

to strengthening the coordination of transportation and land use planning throughout our region.

SCAG has focused on building upon previous successes by refining and enhancing our RTP/SCS performance measures to meet the region’s evolving policy priorities. In the summer of 2019, SCAG’s Transportation Committee reviewed the initial draft set of Connect SoCal performance measures. With the input received from the Committee, SCAG developed a final revised set of performance measures for use in evaluating the Plan.

The performance measures developed in support of Connect SoCal are focused on outcomes that will serve to strengthen the land-use transportation

connection and enhance the physical health of our region’s residents, while also attending to the reduction of GHG emissions and amelioration of the consequential effects of climate change. The set of outcomes and performance measures used to evaluate alternative scenarios for Connect SoCal are presented in **TABLE 2**. The numbers indicated in the ‘RTP Goals’ column in the table refer to the numbers associated with each of the RTP Goals as presented in **TABLE 1**.

## ENVIRONMENTAL JUSTICE

A critical element in the development of Connect SoCal is the conduct of a comprehensive Environmental Justice (EJ) analysis. EJ is a federal and state mandate designed to ensure the fair treatment and meaningful involvement of all people in the regional planning process regardless of race, color, national origin, or income. As part of the RTP/SCS development process, SCAG

incorporates a comprehensive EJ outreach program designed to maximize participation of all affected communities with respect to the development and implementation of Connect SoCal. A separate set of performance measures were developed in support of our regional EJ program and to assess the potential impacts of Connect SoCal on designated EJ communities in the SCAG region. The 18 EJ performance measures are organized into four categories with relatable questions. These questions include: 1) How will this impact quality of life; 2) how will this impact health and safety; 3) how will this impact the commute experience; and 4) how will this impact transportation costs.

While EJ comprises a significant element of the Connect SoCal performance monitoring program, its scope necessitates a separate technical report to adequately present the totality of its findings. Please see the Connect SoCal Environmental Justice Technical Report for more information regarding the SCAG EJ program, its objectives, and the results of the extensive EJ analyses conducted in support of Connect SoCal.

**TABLE 3 Environmental Justice Performance Measures**

Performance Measure	Definition	Performance Target	Data Source(s)
Jobs/housing balance	Comparison of median earnings for intra-county vs inter-county commuters for each county; analysis of relative housing affordability and jobs throughout the region	Establish existing conditions to evaluate future performance (not a Connect SoCal performance measure)	U.S. Census Public Use Microdata Sample (PUMS), LODES
Neighborhood change and displacement	Examination of historical and projected demographic and housing trends for areas surrounding rail transit stations	Establish existing conditions to evaluate future performance (not a Connect SoCal performance metric)	SCAG, U.S. Census American Community Survey (ACS), National Household Travel Survey (NHTS), California Franchise Tax Board
Accessibility to employment and services	Share of employment and shopping destinations reachable within 30 minutes by automobile or 45 minutes by transit during evening peak period	No unaddressed disproportionately high adverse effects for low income or minority communities	InfoUSA, SCAG Regional Travel Demand Model (RTDM), U.S. Census, SCAG Intergated Growth Forecast (IGF)
Accessibility to parks and educational facilities	Share of park acreage reachable within 30 minutes by automobile or 45 minutes by transit during evening peak period	No unaddressed disproportionately high adverse effects for low income or minority communities	SCAG parcel land use data, California Protected Areas Database, SCAG RTDM, SCAG IGF
Active transportation hazards	Analysis of population by demographic group for areas that experience highest rates of bicycle and pedestrian collisions	Establish existing conditions to evaluate future performance	SCAG IGF, Statewide Integrated Traffic Records System (SWITRS), Transportation Injury Management System (TIMS)

**TABLE 3 Environmental Justice Performance Measures – Continued**

Performance Measure	Definition	Performance Target	Data Source(s)
Climate vulnerability	Population analysis by demographic group for areas potentially impacted by substandard housing, sea level rise, wildfire risk, or extreme heat effects related to climate change	Establish existing conditions to evaluate future performance (not a Connect SoCal performance metric)	SCAG IGF, NOAA Coastal Services Center, California Public Utilities Commission, FEMA
Public health analysis	Summary of historical emissions and health data for areas with high concentrations of minority and low income population	Establish existing conditions to evaluate future performance (not a Connect SoCal performance metric)	ARB historical emissions data, CalEnviroScreen, SCAG IGF
Aviation noise impacts	Descriptive analysis of aviation noise in terms of trends in passenger demand and aircraft operations	Establish existing conditions to evaluate future performance	FAA, Community Noise Equivalent Level (CNEL), Caltrans Division of Aeronautics, local airports
Roadway noise impacts	Comparison of Plan and Baseline scenarios, identification of areas that are low performing due to Connect SoCal investments; breakdown of population for impacted areas by ethnicity and income	No unaddressed disproportionately high adverse effects for low income or minority communities	SCAG RTDM, SCAG IGF
Emissions impact analysis	Comparison of Plan and Baseline scenarios; identification of areas that are lower performing as a result of the Plan, including a breakdown of demographics for those areas	No unaddressed disproportionately high adverse effects for low income or minority communities	ARB EMFAC Model, SCAG IGF
Impacts along freeways and highly traveled roadways	Comparison of Plan and Baseline scenarios and demographic analysis of communities in close proximity to freeways and highly traveled corridors	No unaddressed disproportionately high adverse effects for low income or minority communities	ARB EMFAC Model, SCAG IGF, HQT A
Travel time and travel distance savings	Assessment of comparative benefits received as a result of Connect SoCal investments by demographic group in terms of travel time and travel distance savings	No unaddressed disproportionately high adverse effects for low income or minority communities	SCAG IGF, SCAG RTDM
Rail-related impacts	Breakdown of population by demographic group for areas in close proximity to rail corridors and planned grade separations	No unaddressed disproportionately high adverse effects for low income or minority communities	Rail network geodata, rail traffic data, grade separation geodata, U.S. Census, SCAG IGF
Share of transportation system usage	Comparison of transportation system usage by mode for low income and minority households relative to each group's regional population share	No unaddressed disproportionately high adverse effects for low income or minority communities	SCAG IGF, SCAG RTDM
Connect SoCal revenue sources in terms of tax burdens	Proportion of Connect SoCal revenue sources (taxable sales, income, and gasoline taxes) generated from low income and minority populations	No unaddressed disproportionately high adverse effects for low income or minority communities	U.S. Census, U.S. Bureau of Labor Statistics (BLS) Consumer Expenditure Survey, California Board of Equalization (BOE), SCAG IGF
Connect SoCal investments	Analysis of Connect SoCal investments by mode (bus, HOV lanes, commuter/high speed rail, highways/arterials, and light/heavy rail transit)	No unaddressed disproportionately high adverse effects for low income or minority communities	RTP/SCS Financial Strategy, SCAG IGF, SCAG RTDM
Geographic distribution of Connect SoCal transportation investments	Evaluation of Connect SoCal transit, roadway, and active transportation infrastructure investments in various communities throughout the region	No unaddressed disproportionately high adverse effects for low income or minority communities	Connect SoCal, U.S. Census, SCAG IGF
Mileage-Based User Fee impacts	Examination of potential impacts from implementation of a mileage-based user fee on low income households in the region	No unaddressed disproportionately high adverse effects for low income or minority communities	U.S. Census, BLS Consumer Expenditure Survey, BOE Taxable Sales, SCAG IGF

Source: SCAG

**TABLE 3** presents the Environmental Justice performance measures used to evaluate regional performance on matters of social equity and disproportionate impacts. The full results of the analyses conducted in support of the Connect SoCal EJ program are provided in extensive detail in the Environmental Justice Technical Report.

## ENVIRONMENTAL JUSTICE TOOLBOX

For Connect SoCal, SCAG has developed a toolbox of recommended practices and approaches to help assess, mitigate and avoid potential impacts of the Plan on designated EJ communities. The toolbox presents optional policy recommendations that may be effective in addressing project-specific or regional impacts on our EJ communities following a comprehensive analysis and review of those impacts and consultation with regional stakeholders. The full list of strategies included in the Environmental Justice Toolbox may be found in the Connect SoCal Environmental Justice Technical Report.

## ON-GOING PERFORMANCE MONITORING

Connect SoCal uses two types of performance measures for monitoring progress toward achieving our regional goals. One type of measure relies on readily available data that may be forecast into the future and is therefore used in the evaluation of Connect SoCal alternatives. The second type of measure provides value for on-going regional performance monitoring. These metrics are not readily forecast or modeled, and are therefore not feasible for use in the RTP/SCS scenario evaluation process. However, they are useful for monitoring how well the goals of the Plan are being achieved over time.

**TABLE 4** presents the set of performance measures that will be used for on-going monitoring of our regional transportation system. Each of these measures will be discussed in greater detail later in this Technical Report, with results presented where data is available.

## ASSOCIATED CONNECT SOCIAL RESOURCES

While this Technical Report focuses on the specific performance metrics that will be used to guide development of Connect SoCal and monitor its implementation, other regionally significant performance measures are discussed in other sections of the Plan. Chapter 5 ('Measuring Our Progress') of the main Connect SoCal document includes a concise overview of the SCAG performance monitoring program and this Technical Report should be considered supplemental to that more general discussion.

Connect SoCal includes a total of 20 Technical Reports. While each of these reports is focused on a specific topical area, many of them provide important regional performance information that may be used to supplement the information provided here. For example, infrastructure investment metrics, such as the percentage of total funding to be invested in transit and non-motorized transportation, are addressed as part of the investment allocation descriptions in the Connect SoCal Transportation Finance Technical Report. As discussed in the previous section, SCAG's Environmental Justice program, along with its associated performance measures and detailed analyses, is presented in detail in the Connect SoCal Environmental Justice Technical Report.

Because the performance metrics discussed in this report are intended to evaluate the performance of Connect SoCal over a wide range of regional planning outcomes, the scope of this Technical Report is by necessity limited to an overview of these very complex and substantive focal areas. The extensive set of technical reports that support Connect SoCal provide much more detailed information regarding several of the specific planning topics discussed in this report, including Public Health, Active Transportation, Transit, Demographics, and Transportation Conformity Analysis.

The Connect SoCal performance measures are designed to evaluate the integrated performance of the comprehensive set of regional investments included in the Plan. The specific projects associated with Connect SoCal are identified in the Project List Technical Report.

**TABLE 4 Connect SoCal Performance Measures for On-Going Monitoring**

Outcome	Performance Measure	Definition	Performance Target	Data Source(s)
Location Efficiency	Share of household growth in High Quality Transit Areas (HQTAs)	Share of total regional household growth occurring in HQTAs	Improvement (increase) over Base Year	American Community Survey (ACS), SCAG
	Share of employment growth in High Quality Transit Areas (HQTAs)	Share of total regional employment growth occurring in HQTAs	Improvement (increase) over Base Year	ACS, SCAG
	Land consumption	Number of square miles of previously agricultural or otherwise rural land changed to urban uses	Improvement (decrease) over Base Year	California Farmland Mapping & Monitoring Program
	Vehicle Miles Traveled (VMT) per capita	Average annual vehicle miles traveled per person (automobiles & light trucks)	Improvement (decrease) over Base Year	Highway Performance Monitoring System (HPMS)
	Transit mode share	Transit mode share for work and non-work trips	Improvement (increase) over Base Year	ACS, California Household Travel Survey (CHTS)
	Transit boardings per capita	Average annual number of transit boardings per person	Improvement (increase) over Base Year	National Transit Database (NTD)
	Annual household transportation cost	Annual household spending on transportation including cost of vehicle ownership, operation and maintenance, and transit	Improvement (decrease) over Base Year	ACS
	Share of annual household income spent on housing	Share of annual household income spent on housing-related expenses	Improvement (decrease) over Base Year	U.S. Bureau of Labor Statistics, ACS
Mobility and Accessibility	Highway non-recurrent delay	Delay caused by atypical traffic patterns including accidents, weather, planned lane closures, special events	Improvement (decrease) over Base Year	Caltrans Performance Measurement System (PeMS)
	Mode share for work trips	Share of work trips using various travel modes	Decrease in SOV mode share over Base Year	ACS
	Travel time to work	Average travel time to work	Improvement (decrease) over Base Year	ACS

**TABLE 4 Connect SoCal Performance Measures for On-Going Monitoring - Continued**

Outcome	Performance Measure	Definition	Performance Target	Data Source(s)
Safety and Public Health	Collision rates by severity and by mode	Serious injury and fatality rates per 100 million vehicle miles by mode (all, bicycle/pedestrian); and number of fatalities and serious injuries by mode	Improvement (decrease) over Base Year	PeMS, Traffic Accident Surveillance & Analysis System (TASAS)
	Mode share of walking and biking	Mode share of walking and biking for work and non-work trips	Improvement (increase) over Base Year	ACS, CHTS
	Daily amount of walking and biking	Percent of population having walk or bike trips by age group; and number of minutes of walking and biking for those who had walk or bike trips	Improvement (increase) over Base Year	CHTS
	Asthma incidence	Share of population in the region who were ever diagnosed with asthma	Improvement (decrease) over Base Year	California Health Interview Survey (CHIS)
	Asthma exacerbation	Share of population in the region already diagnosed with asthma who had asthma-related emergency room visits	Improvement (decrease) over Base Year	CHIS
	Percent of households living <500 feet from high volume roadways	Share of households within 500 feet of a high volume roadway, (traffic volumes of over 100,000 vehicles per day in urban areas, or 50,000 vehicles per day in rural areas)	Improvement (decrease) over Base Year	SCAG
	Premature deaths due to PM2.5	Number of premature deaths due to long-term exposure to particulate matter (estimated from monitored or modeled PM2.5 concentrations)	Improvement (decrease) over Base Year	California Air Resources Board (ARB)
	Percent of residents within 1/2 mile walk to parks and open space	Share of regional population living within walking distance to open space	Improvement (increase) over Base Year	SCAG GIS database
	Number of acres of parks for every 1,000 residents	Number of acres of parks (local, regional, and beach parks) for every 1,000 residents	Improvement (increase) over Base Year	SCAG GIS database
	Ambient air quality conditions	Existing condition of air quality in the various air basins	Improvement over Base Year	ARB

**TABLE 4 Connect SoCal Performance Measures for On-Going Monitoring - Continued**

Outcome	Performance Measure	Definition	Performance Target	Data Source(s)
Transportation System Sustainability	State Highway System pavement condition	Share of State Highway System lane miles in 'Poor' condition and in 'Good' condition	Improvement (decrease) over Base Year	Pavement Management System (Caltrans)
	Local roads pavement condition	Pavement Condition Index (PCI) for local roads	Improvement over Base Year	Local Arterial Survey Database
Resource Efficiency	Energy consumption	Energy (electricity, natural gas, vehicle fuel) consumption per capita	Improvement (decrease) over Base Year	California Energy Commission, Caltrans
	Water consumption	Urban water consumption per capita	Improvement (decrease) over Base Year	Metropolitan Water District
Reliability	Travel time reliability for automobiles	Day-to-day variation in travel times experienced by automobile travelers along a specified roadway	Improvement (decrease) over Base Year	PeMS
	Travel time reliability for trucks	Day-to-day variation in travel times experienced by trucks along a specified roadway	Improvement (decrease) over Base Year	PeMS
Productivity	Lost highway lane miles	Percent utilization of regional transportation system during peak demand conditions	Decrease in lost highway lane miles over Base Year	PeMS, NTD

Source: SCAG

## ANALYTICAL APPROACH

Comprehensive regional performance monitoring provides a critical foundation for the development and continuous refinement of SCAG’s planning priorities, helping to ensure that our region stays on track toward achieving the ambitious goals outlined in Connect SoCal. Performance monitoring provides guidance in defining the trajectory of how we aspire to grow as a region and what we need to do to get there. The monitoring process establishes clearly defined regional

goals and objectives toward attaining the future envisioned in the Plan.

Regional performance monitoring allows us to set targets and milestones so that progress may be evaluated in a timely manner. It also serves to identify emerging trends in the region that may need to be accounted for in our interim planning activities as well as to inform development of the next RTP/SCS.

In the discussion of performance measures and outcomes, three scenarios are

referenced: Base Year, Baseline, and Plan.

- 'Base Year' represents existing conditions as of 2016 – that is, the regional transportation system as it was on the ground and in service in 2016. The year 2016 was selected as the Base Year for this analysis because it is the year of the most recent available data for all of the outcome variables.
- 'Baseline' represents the future regional transportation system that will result from the continuation of current programs including projects currently under construction or undergoing right of way acquisition; those programs and projects programmed and committed to in the 2019 Federal Transportation Improvement Program (FTIP); and projects that have already received environmental clearance.
- 'Plan' represents future conditions in 2045 in which the investments and strategies detailed in Connect SoCal are fully implemented and its benefits realized.

To evaluate the performance of the Plan under various scenarios, empirical performance data is compiled for the Base Year. For Connect SoCal, the comparative Base Year is 2016. Base Year data is used as a benchmark for comparing projected performance in future years with and without implementation of Connect SoCal. Base Year data is compiled for each of the performance measures used to evaluate the Plan using various publicly available data sources as indicated in the applicable tables provided at the beginning of this Technical Report. SCAG then uses several modeling routines to generate future year projections for those same variables using varying sets of planning assumptions. For Connect SoCal, the future year projections are for the year 2045.

The first set of assumptions, or modeling scenario, assumes that the region continues along its current trajectory of development, without the intervention of the transportation system improvement investments planned in Connect SoCal. This scenario is referred to as the 'Baseline'. Comparing the Baseline results with the Base Year performance data shows how our regional transportation system will perform in 2045 relative to how it is currently functioning without the program of projects included in Connect SoCal. SCAG

then models the performance of the regional multimodal transportation system for those same performance metrics under the assumption that all of the regional programs, projects and strategies included in the Plan are fully implemented. This set of results is referred to as the 'Plan'.

Comparing the performance results of the Plan scenario with the Baseline scenario reveals the impact of the Connect SoCal investments on the performance of our regional transportation system. Since the Baseline scenario projects the continuation of existing plans and strategies into 2045, without intervention of the specific transportation system improvements and land use changes planned in Connect SoCal, the scope of the benefits provided by the Plan may be isolated and identified.

Likewise, comparison of the Base Year performance data with the Plan modeling results provides insight as to how the transportation system in the SCAG region will perform in 2045 relative to how it functions currently, assuming that the Connect SoCal program of investments and strategies is fully implemented.

## CONNECT SOCIAL PERFORMANCE MEASURES

### OUTCOME 1: LOCATION EFFICIENCY

As an outcome for evaluating Connect SoCal, 'Location Efficiency' reflects the degree to which improvements in the coordination of land use and transportation planning impacts the movement of people and goods in the SCAG region. This outcome has several associated performance measures that will be used for monitoring the degree to which the region is advancing toward our Location Efficiency goals:

- Share of Regional Household Growth in High Quality Transit Areas (HQTAs)
- Share of Regional Employment Growth in HQTAs
- Land Consumption



- Vehicle Miles Traveled (VMT) per Capita
- Average Distance Traveled for Work and Non-Work Trips
- Percent of Trips Less than Three Miles
- Work Trip Length Distribution

The seven Connect SoCal performance measures that support the Location Efficiency outcome are summarized below:

## 1. SHARE OF REGIONAL HOUSEHOLD GROWTH IN HQTAS

High Quality Transit Areas (HQTAs) are locations within one-half mile of a major transit stop or the intersection of two or more major transit routes which provide a service frequency of 15 minutes or less during peak commute periods. HQTAs also include areas located within one-half mile of a major transit corridor that provides intervals of service no longer than 15 minutes during peak commute hours. One of the goals of Connect SoCal is to focus as much new development into HQTAs as possible. By locating employment centers and households near viable transit options, it may be expected that dependency on single occupancy vehicles (SOV) will be reduced.

Between 2016 and 2045, growth in the share of new households located within HQTAs is projected to increase with implementation of Connect SoCal. Specifically, the share of household growth occurring in HQTAs increases from 45.2 percent under the Baseline to 51.2 percent under Connect SoCal.

## 2. SHARE OF REGIONAL EMPLOYMENT GROWTH IN HQTAS

Over the Connect SoCal performance period, the share of regional employment growth occurring in HQTAs is also expected to increase substantially, from 44.8 percent under the Baseline to 59.7 percent under the Plan. The map featured in **EXHIBIT 1** shows Connect SoCal 2045 HQTA locations.

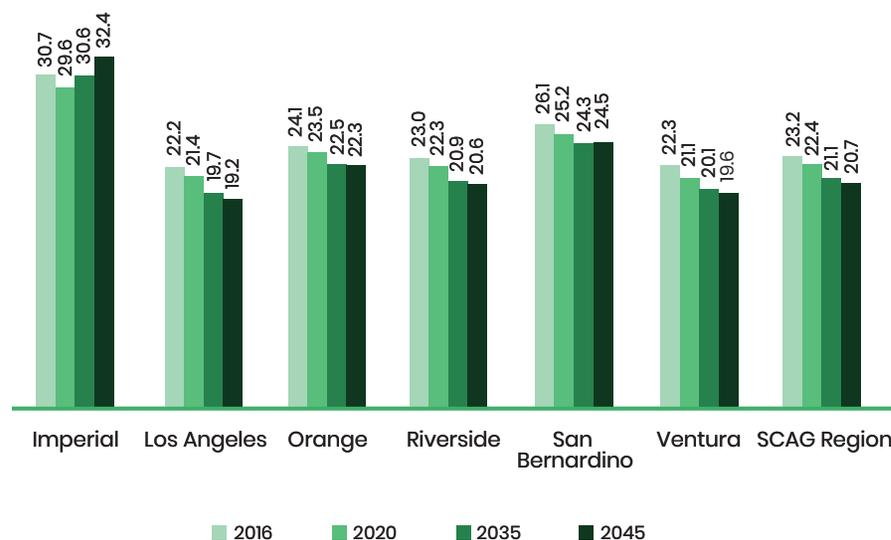
## 3. LAND CONSUMPTION

The land consumption metric tracks the amount of agricultural land that has changed from rural to more intensive urban development patterns to accommodate new growth. Greenfield land consumption refers to development that occurs on land that has not previously been developed for, or otherwise impacted by, urbanized use, including agricultural land, forests, deserts and other undeveloped sites. As discussed above, Connect SoCal directs more growth into HQTAs than does the Baseline. The vast majority of HQTAs are located within existing urbanized areas. Accordingly, the Plan consumes about 29 percent fewer square miles of greenfield land than the Baseline; 71 square miles compared to 100 square miles.

## 4. VEHICLE MILES TRAVELED (VMT) PER CAPITA

VMT for automobiles and light trucks per capita has become an increasingly significant metric since the passage of SB 375, which includes a requirement to

**FIGURE 1** Vehicle Miles Traveled (VMT) per Capita by County



Source: SCAG Regional Travel Demand Model

meet state-mandated reduction targets for regional GHG emissions. According to the U.S. Environmental Protection Agency (U.S. EPA), the transportation sector contributes approximately 29 percent of all GHG emissions nationwide, with automobiles and light duty trucks accounting for the majority (59 percent) of transportation sector emissions. By monitoring progress in reducing per capita VMT through implementation of the various transportation investments and land use strategies outlined in Connect SoCal, we will be better equipped to accurately gauge momentum toward achieving our regional GHG emissions reduction targets.

**FIGURE 1** illustrates per capita VMT projections for each of the six counties in the SCAG region for the Base Year (2016), Baseline (2045), and Connect SoCal (2045). Daily per capita VMT in the SCAG region was 23.2 miles in 2016. By 2045, per capita VMT is projected to decrease to 21.8 miles under the Baseline. However, implementation of Connect SoCal will further reduce daily per capita VMT by more than one full mile from the Baseline, to 20.7 miles.

## 5. AVERAGE DISTANCE TRAVELED

By 2045, the average commuting distance for work trips is projected to decrease slightly from 17.9 miles under the Baseline to 17.7 miles under Connect SoCal. The average distance traveled for non-work trips is also expected to decrease in 2045 from 5.8 miles under the Baseline to 5.7 miles with the Plan. Both of these 2045 scenarios represent an improvement over the 2016 Base Year figures of 18.8 miles for work trips and 6.0 percent for non-work trips.

## 6. PERCENT OF TRIPS LESS THAN THREE MILES

The majority of trips in Southern California today are made by people driving alone. However, as trip lengths become shorter, particularly to within a few miles, people are more likely to use transit, bike, walk, or choose other alternatives to driving alone. By 2045, the share of work trips that are less than three miles in length is projected to increase from 14.0 percent under the Baseline to 14.3 percent under Connect SoCal. For non-work trips, 40.5 percent would be less than three miles under the Baseline, while 41.4 percent will be

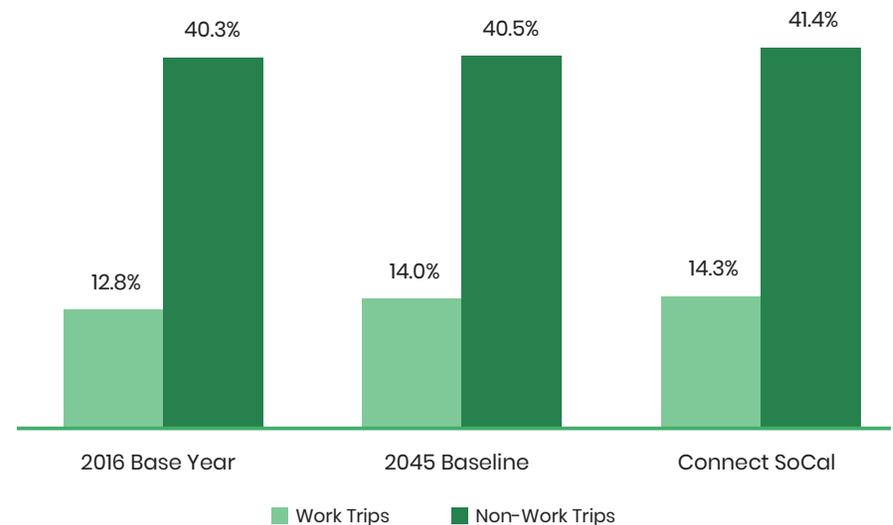
less than three miles under the Plan. Changes in land use, investments in active transportation, and improvements in the regional jobs/housing balance all contribute toward achieving these results.

**FIGURE 2** shows the percentage of trips less than three miles in length for work trips and for all trips in the SCAG region for the Base Year, Baseline, and Connect SoCal.

## 7. WORK TRIP LENGTH DISTRIBUTION

**TABLE 5** shows the distribution of work trip travel distances in accordance with Connect SoCal 2045 projections. As indicated in the table, 42.4 percent of total work trips are projected to be less than ten miles in length by 2045 under Connect SoCal, with 76.6 percent of work trips less than 25 miles. By comparison, in 2016, 39.3 percent of work trips were less than ten miles in length, and 73.8 percent of trips were less than 25 miles.

**FIGURE 2** Percentage of Trips Less than 3 Miles



Source: SCAG Regional Travel Demand Model

**TABLE 5 Work Trip Length Distribution: 2045 (Connect SoCal)**

Distance (miles)	Number of Trips	Share of Total
0 to <5	2,997,023	20.2%
5 to <10	3,307,154	22.3%
10 to <15	2,358,925	15.9%
15 to <20	1,593,484	10.7%
20 to <25	1,133,070	7.6%
25 to <30	824,428	5.5%
30 to <35	622,687	4.2%
35 to <40	489,815	3.3%
40 to <45	399,557	2.7%
45 to <50	321,247	2.2%
50 to <55	238,668	1.6%
55 to <60	168,277	1.1%
60 to <65	113,484	0.8%
65 to <70	76,897	0.5%
70 to <75	51,675	0.3%
75 to <80	34,731	0.2%
80 to <85	24,496	0.2%
85 to <90	18,167	0.1%
90 to <95	13,759	0.1%
95 to <100	10,774	0.1%
100+	62,604	0.4%
<b>Total Trips</b>	<b>14,860,922</b>	<b>100.0%</b>

Source: SCAG Regional Travel Demand Model

## OUTCOME 2: MOBILITY AND ACCESSIBILITY

The ‘Mobility and Accessibility’ outcome is defined as the ability to reach desired destinations with relative ease within a reasonable amount of time, using reasonably available transportation choices. In previous RTPs, mobility and accessibility were featured as separate outcomes. However, beginning with the 2012 RTP/SCS, these were combined into a single outcome category with multiple performance measures. This section discusses the mobility and accessibility performance measures used for Connect SoCal and provides results based on outputs from the SCAG Regional Travel Demand Model (RTDM).

While the term ‘mobility’ refers generally to the ability to move freely from place to place, ‘accessibility’ refers more specifically to the ability to reach particular destinations with minimal obstacles or barriers. Combined as a single outcome to evaluate performance of Connect SoCal, these two elements provide a comprehensive assessment of how our regional transportation investments are serving to improve movement of people and goods throughout the region.

Mobility is typically assessed through the concept of ‘delay’. Delay is defined as the difference between the actual amount of time it takes to travel between a specified origin and destination, and the expected travel time it would take at a reference speed. Delay is measured in vehicle-hours of delay, which is then used to derive person-hours of delay. The Connect SoCal performance measures used to evaluate delay include:

- Person Delay per Capita
- Person Hours of Delay by Facility Type (Mixed Flow, HOV, Arterial)
- Heavy-Duty Truck Delay by Facility Type (Highway, Arterial)

One additional measure for delay that is readily available for on-going monitoring, but which cannot be readily forecasted, is non-recurrent delay. Non-recurrent delay, and its impact on total congestion in the SCAG region, is discussed in greater detail in the ‘Performance Measures for On-going Regional Monitoring’ section of this Technical Report.

## 1. PERSON DELAY PER CAPITA

Normalizing total delay by the number of people living in an area provides insight as to how well the region is mitigating traffic congestion with increasing population growth. Under Baseline conditions, person delay per capita would be expected to increase significantly by 2045, especially in the Inland Empire counties of Riverside and San Bernardino. However, implementation of Connect SoCal would reduce per capita delay in the SCAG region substantially, to below 2016 levels. Average travel time delay per capita in the region is expected to improve significantly, from 11.3 minutes under the Baseline to 8.4 minutes with Connect SoCal. Not only does this represent a 25.7 percent improvement over the 2045 Baseline, but also a 20 percent improvement over the 2016 Base Year.

**FIGURE 3** depicts daily per capita person delay experienced by county for the Base Year, Baseline, and for Connect SoCal. For each of the six counties in the SCAG region, per capita delay increases from the 2016 Base Year to 2045 Baseline; with Riverside, San Bernardino and Imperial counties each showing increases exceeding 50 percent. For the SCAG region, per capita delay increases from 10.5 minutes in 2016 to 11.3 minutes in 2045 under the Baseline projection, an increase of about eight percent.

Conversely, comparing Base Year performance with projections for 2045 under Connect SoCal, time spent in traffic is significantly reduced in the region, with Los Angeles, Orange, and Ventura counties each showing decreases in delay exceeding 20 percent. For the SCAG region, Connect SoCal will serve to reduce per capita delay from 10.5 minutes in 2016 to 8.4 minutes by 2045, a reduction of 20 percent.

## 2. PERSON HOURS OF DELAY BY FACILITY TYPE

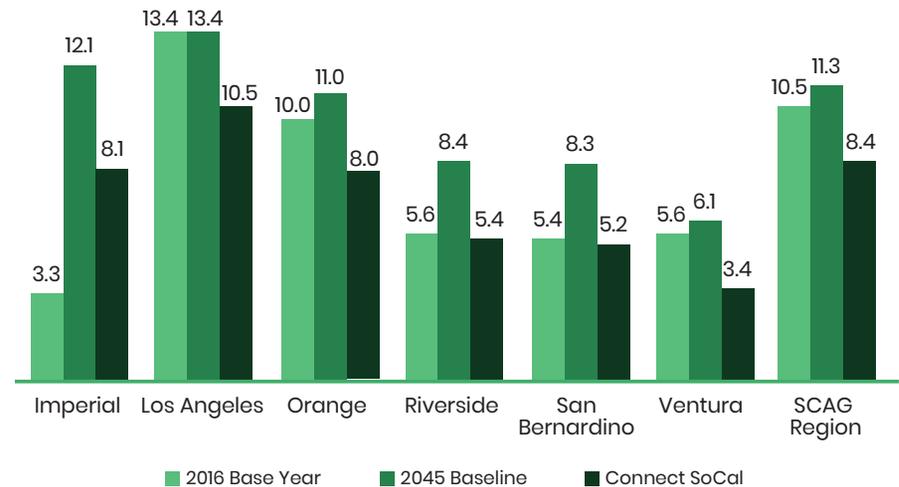
This performance measure differentiates levels of delay experienced by commuters on various roadway facility types: Highway mixed use lanes, high-occupancy vehicle (HOV) lanes, and major arterial roadways. As illustrated in **FIGURE 4**, total person-hours of delay would be expected to increase from the Base Year to the Baseline on our highway mixed flow lanes and on our arterial roadways, including an increase of over 27 percent in overall regional person-

hours of delay. However, implementation of Connect SoCal would provide significant reduction (26 percent) in total person hours of delay experienced in the SCAG region compared to the Baseline.

## 3. TRUCK DELAY BY FACILITY TYPE

This measure estimates the average daily amount of delay encountered by heavy duty trucks on freeways and on arterials. Connect SoCal includes significant investments (\$67.4 billion) in regional freight corridors and other improvements to facilitate goods movement. As illustrated in **FIGURE 5**, the Plan is estimated to reduce heavy-duty truck delay by 22.3 percent over the Baseline on the regional freeway system and by about 27 percent on our arterial roadways. However, truck delay under Connect SoCal is still expected to be above Base Year (2016) levels due to projected increases in demand for freight movement in the SCAG region.

**FIGURE 3 Daily Per Capita Person Delay by County (Minutes)**



Source: SCAG Regional Travel Demand Model

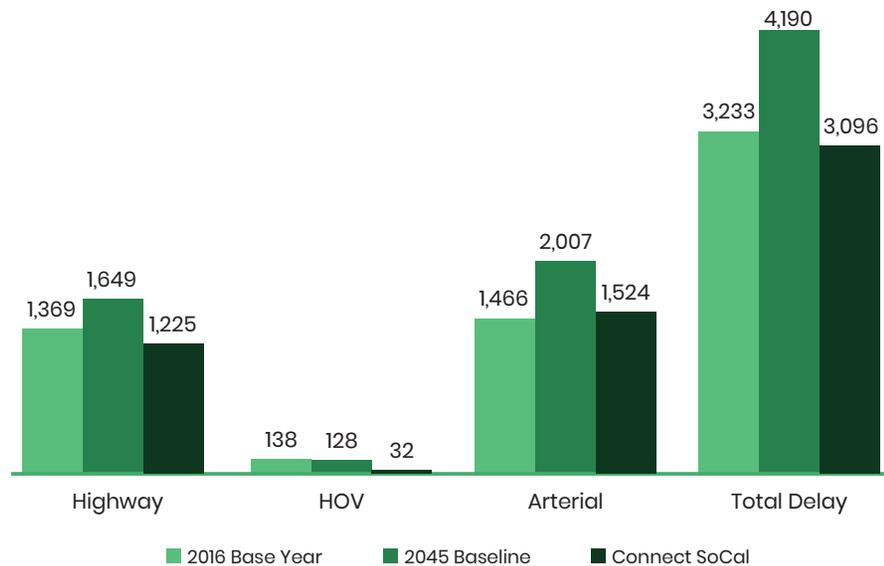
Other metrics used in the assessment of the Connect SoCal 'Mobility and Accessibility' outcome include:

- Travel Time Distribution by Mode
- Transit Mode Share
- Mean Commute Time

#### 4. TRAVEL TIME DISTRIBUTION BY MODE

A useful metric used for assessing regional accessibility improvements provided through Connect SoCal is the statistical distribution of travel times by various travel modes including transit, High Occupancy Vehicle (HOV), and Single Occupancy Vehicle (SOV), for both work and non-work trips. As non-SOV travel mode options are enhanced through targeted investments in the Plan, it may be expected that travel times for those modes will decrease relative to that for SOV, thereby improving accessibility.

**FIGURE 4 Daily Person-Hours of Delay by Facility Type (Thousands)**



Source: SCAG Regional Travel Demand Model

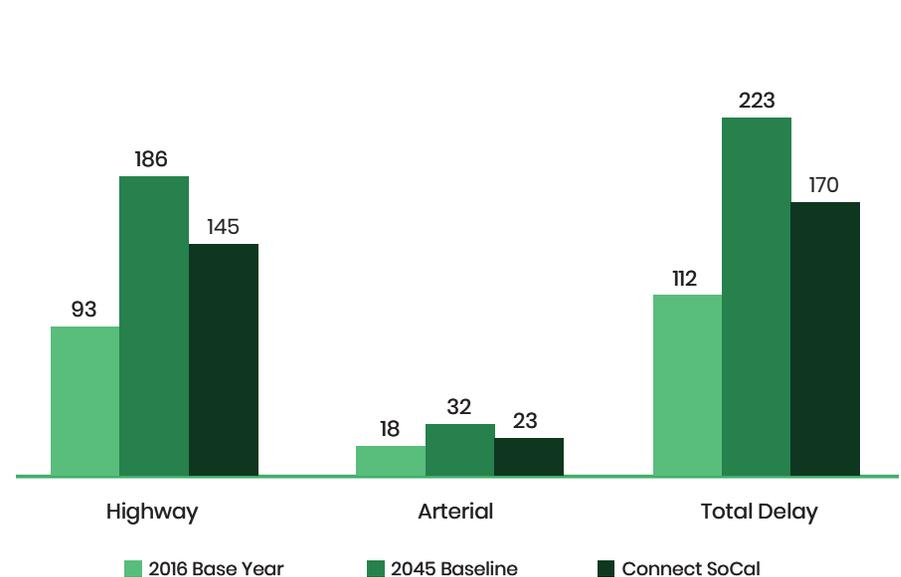
Travel time analyses by trip type are provided in **TABLE 6** (SOV), **TABLE 7** (HOV), and **TABLE 8** (Transit).

#### 5. TRANSIT MODE SHARE

Transit mode share measures the percentage of trips made throughout the region for work and non-work purposes that make use of transit. This metric helps us identify how well the transit system strategies and improvements proposed in Connect SoCal work toward providing better and more diverse commuting options for the traveling public. Ideally, with the provision of better and more efficient transit service, more commuters will choose that option over driving alone in their automobiles, further reducing VMT and regional GHG emissions.

The transit mode share for all trips is projected to increase in 2045 from 3.6 percent under the Baseline to 4.9 percent with Connect SoCal. However, for

**FIGURE 5 Daily Heavy-Duty Truck Hours of Delay (Thousands)**



Source: SCAG Regional Travel Demand Model

work trips, the transit mode share projects to 4.0 percent under the Baseline and 6.1 percent with the Plan. **TABLE 9** shows transit mode shares by county for work trips and for all trips.

## 6. MEAN COMMUTE TIME

The Connect SoCal transportation system investments are coordinated to improve the overall travel experience in the SCAG region. A primary determinant of success of our regional transportation system investments is

how much time the average commuter spends traveling to work. While SCAG has no influence over the high rates of population growth that have challenged the Southern California region for decades and continues to this day, our efforts to coordinate regional land use and transportation planning through Connect SoCal will serve to orient our still growing region toward a more sustainable and efficient urban form. While average commute times should not be expected to significantly decrease over time, they may be reduced relative to regional population growth.

**TABLE 6 Travel Time Distribution: SOV Trips**

Trip Type	Time Period	Scenario	<=5 min	<=10 min	<=15 min	<=30 min	<=45 min	<=60 min	<=90 min	>90 min
Work	AM Peak	2016 Base Year	4.4%	16.1%	29.0%	59.8%	77.5%	88.7%	97.9%	100.0%
		2045 Baseline	4.6%	17.3%	31.4%	63.6%	80.2%	89.8%	97.9%	100.0%
		Connect SoCal	4.8%	18.3%	33.4%	67.2%	84.5%	93.5%	99.0%	100.0%
	Mid-Day	2016 Base Year	2.9%	11.7%	22.6%	51.5%	71.8%	84.6%	96.3%	100.0%
		2045 Baseline	3.0%	12.3%	23.9%	53.9%	73.5%	85.3%	96.1%	100.0%
		Connect SoCal	3.1%	13.0%	25.2%	56.8%	77.3%	89.2%	98.2%	100.0%
	PM Peak	2016 Base Year	5.5%	19.5%	33.8%	63.2%	77.7%	86.8%	96.7%	100.0%
		2045 Baseline	5.6%	20.5%	35.7%	66.4%	80.1%	87.8%	96.4%	100.0%
		Connect SoCal	5.9%	22.0%	38.6%	71.0%	85.4%	93.6%	98.8%	100.0%
	Evening	2016 Base Year	7.2%	28.1%	49.1%	82.8%	94.3%	98.3%	99.5%	100.0%
		2045 Baseline	7.7%	29.7%	51.4%	84.1%	94.6%	98.3%	99.6%	100.0%
		Connect SoCal	7.6%	29.7%	51.7%	84.4%	95.0%	98.6%	99.7%	100.0%
	Night	2016 Base Year	4.0%	16.0%	29.6%	56.8%	75.4%	88.3%	96.6%	100.0%
		2045 Baseline	4.4%	17.6%	32.1%	59.1%	76.0%	87.9%	96.5%	100.0%
		Connect SoCal	4.3%	17.7%	32.6%	60.1%	77.5%	89.4%	97.2%	100.0%

**TABLE 6 Travel Time Distribution: SOV Trips Continued**

Trip Type	Time Period	Scenario	<=5 min	<=10 min	<=15 min	<=30 min	<=45 min	<=60 min	<=90 min	>90 min
Non-Work	AM Peak	2016 Base Year	25.7%	57.5%	76.8%	95.7%	98.8%	99.6%	100.0%	100.0%
		2045 Baseline	25.6%	58.1%	77.6%	96.4%	99.1%	99.7%	100.0%	100.0%
		Connect SoCal	26.7%	60.4%	80.2%	97.5%	99.5%	99.9%	100.0%	100.0%
	Mid-Day	2016 Base Year	19.3%	49.4%	71.7%	96.3%	99.5%	99.9%	100.0%	100.0%
		2045 Baseline	18.9%	49.0%	71.3%	96.3%	99.6%	99.9%	100.0%	100.0%
		Connect SoCal	19.9%	51.3%	74.0%	97.4%	99.8%	100.0%	100.0%	100.0%
	PM Peak	2016 Base Year	17.0%	45.4%	66.1%	92.0%	97.8%	99.3%	99.9%	100.0%
		2045 Baseline	17.1%	45.5%	66.4%	92.5%	98.2%	99.5%	100.0%	100.0%
		Connect SoCal	18.2%	48.7%	70.4%	95.2%	99.3%	99.8%	100.0%	100.0%
	Evening	2016 Base Year	18.9%	55.9%	79.9%	97.9%	99.6%	99.9%	100.0%	100.0%
		2045 Baseline	19.9%	58.2%	82.0%	98.5%	99.8%	100.0%	100.0%	100.0%
		Connect SoCal	20.1%	58.8%	82.5%	98.6%	99.8%	100.0%	100.0%	100.0%
	Night	2016 Base Year	18.2%	57.1%	81.9%	98.4%	99.6%	99.9%	100.0%	100.0%
		2045 Baseline	19.3%	59.8%	84.1%	98.8%	99.8%	100.0%	100.0%	100.0%
		Connect SoCal	19.2%	60.0%	84.3%	98.8%	99.8%	100.0%	100.0%	100.0%

Source: SCAG Regional Travel Demand Model

**TABLE 7 Travel Time Distribution: HOV Trips**

Trip Type	Time Period	Scenario	<=5 min	<=10 min	<=15 min	<=30 min	<=45 min	<=60 min	<=90 min	>90 min
Work	AM Peak	2016 Base Year	3.6%	13.9%	26.8%	61.0%	80.2%	91.2%	98.5%	100.0%
		2045 Baseline	3.7%	14.5%	28.3%	63.8%	81.6%	91.1%	98.1%	100.0%
		Connect SoCal	3.9%	15.6%	30.5%	66.9%	84.7%	93.3%	98.7%	100.0%
	Mid-Day	2016 Base Year	3.1%	11.9%	23.0%	53.5%	73.8%	86.0%	96.7%	100.0%
		2045 Baseline	3.2%	12.2%	23.8%	55.1%	74.8%	86.2%	96.2%	100.0%
		Connect SoCal	3.4%	13.0%	25.3%	57.8%	77.7%	88.8%	97.4%	100.0%
	PM Peak	2016 Base Year	6.9%	21.4%	35.4%	63.7%	77.5%	87.0%	96.7%	100.0%
		2045 Baseline	7.3%	22.4%	37.2%	66.1%	78.6%	86.3%	95.3%	100.0%
		Connect SoCal	7.9%	24.6%	41.0%	71.4%	84.1%	91.5%	97.6%	100.0%
	Evening	2016 Base Year	7.2%	25.2%	43.7%	78.9%	91.8%	96.8%	98.9%	100.0%
		2045 Baseline	7.5%	25.9%	45.0%	79.0%	91.2%	96.2%	98.7%	100.0%
		Connect SoCal	7.3%	26.3%	45.6%	80.0%	92.1%	96.8%	99.0%	100.0%
	Night	2016 Base Year	5.0%	16.9%	29.2%	55.1%	72.1%	85.0%	94.5%	100.0%
		2045 Baseline	5.3%	17.5%	30.1%	54.6%	70.0%	82.1%	93.1%	100.0%
		Connect SoCal	5.5%	18.5%	32.0%	57.9%	73.3%	84.8%	94.6%	100.0%

**TABLE 7 Travel Time Distribution: HOV Trips – Continued**

Trip Type	Time Period	Scenario	<=5 min	<=10 min	<=15 min	<=30 min	<=45 min	<=60 min	<=90 min	>90 min
Non-Work	AM Peak	2016 Base Year	39.9%	69.9%	84.3%	97.3%	99.4%	99.9%	100.0%	100.0%
		2045 Baseline	39.5%	70.0%	84.4%	97.4%	99.4%	99.8%	100.0%	100.0%
		Connect So Cal	40.7%	71.7%	86.2%	98.0%	99.6%	99.9%	100.0%	100.0%
	Mid-Day	2016 Base Year	26.8%	57.7%	76.2%	96.5%	99.6%	99.9%	100.0%	100.0%
		2045 Baseline	26.2%	57.2%	75.9%	96.3%	99.6%	99.9%	100.0%	100.0%
		Connect So Cal	27.4%	59.1%	77.9%	97.1%	99.7%	100.0%	100.0%	100.0%
	PM Peak	2016 Base Year	25.0%	53.9%	71.0%	92.1%	97.8%	99.5%	100.0%	100.0%
		2045 Baseline	24.5%	53.6%	71.0%	92.2%	97.8%	99.4%	100.0%	100.0%
		Connect So Cal	25.8%	56.3%	74.1%	94.5%	98.9%	99.8%	100.0%	100.0%
	Evening	2016 Base Year	18.6%	49.2%	69.8%	95.4%	99.3%	99.9%	100.0%	100.0%
		2045 Baseline	19.5%	51.1%	71.5%	95.6%	99.3%	99.9%	100.0%	100.0%
		Connect So Cal	19.8%	51.9%	72.4%	95.8%	99.3%	99.9%	100.0%	100.0%
	Night	2016 Base Year	16.8%	45.2%	65.5%	93.4%	98.7%	99.8%	100.0%	100.0%
		2045 Baseline	17.5%	46.7%	66.9%	93.4%	98.6%	99.7%	100.0%	100.0%
		Connect So Cal	17.7%	47.5%	67.7%	93.6%	98.6%	99.7%	100.0%	100.0%

Source: SCAG Regional Travel Demand Model

**TABLE 8 Travel Time Distribution: Transit Trips**

Trip Type	Time Period	Scenario	<=5 min	<=10 min	<=15 min	<=30 min	<=45 min	<=60 min	<=90 min	>90 min
Work	AM Peak	2016 Base Year	0.1%	0.5%	1.9%	13.0%	29.3%	46.1%	73.7%	100.0%
		2045 Baseline	0.1%	0.4%	1.8%	12.0%	28.2%	45.6%	73.5%	100.0%
		Connect SoCal	0.1%	0.5%	1.9%	12.4%	29.5%	48.1%	75.7%	100.0%
	Mid-Day	2016 Base Year	2.1%	2.6%	3.8%	11.7%	24.1%	37.5%	62.7%	100.0%
		2045 Baseline	2.1%	2.5%	3.6%	10.6%	21.7%	34.9%	60.2%	100.0%
		Connect SoCal	2.1%	2.4%	3.5%	10.7%	22.3%	35.7%	61.0%	100.0%
	PM Peak	2016 Base Year	17.1%	17.7%	19.2%	30.9%	47.9%	63.7%	86.4%	100.0%
		2045 Baseline	16.9%	17.4%	18.8%	29.3%	46.7%	63.3%	85.9%	100.0%
		Connect SoCal	14.8%	15.3%	16.8%	28.2%	47.0%	65.5%	87.5%	100.0%
	Evening	2016 Base Year	5.7%	6.1%	7.7%	19.9%	38.3%	55.8%	80.6%	100.0%
		2045 Baseline	5.7%	6.2%	7.5%	18.1%	35.7%	53.1%	78.7%	100.0%
		Connect SoCal	5.7%	6.1%	7.4%	18.2%	36.2%	54.7%	80.0%	100.0%
	Night	2016 Base Year	4.3%	4.5%	5.4%	14.8%	30.1%	45.8%	72.5%	100.0%
		2045 Baseline	4.0%	4.3%	5.1%	12.8%	26.5%	41.9%	68.4%	100.0%
		Connect SoCal	4.0%	4.2%	5.0%	12.8%	26.7%	42.8%	70.0%	100.0%

**TABLE 8 Travel Time Distribution: Transit Trips – Continued**

Trip Type	Time Period	Scenario	<=5 min	<=10 min	<=15 min	<=30 min	<=45 min	<=60 min	<=90 min	>90 min
Non-Work	AM Peak	2016 Base Year	25.5%	51.6%	60.4%	69.9%	79.6%	87.4%	96.1%	100.0%
		2045 Baseline	21.7%	46.0%	54.6%	65.4%	76.9%	86.4%	96.2%	100.0%
		Connect SoCal	17.8%	38.2%	45.8%	58.3%	73.8%	85.7%	96.5%	100.0%
	Mid-Day	2016 Base Year	22.2%	42.7%	48.9%	58.4%	71.3%	82.0%	93.8%	100.0%
		2045 Baseline	16.6%	32.7%	38.2%	48.6%	64.1%	77.8%	93.1%	100.0%
		Connect SoCal	12.6%	25.2%	29.9%	42.3%	61.2%	77.3%	94.1%	100.0%
	PM Peak	2016 Base Year	16.7%	36.6%	44.2%	54.3%	66.7%	77.5%	91.3%	100.0%
		2045 Baseline	13.7%	31.0%	38.0%	49.2%	64.1%	77.1%	92.2%	100.0%
		Connect SoCal	10.8%	24.3%	30.0%	43.2%	62.0%	77.4%	93.6%	100.0%
	Evening	2016 Base Year	7.7%	16.3%	20.0%	27.1%	41.1%	56.4%	80.7%	100.0%
		2045 Baseline	7.2%	14.8%	18.4%	26.5%	42.7%	59.5%	83.4%	100.0%
		Connect SoCal	5.4%	10.7%	13.2%	23.1%	42.1%	61.3%	86.5%	100.0%
	Night	2016 Base Year	12.5%	19.7%	22.0%	31.1%	46.9%	62.0%	84.0%	100.0%
		2045 Baseline	11.2%	17.4%	19.6%	28.9%	47.0%	64.8%	87.5%	100.0%
		Connect SoCal	8.0%	11.8%	13.5%	24.0%	44.7%	64.9%	88.9%	100.0%

Source: SCAG Regional Travel Demand Model

**FIGURE 6** shows mean commute times in the region by mode for the Base Year, Baseline, and Plan (Connect SoCal) scenarios. As illustrated in the figure, by 2045 Connect SoCal would reduce the average commute time for all modes in the SCAG region by about six percent in comparison to the Baseline, including reductions of more than nine percent for automobile travel and about two percent for transit.

Supplemental to the mean commute time data, **FIGURE 7** shows the percentage of PM peak period commute times by mode in the SCAG region that are completed within 45 minutes under the three modeling scenarios. As illustrated in the graph, the Connect SoCal scenario increases the share of trips completed within 45 minutes relative to the Baseline for each of the three assessed modes (transit, HOV, and SOV).

**TABLE 9 Transit Mode Share by County: 2045 (Connect SoCal)**

County	Work Trips	All Trips
Imperial County	0.7%	1.4%
Los Angeles County	9.8%	7.0%
Orange County	2.2%	2.6%
Riverside County	1.2%	2.1%
San Bernardino County	1.7%	2.4%
Ventura County	2.0%	2.1%
<b>SCAG Region</b>	<b>6.1%</b>	<b>4.9%</b>

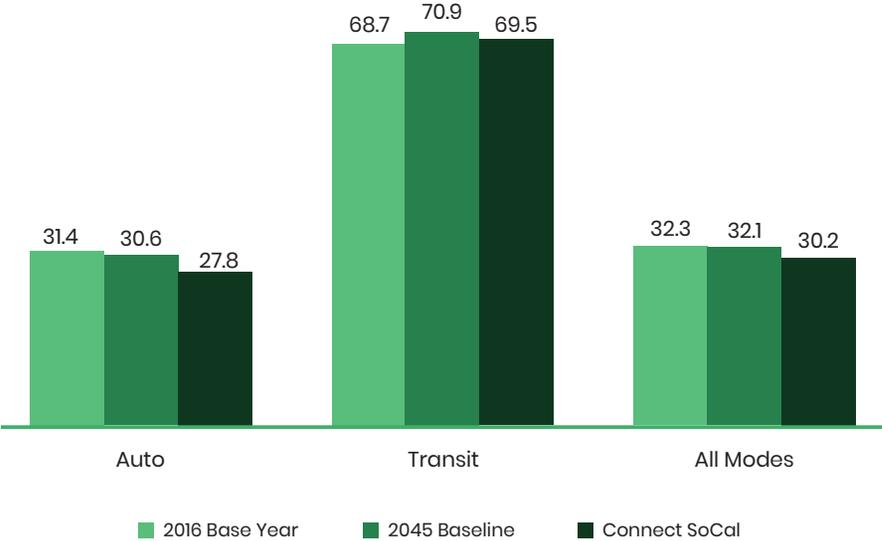
Source: SCAG Regional Travel Demand Model

### OUTCOME 3: SAFETY AND PUBLIC HEALTH

Designated in previous RTP/SCS cycles as separate outcome groups, 'Safety' and 'Public Health' have been combined in Connect SoCal into a single, comprehensive outcome. While the two performance categories include specific component assessment metrics, both focus on the physical well-being of residents in the SCAG region and thereby serve complementary, mutually reinforcing purposes.

The safety impacts of regional transportation system improvements are not readily forecast or modeled, but are critical components of our regional performance monitoring program. Improving highway safety is a high planning priority at the national, statewide, and regional levels. Highway safety monitoring seeks to assess how well the transportation system performs over time in minimizing serious incidents and is typically measured by the rate of collisions involving fatalities or serious injuries per million vehicle miles traveled. It is not feasible to accurately project future highway incidents due to

**FIGURE 6 Mean Commute Time by Travel Mode (Minutes)**



Source: SCAG Regional Travel Demand Model

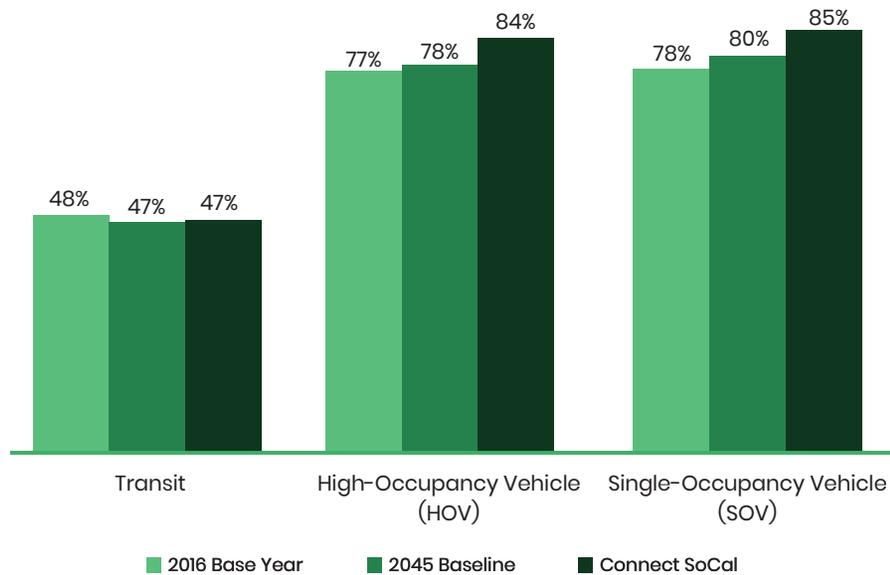
the multitude of factors that contribute to such events. However, a shift to safer travel modes may reduce the total number of collisions that result in fatalities or serious injuries.

The total number of collisions may be partially projected by using mode and facility specific collision rates (highways, arterials, and transit). This approach was used for Connect SoCal, but it is important to note that this methodology does not take into account safety improvements specific to individual travel modes. Highway safety performance estimates using this approach are based only on modal or facility shifts. For on-going monitoring, this measure may be reported historically over time and by travel mode (including for active transportation).

## COLLISION FATALITY RATE

For the 2016 Base Year, the SCAG region recorded approximately one fatal

**FIGURE 7 Work Trips Completed within 45 Minutes (PM Peak Period)**



Source: SCAG Regional Travel Demand Model

collision per 100 million vehicle miles traveled. However, with implementation of the program of transportation system improvements included in Connect SoCal, the regional collision fatality rate is expected to decrease.

## COLLISION SERIOUS INJURY RATE

In 2016, the rate of collisions resulting in serious injury in the SCAG region was 3.5 per 100 million VMT. The safety of our regional transportation system is a priority for Connect SoCal, and full implementation of the Plan is expected to decrease the rate of incidents resulting in serious injuries occurring on our regional multimodal transportation system.

Connect SoCal seeks to further integrate the transportation and land use planning processes and these coordinated planning areas feature impacts and benefits that extend beyond the realm of highway safety. To account for some of these, Connect SoCal includes three additional public health-related measures: incidence of pollution-related respiratory disease, rates of physical activity and weight-related disease, and active transportation mode share (walking and biking).

The health benefits of an active lifestyle have become increasingly recognized in recent years, and there is growing support for improving the walkability and bikeability of the communities where we live and work. The linkage between obesity and chronic disease has been well documented, and providing the appropriate community design and infrastructure to support a more active lifestyle may be an important first step toward promoting healthy communities.

## AIR POLLUTION-RELATED HEALTH IMPACTS

The impact of regional air quality on the quality of life in Southern California is multi-faceted. Air pollution affects our health, our climate, and even our regional economy. For these reasons, air pollution-related health outcomes are included as performance measures for Connect SoCal. Specifically assessed under this outcome is the incidence of respiratory-related health events triggered by poor air quality, including asthma, and the total costs associated with air pollution-related respiratory pathology in the SCAG region. As indicated

in **TABLE 20** (at the end of this report), Connect SoCal is expected to improve outcomes by over five percent for both the number of incidences and health costs associated with air pollution-related pathologies.

## 4. PHYSICAL ACTIVITY-RELATED HEALTH IMPACTS

Connect SoCal will improve physical activity outcomes through its focus on improved location efficiency, which increases the share of short trips; and through the provision of additional investments in our regional active transportation networks, including first-last mile improvements, Safe Routes to School projects and regional bikeway infrastructure. Connect SoCal will also improve access to natural lands and parks, further enhancing opportunities for physical activity.

Connect SoCal includes modeling data obtained from the Public Health module of the SCAG Scenario Planning Model (SPM) to assess the Plan's impact on opportunities for daily physical activity. Implementation of Connect SoCal is expected to result in an increase of nearly 17 percent in daily minutes of walking per person, and a 32 percent increase in daily minutes of bicycling per capita. The enhanced opportunities for daily physical activity promoted through Connect SoCal will serve to modestly reduce obesity, high blood pressure, and type 2 diabetes rates in the SCAG region, as shown in Table 20 of this report. For a more detailed discussion of the SPM, please see the Connect SoCal SCS Background Documentation Technical Report.

For more detailed information on the connection between physical activity and public health outcomes please see the Connect SoCal Public Health Technical Report.

### ACTIVE TRANSPORTATION MODE SHARE

The mode share for active transportation (walking and biking) provides a useful metric for evaluating the efficiency of locally and regionally implemented plans, projects, and strategies designed to improve the pedestrian and bicycling experience. By making the experience of biking and walking more convenient,

safe, and viable, it may be expected that more people will choose to make use of these sustainable transportation options as part of their daily activities, including the commute to work. A robust regional active transportation network will serve not only to improve regional air quality and traffic congestion by reducing the share of single occupancy vehicles on our roadways, it will also contribute meaningfully to our regional public health goals by providing more and better opportunities for the people of Southern California to engage in daily physical exercise.

Under Connect SoCal, the combined bicycle and pedestrian mode share for non-work trips is projected to increase by 2045 from 10.9 percent under the Baseline to 12.4 percent under the Plan. The active transportation mode share for work trips is typically lower than for non-work trips, with the Baseline combined active transportation share of 3.7 percent increasing to 4.2 percent with Connect SoCal. For all trips, the active transportation mode share increases from 9.5 percent to 10.8 percent.

The active transportation mode share performance measures make use of results provided by the SCAG Regional Travel Demand Model (RTDM) to estimate the share of trips made by walking or bicycling. To supplement RTDM bicycle and pedestrian mode share projections, SCAG also conducted an "off-model" analysis to account for additional variables that impact active transportation, including Safe Routes to School safety enhancements, first/last mile improvements, pedestrian infrastructure, bike share, and other micro-mobility investments and strategies. More detailed discussion of the active transportation off-model analysis may be found in the Connect SoCal Active Transportation Technical Report.

## OUTCOME 4: ENVIRONMENTAL QUALITY

The 'Environmental Quality' outcome is measured in terms of criteria air pollutant and GHG emissions. As it is closely correlated with GHG emissions, non-single occupancy vehicle (non-SOV) mode share is also included in the Environmental Quality outcome category. Emissions are estimated using results of the SCAG RTDM, which are then input to the California Air Resources Board (ARB) Emission Factors (EMFAC) model. Criteria air pollutant emissions are

reported in detail in the Connect SoCal Transportation Conformity Analysis Technical Report. The impact of air quality on public health is further discussed in the ‘Safety and Public Health’ outcome section of this Technical Report.

## CRITERIA AIR POLLUTANT EMISSIONS

There are four common transportation-related air pollutants that are monitored in the SCAG region in accordance with federal air quality regulations. These ‘criteria’ air pollutants include ground level ozone, particulate matter (PM<sub>10</sub> and PM<sub>2.5</sub>), carbon monoxide (CO), and nitrogen dioxide (NO<sub>2</sub>). These pollutants require careful monitoring because of their known adverse effects on human health.

Ground level ozone is formed by the reaction between reactive organic gases (ROG) and oxides of nitrogen (NO<sub>x</sub>) in the presence of sunlight. While children, older citizens, and persons with existing respiratory illnesses are most vulnerable to the effects of ozone pollution, the health effects of long term ozone exposure are a concern for everyone in the region. Some of the major health concerns of exposure to high levels of ozone include respiratory irritation, reduced lung capacity, chest pain, and aggravation of asthma and other respiratory illnesses.

Particulate matter (PM) consists of extremely small airborne particles and liquid droplets associated with dust, soot and combustion byproducts. Particulate pollution, especially from fine particulate matter (PM<sub>2.5</sub>), has been linked to significant human health impacts, including aggravated asthma, increases in respiratory diseases, chronic bronchitis, decreased lung function and even premature death.

A byproduct of automobile exhaust, elevated levels of carbon monoxide (CO) is also considered a significant health hazard, especially for people with compromised respiratory or coronary function, as CO is known to reduce the flow of oxygen through the body. The Centers for Disease Control and Prevention estimates that 20,000 Americans visit the emergency room each year due to carbon monoxide poisoning. Since CO is an odorless gas, many new homes are now being equipped with CO detectors.

Nitrogen dioxide (NO<sub>2</sub>) is created under the conditions of high pressure and temperature found in internal combustion engines. NO<sub>2</sub> pollution is known to have adverse impacts on the human respiratory system, including the aggravation of asthma symptoms. Due to its brownish color NO<sub>2</sub> pollution may also reduce visibility, increasing the risk for roadway collisions as well as generally degrading the visual aesthetic of the natural environment.

## GREENHOUSE GAS (GHG) EMISSIONS

According to ARB, the transportation sector comprises the largest single contributor to GHG emissions in our state. Pursuant to SB 375, ARB set per capita GHG emissions reduction targets from passenger vehicles for each of the state’s 18 Metropolitan Planning Organizations (MPOs). These regional targets were updated by ARB in 2018 to ensure consistency with the more stringent statewide reduction goals subsequently introduced by the California legislature and the Governor’s office. For the SCAG region, the updated targets are eight percent below 2005 per capita emissions levels by 2020 (this value is unchanged from the previous 2020 ARB target), and 19 percent below 2005 per capita emissions levels by 2035. This revised 2035 target is significantly higher than the previous ARB target of 13 percent for the SCAG region.

The ambitious program of investments and strategies contained in Connect SoCal achieves per capita GHG emissions reductions relative to 2005 of eight percent in 2020 and 19 percent in 2035 (**TABLE 10**).

**TABLE 10** Connect SoCal Greenhouse Gas Reductions (per Capita)

Year	% Reduction from 2005 Levels		
	ARB Target	Connect SoCal	% Difference
2020	8%	8%	0%
2035	19%	19%	0%

Source: SCAG Regional Travel Demand Model

## MONITORING REGIONAL GHG EMISSIONS

Like all of California's MPOs, SCAG must prepare its RTP/SCS within the context of the requirements of SB 375. In support of this effort, the California Transportation Commission (CTC) published its '2017 California Regional Transportation Plan Guidelines for Metropolitan Planning Organizations'. This comprehensive set of RTP development guidelines recommends that on-model or off-model calculations be formulated to produce realistic sensitivities to localized land use variations. For Connect SoCal, our scenario modeling capabilities have been enhanced to provide added functionality in support of monitoring the impact of various land use options on regional GHG emissions.

Using SPM modeling results, we are able to evaluate a wider range of potential strategies, including land use changes, for reducing regional VMT and GHG emissions. The SPM is also used as a tool for estimating regional natural resource conservation co-benefits such as water and energy consumption and rural land conservation. The enhanced SPM will also be equipped to provide local fiscal impact analysis in support of Connect SoCal.

Investments in our regional active transportation network are critical components for achieving our community sustainability and GHG reduction goals in the SCAG region. To improve our ability to assess the comprehensive set of co-benefits associated with investing in our regional transportation network, the SPM is also equipped with an improved Public Health module to assess the public health co-benefits resulting from the transportation investments and land use strategies contained in Connect SoCal. Providing more and better opportunities for physical activity is one of the public health goals of Connect SoCal, and our enhanced scenario modeling capabilities are a valuable tool for monitoring regional performance in regard to achieving that outcome.

## OUTCOME 5: ECONOMIC OPPORTUNITY

The 'Economic Opportunity' outcome is measured in terms of additional jobs created both through improved regional economic competitiveness resulting from the transportation investments provided through Connect SoCal, and the construction and operation of those regional multimodal transportation system investments. An average of 168,400 new jobs are expected to be generated each year through construction and operations expenditures in support of the Plan, and an additional 264,500 jobs will be created annually over a broad cross-section of industries as a result of the SCAG region's increased competitiveness and improved economic performance due to regional transportation system improvements. The economic benefits provided by Connect SoCal are discussed in greater detail in Chapter 3 of the main Connect SoCal document, 'Road to Greater Mobility and Sustainability'.

## OUTCOME 6: INVESTMENT EFFECTIVENESS

The 'Investment Effectiveness' outcome is measured in terms of the degree to which the Plan's expenditures generate benefits that users of the regional multimodal transportation system may experience directly. This outcome is significant because it describes how the Connect SoCal transportation investments make efficient and productive use of available funding resources. The benefit/cost ratio is the measure used to evaluate the cost-effectiveness outcome, as it compares the incremental benefits received with the incremental costs of regional transportation system capital investments.

The Connect SoCal investment benefits are organized by several categories, including:

- Travel time savings resulting from reduced travel delay
- Air quality improvements
- Safety improvements
- Reductions in vehicle operating costs

For these categories, travel demand and air quality models are used to estimate the benefits provided by the Plan as compared to the Baseline. Most of these benefits are a function of changes in Vehicle Miles Traveled (VMT) and Vehicle Hours Traveled (VHT). Not all impacts are linear, as reductions in congestion may potentially either increase or decrease vehicle operating costs and emissions. Delay savings are reflected directly in the VHT statistics.

To estimate the benefit/cost ratio, the benefits provided in each category are converted into dollars and added together. These are then divided by the total incremental costs of the Connect SoCal transportation system investments to generate a ratio.

The results of the benefit/cost analysis indicate that the investments contained in Connect SoCal provide a return of \$2.06 for every dollar invested. For this analysis, all benefits and costs are expressed in 2016 dollars. Benefits are estimated over the 25-year Connect SoCal planning period from 2020 to 2045. The user benefits are estimated using the Cal-B/C benefit/cost framework and incorporate SCAG RTDM outputs. The costs include the incremental capital expenditures over the entire Connect SoCal planning period.

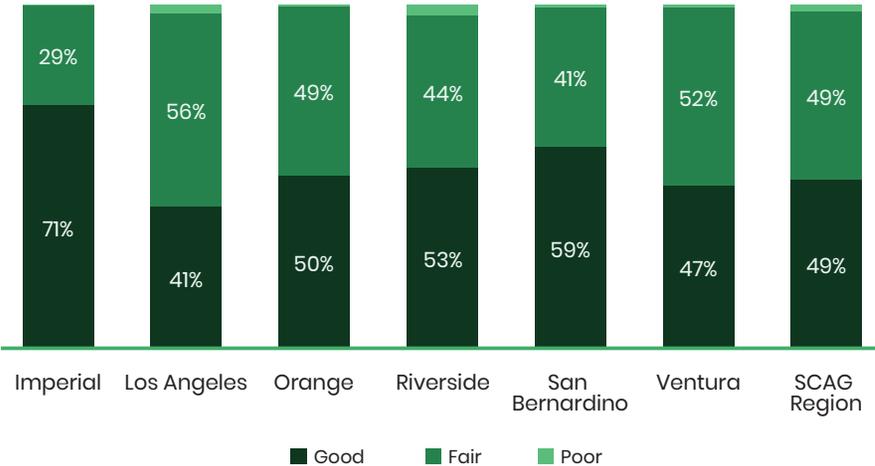
## OUTCOME 7: TRANSPORTATION SYSTEM SUSTAINABILITY

A transportation system may be considered 'sustainable' if it maintains its overall performance over time in an equitable manner with minimum damage to the environment, while at the same time not compromising the ability of future generations to address their transportation needs. Sustainability, therefore, refers to how our decisions today impact future generations. One of the measures used to evaluate system sustainability is the total inflation-adjusted cost per capita to maintain our overall multimodal transportation system performance in a State of Good Repair. Connect SoCal includes two additional measures to support this outcome: State Highway System pavement condition and local roadways pavement condition. These performance measures will strengthen the Transportation System Sustainability outcome and further support implementation of the federal performance-based planning and reporting requirements established by MAP-21 and the FAST Act.

The performance measures presented in this Technical Report serve to demonstrate that our regional multimodal transportation system will perform better and more efficiently in 2045 as compared to today. Connect SoCal is committed to maintaining a sustainable system by allocating \$316 billion toward maintaining and operating the system in a State of Good Repair over the period of the Plan. This is an average annual per capita investment of about \$562 per person (in 2019 dollars) for each year of the Plan period, or approximately \$1.50 per person per day.

Another measure used to monitor the sustainability of our regional transportation system is pavement condition. The condition of our regional roadways impacts transportation safety for all modes. Smooth, well maintained pavement allows for better vehicle and bicycle control and reduced hazards. With limited resources available to construct new roadways or finance major roadway rehabilitation projects, the condition of our regional transportation infrastructure, including highway pavement, has deteriorated over the years. The maintenance of our existing infrastructure has therefore become increasingly important. By monitoring the condition of our regional roadways

**FIGURE 8** Pavement Condition: State Highway System

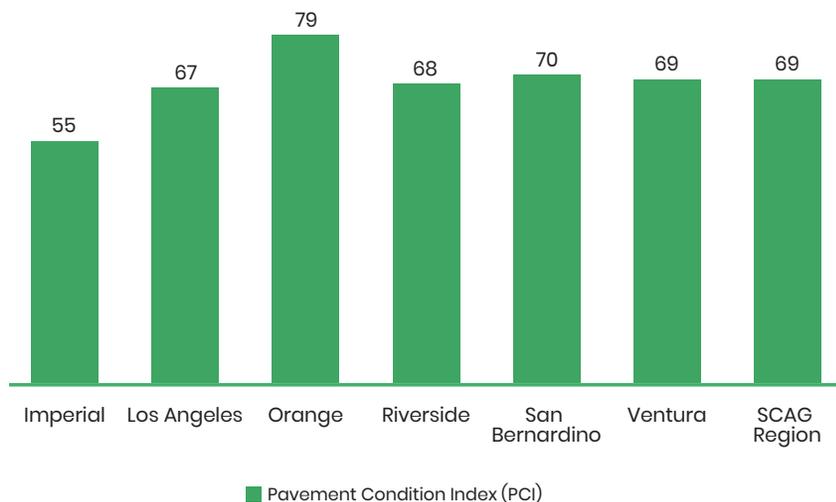


Source: Caltrans Automated Pavement Condition Survey

and highways over time, we are better able to allocate resources to facilities that are most in need. Pavement condition is monitored for both the State Highway System and for our locally maintained arterial roadways.

The Caltrans Automated Pavement Condition Survey reports State Highway System pavement condition using three categories based on surface cracking, rutting, faulting, and the International Roughness Index (IRI). Pavement classified in the 'Good' category refers to roadways that feature a smooth riding surface, little or no cracking, and strong structural integrity. The 'Fair' category refers to roadways with some surface cracking and areas of roughness but not enough to substantially impact the quality or safety of the ride. These pavements may require some capital investment for preventative maintenance. The 'Poor' category refers to pavements with substantial surface roughness, cracking, or rutting that negatively impacts ride quality and safety. Pavements classified as being in 'Poor' condition should be prioritized for rehabilitation investment to ensure their continued viability and operational safety.

**FIGURE 9 Pavement Condition Index: Local Roadways**



Source: California Statewide Local Streets & Roads Assessment

**FIGURE 8** shows pavement condition on the state highway system by county using the three classifications described above. Currently, about 50 percent of State Highway System pavement in the SCAG region is considered to be in either 'Fair' or 'Poor' condition, meaning it may require some level of investment in maintenance or rehabilitation to improve conditions. Riverside (3.1 percent) and Los Angeles (2.6 percent) counties currently have the highest share of highway pavement in 'Poor' condition; while Imperial (70.8 percent) and San Bernardino (58.6 percent) counties have the highest share of highway pavement classified as being in 'Good' condition.

For our local roadways, pavement condition is usually reported by our local agencies using the Pavement Condition Index (PCI). PCI evaluates pavement condition on a scale of 0 to 100, with 100 being the best possible score and 0 being the worst. In 2016, local arterials in the SCAG region had an average PCI rating of 69 out of 100, where scores below 70 typically translate to conditions that are considered inadequate, and ratings below 50 indicating a likely need for major roadway rehabilitation. These findings suggest that a substantial portion of our local roadways are in need of pavement improvements to enhance multimodal safety and to improve the longevity of our existing transportation infrastructure.

**FIGURE 9** shows the pavement condition summary for local roadways in the SCAG region by county. In 2016, average countywide PCI ratings ranged from a low of 55 in Imperial County to a high of 79 in Orange County.

## OUTCOME 8: ENVIRONMENTAL JUSTICE

As a critical component of the Connect SoCal performance monitoring program, SCAG has developed a separate set of performance measures to monitor the progress of our regional Environmental Justice (EJ) program. As discussed previously in this Technical Report, EJ is a federal and state requirement designed to ensure the equitable treatment and meaningful involvement of all people in the regional planning process regardless of race, ethnicity, national origin, or income.

The full list of EJ performance measures in support of Connect SoCal is provided

in **TABLE 3** of this Technical Report. For a more detailed description of the SCAG EJ program and the results of the EJ analyses conducted in support of Connect SoCal, please refer to the Environmental Justice Technical Report.

## ON-GOING PERFORMANCE MONITORING

In addition to the performance measures used to evaluate performance of Connect SoCal, SCAG developed a separate set of metrics to support on-going performance monitoring of the Plan over time. While some of the on-going performance metrics are also used to evaluate the Plan, many of them are not readily forecast or modeled and are therefore not appropriate for use in the Connect SoCal scenario assessment process. However, they are useful for evaluating progress being made toward achievement of our regional performance goals over time. The measures to be used for on-going performance monitoring are presented at the beginning of this Technical Report in **TABLE 4**.

### 1. LOCATION EFFICIENCY

The 'Location Efficiency' outcome is used both to evaluate performance of Connect SoCal and for on-going regional monitoring. Location Efficiency includes several associated performance measures that reflect the impact of improved land use and transportation coordination in support of the SCS, as required by SB 375. The Location Efficiency outcome reflects the degree to which improved land use and transportation coordination impacts the efficient movement of people and goods. The performance measures to be used to support this outcome for on-going regional monitoring are described below.

#### SHARE OF GROWTH IN HIGH QUALITY TRANSIT AREAS (HQTA)

As an on-going performance metric, this variable will focus on regional growth trends occurring within HQTAs. Between the years 2016 and 2045, about 45 percent of regional household growth and 45 percent of regional employment

growth would be expected to occur in HQTAs under the Baseline scenario. With Connect SoCal, however, these percentages would significantly increase, to more than 51 percent for households and to nearly 60 percent for employment. The Connect SoCal map of 2045 HQTA locations is provided in **EXHIBIT 1** of this Technical Report.

## LAND CONSUMPTION

Also included as a measure for evaluating performance of the various Connect SoCal scenario alternatives, this metric will also be used in an on-going regional monitoring capacity, focusing on the identification of trends in the conversion of agricultural and other existing rural lands to urban uses over time.

## VEHICLE MILES TRAVELED (VMT) PER CAPITA

As an on-going performance monitoring metric, VMT per capita will evaluate regional trends over time in regional automobile travel mileage in comparison to the 2016 Base Year. In 2016, regional VMT per capita was 23.2 miles. By 2045, per capita VMT is projected to decrease to 21.8 miles per capita under the Baseline, but will be further reduced by more than one full mile to 20.7 miles under the Plan. Results for this indicator as a performance measure for Connect SoCal are discussed in more detail in the 'RTP/SCS Outcomes and Performance Measures' section of this Technical Report.

## TRANSIT MODE SHARE

Transit mode share for work trips and for all trips will be monitored on an on-going basis to identify regional trends occurring since 2016. In 2016, the transit mode share in the SCAG region for all trips was 3.2 percent. Transit mode share is projected to increase for all trips in 2045 from 3.6 percent under the Baseline to 4.9 percent with Connect SoCal. For work trips, transit accounted for a 2.7 percent mode share for the 2016 Base Year, 4.0 percent under the Baseline, and 6.1 percent with Connect SoCal.

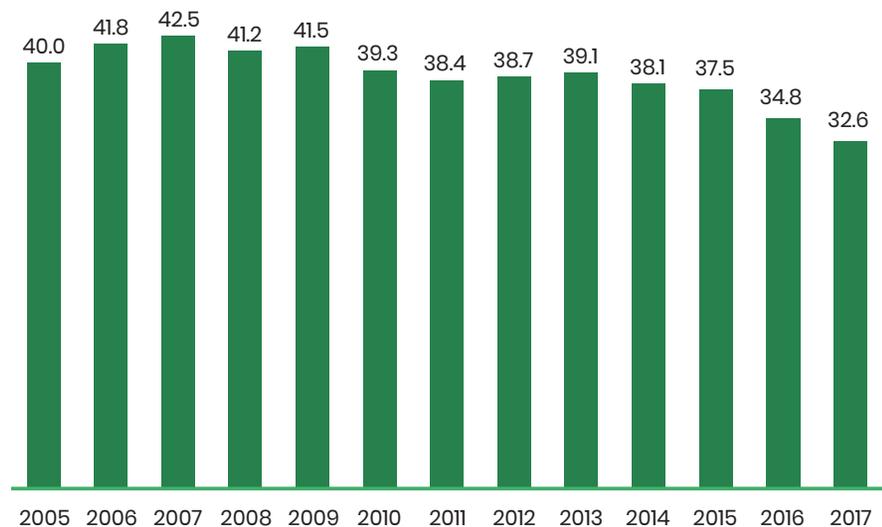
## TRANSIT BOARDINGS PER CAPITA

Transit boardings per capita for work trips and for all trips will be monitored on an on-going basis to identify regional transit use trends occurring since 2016. Monitoring the average annual number of transit trips taken per capita provides a complementary metric to transit mode share. While transit mode share captures the relative proportion of all travelers who use transit, transit boardings per capita provides a more precise assessment of the intensity in which transit is being used by residents of the SCAG region.

**FIGURE 10** shows the trend line for annual per capita transit boardings in the SCAG region since 2005. As illustrated in the chart, boardings reached their high point in 2007, with 42.5 boardings per capita. Since that time, however, transit boardings have shown a steady decline in the SCAG region, with 32.6 boardings per capita in 2017, a 23 percent decrease since 2007.

While much of the recent decline in transit use is due to economic and other structural factors beyond the reach of SCAG’s long range planning efforts, the

**FIGURE 10** Annual Transit Boardings per Capita: 2005–2017



Source: National Transit Database, Federal Transit Administration

projects, plans, and strategies contained in Connect SoCal are designed to improve the transit experience and to increase its viability as an alternative to single occupancy vehicle use.

## ANNUAL HOUSEHOLD TRANSPORTATION COST

The average annual household transportation cost for the SCAG region in 2016 was estimated to be \$13,008, or about 22 percent of the average annual household income. By 2045, household transportation expenses are projected decrease by about 12 percent to \$11,461 under the Baseline. However, with Connect SoCal, transportation-related expenses will decrease even further to \$10,852, a reduction of nearly 17 percent.

## ANNUAL HOUSEHOLD INCOME SPENT ON HOUSING

Estimates for the share of annual household income consumed by housing-related expenses are based on average rent and mortgage cost data. As an on-going performance measure, this metric will be assessed on an annual basis to identify regional trends in housing affordability in the SCAG region. In 2017, the average share of median annual household income spent on housing was about 28 percent. Disparity among the six counties was minimal, with Los Angeles County registering the highest share at 29 percent and Imperial County having the lowest share at 24 percent. Combining both housing and transportation expenses, the average SCAG household spent about 61 percent of its annual income on these essential costs. Again, disparity among the six counties was relatively modest, with Ventura (54 percent) and Los Angeles (57 percent) counties having the lowest combined shares, and Imperial (68 percent) and Orange (66 percent) counties recording the highest shares. Riverside (63 percent) and San Bernardino (59 percent) counties ranked third and fourth, respectively.

## 2. MOBILITY AND ACCESSIBILITY

This section reviews the mobility and accessibility performance measures that

will be used for on-going monitoring of the regional transportation network.

## HIGHWAY NON-RECURRENT DELAY

As discussed previously in this Technical Report, the primary measure used for monitoring the 'Mobility' outcome in Connect SoCal is travel delay due to recurrent congestion. Recurrent congestion refers to typical levels of delay experienced on a daily basis as a result of an excessive number of vehicles being on the road and traveling in the same direction at the same time. Another mobility measure that is used for on-going regional monitoring is non-recurrent delay. Non-recurrent delay is congestion caused by collisions, adverse weather, special events or other atypical incidents.

Data from the Caltrans Performance Measurement System (PeMS) is used to assess the level of non-recurrent delay on regional freeways using the 'congestion pie' feature of PeMS. This module categorizes total reported freeway congestion into its recurrent and non-recurrent components. Non-recurrent congestion is further analyzed in PeMS by disaggregating the data into two categories: 'Accidents' and 'Miscellaneous'. Non-recurrent congestion due to collisions is estimated using the Caltrans 'Traffic Accident Surveillance and Analysis System' (TASAS). TASAS overlays highway congestion data reported by roadway sensors with collision data. If excessive congestion is reported at a time and location where TASAS indicates a collision occurred, that congestion is classified in the 'Accident' category. If roadway sensors report excessive congestion where there is no corresponding collision information, that supplemental congestion is classified in the 'Miscellaneous' category of non-recurrent congestion.

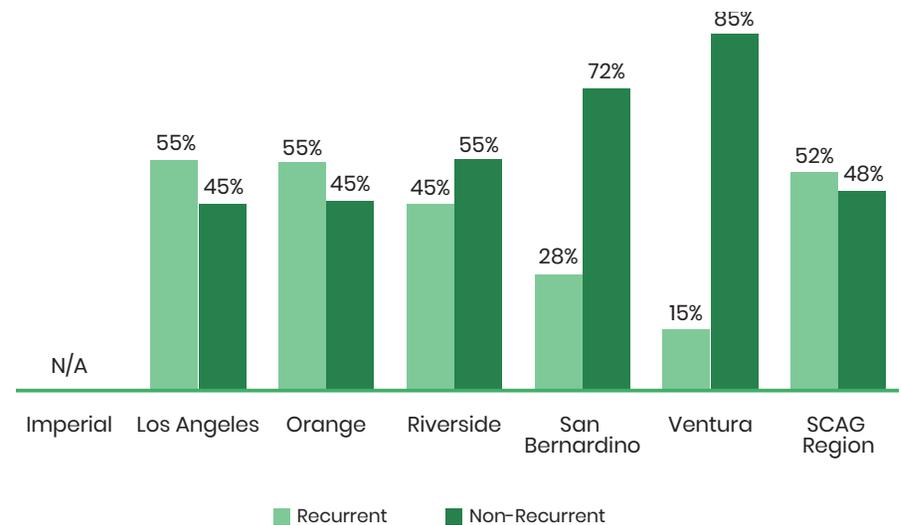
As depicted in **FIGURE 11**, about 48 percent of freeway congestion experienced in the SCAG region in 2015 (the year of the most recent data) was of the non-recurrent variety, although levels vary significantly by county. Accordingly, more than half (52 percent) of congestion in the SCAG region is recurrent. More suburban or rural areas with less overall congestion have a higher percentage of total congestion represented by non-recurring events. Ventura County, for example, was estimated to have the majority (85 percent) of its congestion caused by non-recurrent events. Non-recurrent congestion also comprises the

majority of delay experienced in San Bernardino (72 percent) and Riverside (55 percent) counties. By contrast, the more intensively urbanized counties of Los Angeles and Orange each had approximately 45 percent of its total congestion represented by non-recurring incidents.

Non-recurrent delay may be mitigated or reduced by improving highway incident management strategies. Other uses of intelligent transportation technologies, such as traffic signal coordination and the provision of real-time traffic information allow travelers to make better informed decisions regarding the availability of transportation alternatives, including transit. Primary strategies for ameliorating recurrent congestion focus on reducing dependency on single occupancy vehicle travel and on improving the coordination of regional land use and transportation planning efforts. Enhanced coordination of local and regional land use planning and decision-making with transportation system planning will provide the foundation for a more efficient and sustainable urban living and commuting environment.

The 'Accessibility' outcome is used to evaluate how well the regional

**FIGURE 11 Non-Recurrent Congestion Share by County**



Source: SCAG Regional Travel Demand Model

transportation system performs in providing access to opportunities. Opportunities may include employment, education, medical care, recreation, shopping, and other important lifestyle activities. For on-going monitoring, accessibility is evaluated by analyzing travel time distribution by mode and by time of day.

Accessibility may be measured by reviewing PM peak period commute data to identify the percentage of work trips that are completed within 45 minutes. Peak periods are those times during the weekday when commuting travel reaches its highest levels. Typically peak periods occur twice daily, first during the morning commute when people are traveling to their workplaces, and again in the late afternoon when people are returning home from work. **FIGURE 7**, provided earlier in this report, shows the results of the accessibility modeling analysis conducted in support of Connect SoCal. In all cases, the Plan improves accessibility for work trips over the Baseline scenario. Other mobility and accessibility measures to be used for on-going monitoring include mode share for work trips and travel time to work.

## FREEWAY SPEED MAPS

The amount of time it takes to travel from one place to another on our regional highway system is an essential element of mobility and accessibility. The maps provided in **EXHIBITS 2, 3, and 4** (at end of this Technical Report) depict freeway speed conditions in the SCAG region during the afternoon peak period (3 pm to 7 pm) based upon the SCAG RTDM results for the Base Year (2016), Baseline (2045), and Connect SoCal (2045). Additional speed maps may be found in the Connect SoCal Highways and Arterials Technical Report.

## 3. PRODUCTIVITY AND RELIABILITY

As with the non-recurrent congestion measure, metrics in support of the productivity and reliability outcome are not readily forecast and are therefore not used in the Connect SoCal alternatives analysis. They do, however, provide useful guidance on the benefits that may be obtained through investments in regional transportation system operational and efficiency improvements. As

with the non-recurrent congestion analysis described in the previous section, the productivity and reliability estimates presented here are based on highway operations data obtained through PeMS.

## PRODUCTIVITY

The 'Productivity' outcome is a system efficiency metric that reflects how well the regional transportation system performs during peak demand conditions. The productivity measure is defined as the share of system utilization occurring during peak periods.

For highways, productivity is particularly important because those times when capacity is in greatest demand are frequently when our transportation system provides the lowest levels of production. Congested urban corridors typically lose at least 25 percent of their operational capacity during rush hour, although on some primary commuting corridors throughput may decline by up to 50 percent during peak periods.

**FIGURE 12** provides an example of peak hour productivity losses on I-405 in Orange County. Maximizing the efficiency and productivity of our existing regional multimodal transportation system is a primary goal of the Plan, and the overall system management approach seeks to recapture lost productivity. The investment of \$13.7 billion to implement transportation system management strategies, including Intelligent Transportation Systems (ITS) technologies, on our freeways and arterials is projected to recapture a substantial share of lost productivity. These estimates are based on studies indicating that targeted investments in ramp metering, traffic signal coordination, traveler information systems, and incident management may achieve significant improvements in system productivity.

Connect SoCal improves the productivity of the regional transportation system by committing to significant investments in highway and mobility operational improvements as presented and discussed in the main Connect SoCal document and the Project List Technical Report. Transit productivity will be expected to show improvement through increased ridership, which maximizes the number of seats occupied during times of peak demand. More

detailed regional transit system analysis is provided in the Connect SoCal Transit Technical Report.

## RELIABILITY

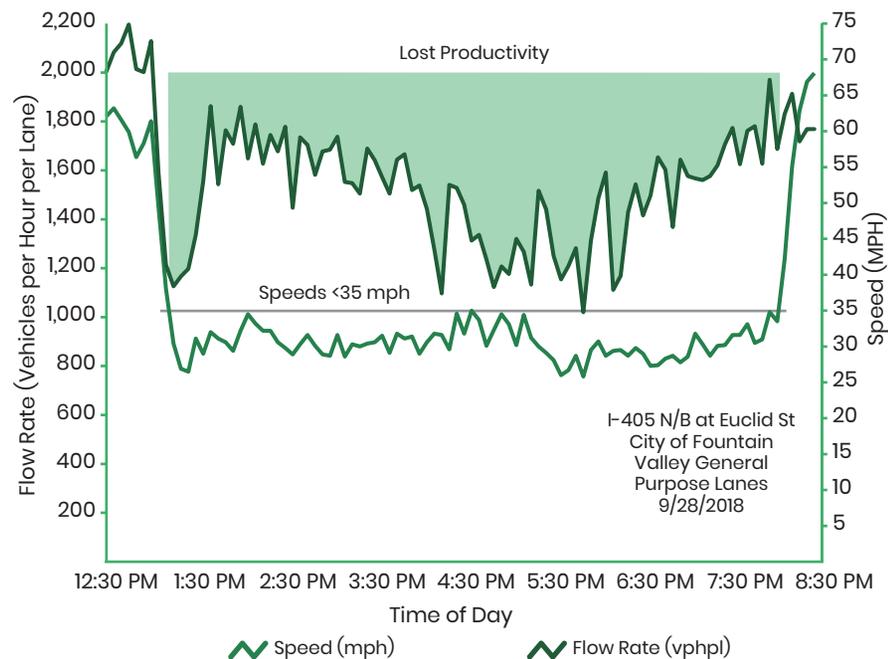
Reliability measures the relative predictability of travel time for commuters. Unlike mobility, which measures how fast the transportation system moves people and goods; and accessibility, which assesses the amount of time required to travel from one place to another; reliability focuses on the degree to which mobility and accessibility vary from day to day.

Reliability metrics reflect the impacts of accidents, incidents, weather, and special events on reaching travel destinations in a predictable manner. There are currently no established methods to accurately forecast reliability because, while existing travel demand models are able to provide accurate estimates

of average travel times and delays, they are not yet equipped to evaluate variations in travel times.

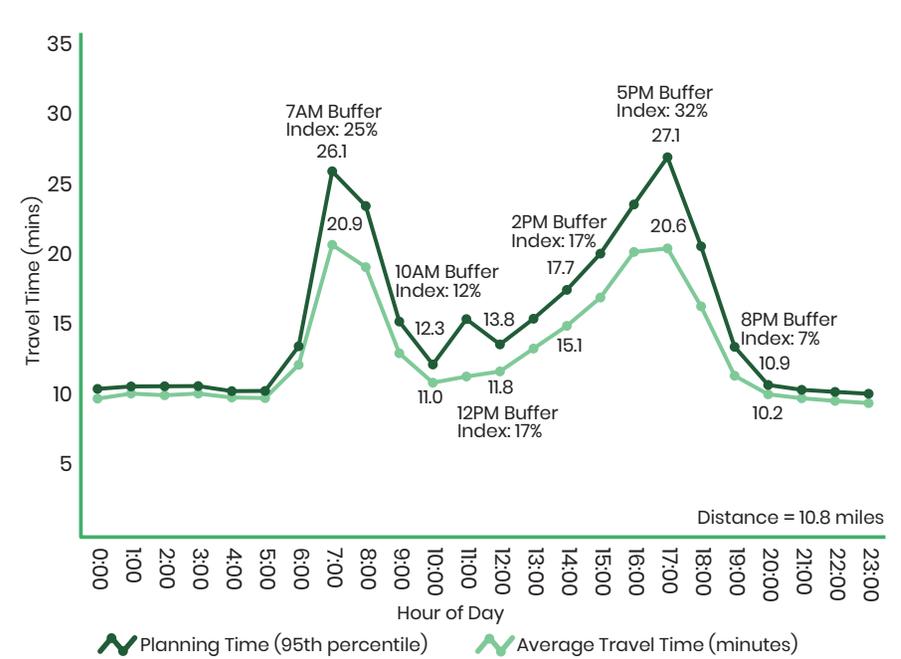
A commonly used method to assess travel time reliability is to calculate the amount of 'planning time' that a traveler would need to ensure an on-time arrival at a desired destination. A useful metric for assessing planning time requirements is calculation of the 95th percentile travel time. The 95th percentile travel time represents the five longest commute times observed along a specific travel corridor out of a total of 100 commuting days (or 19 out of 20 workdays per month). This means that a commuter may expect to reach a desired destination on time 95 percent of the time. Atypical events, such as collisions or adverse weather conditions, could extend travel times, but the 95th percentile represents a balance between the relatively few days when commutes are impeded by unexpected events and more typical travel days. The additional time needed to ensure timely arrival (the difference between the

**FIGURE 12 Highway System Productivity**



Source: SCAG

**FIGURE 13 Example of Reliability on a Freeway Corridor**



Source: SCAG

planning time and the average travel time) is referred to as the 'buffer time' and the percentage of additional buffer time added to the reference travel time is known as the 'Buffer Index'.

**FIGURE 13** demonstrates the concept of reliability using PeMS data for a person traveling eastbound on SR 91 in Orange County between Beach Boulevard in Buena Park and Imperial Highway in the Anaheim Hills, leaving at various times throughout the day. A traveler entering SR 91 at 5:00 PM on a weekday would typically require about 21 minutes to reach Imperial Highway. However, to ensure reaching their destination on time on at least 95 percent of travel days, that person would need to allow for an additional six minutes (or 32 percent more time).

Transportation system management investments that reduce incident response and clearance times, provide dynamic roadway information to travelers, and other data-driven roadway management strategies may serve to effectively reduce the 'buffer time' needed to improve reliability and help ensure on-time arrival.

## 4. SAFETY AND PUBLIC HEALTH

Highway safety is an important element of the on-going evaluation of the performance of our regional transportation system, as well as for federal MAP-21 target setting and reporting. For purposes of on-going monitoring, transportation system safety performance is reported in historical context, allowing for the identification of emerging trends over time.

**FIGURE 14** shows the rate of highway collisions involving fatalities or serious injuries per million vehicle miles traveled in the SCAG region between 2001 and 2017. Serious collision rates showed a steady decline between 2001, when there were 5.3 fatalities or serious injuries per 100 million miles traveled in the region, to a rate of 3.7 in 2010. However, these rates have been trending slightly upward since 2014, with the rate of 4.9 in 2017 being the highest recorded in the SCAG region since 2006. As shown in the chart, this increase is largely due to a higher rate of serious injuries.

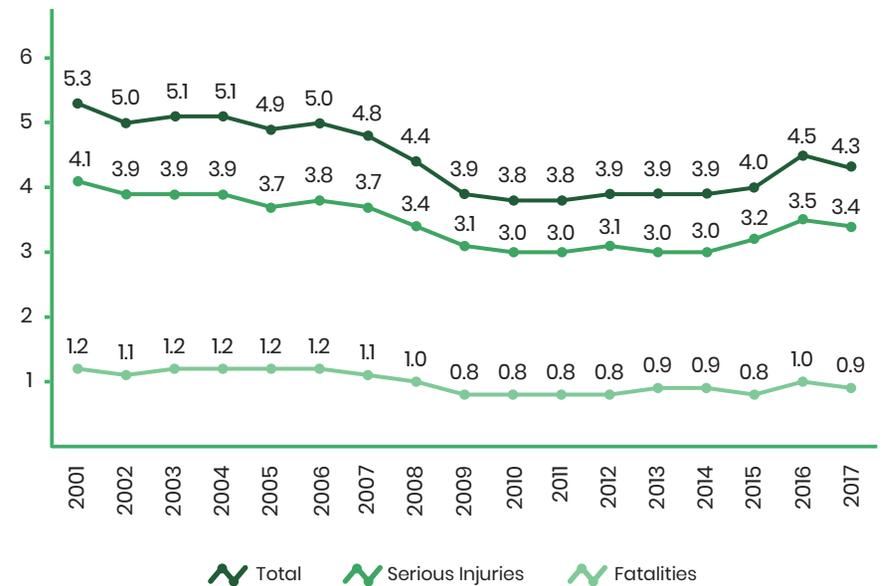
Enhancing the safety of active transportation modes on our roadway network

is imperative for creating a truly multimodal, sustainable transportation culture in the SCAG region that will not only expand commuting choices for local residents, but will also provide public health benefits due to improved opportunities for daily physical activity.

**FIGURE 15** shows the rate of fatalities and serious injuries resulting from collisions involving bicycles and pedestrians per 100,000 population in the SCAG region since 2001. As with motor vehicle collision rates described above, the rate of fatalities and serious injuries involving active transportation modes showed a downward trend between 2001 and 2010, declining from 11.7 to 8.9 over that nine year period. However, the number of serious injuries has propelled the rate back up over the last three years, reaching 11.1 in 2017.

For on-going monitoring purposes, Public Health performance is assessed

**FIGURE 14** Serious Injury/Fatality Rate per Million Vehicle Miles



Source: Statewide Integrated Traffic Records System (SWITRS)

in terms of the health impacts of criteria pollutant emissions and access to opportunities for daily physical activity, including parks and open space. This outcome also includes measures for use of bicycling and walking modes for work and non-work trips. Public health diagnoses that correlate to environmental conditions that may be monitored on an on-going basis in the SCAG region include asthma incidence and exacerbation; and rates of diabetes, cardiovascular disease, hypertension and obesity.

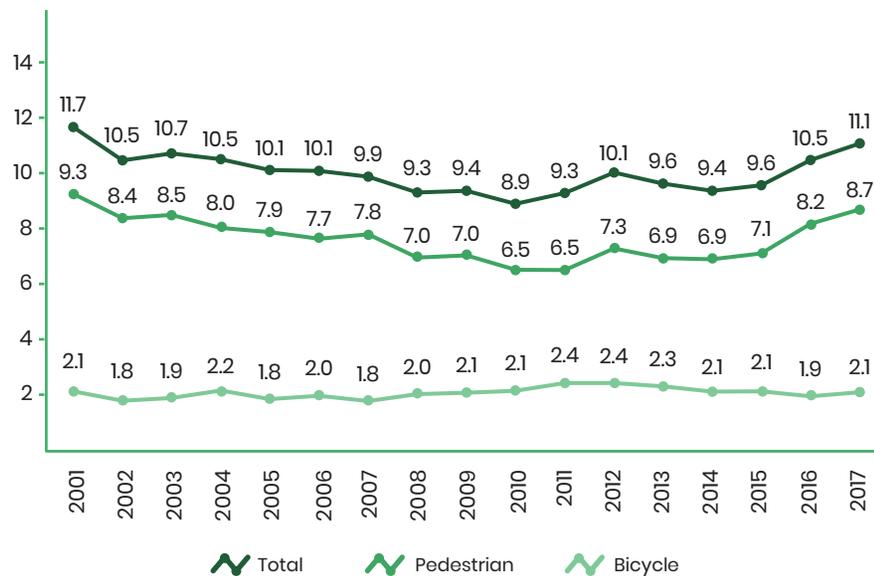
## ENVIRONMENTAL PATHOLOGY

According to the California Health Interview Survey, the share of the population in the SCAG region that had ever been diagnosed with asthma in 2016 was 13.8 percent. Among those currently diagnosed with asthma, 92 percent have

experienced symptoms over the last twelve months and 14.7 percent required a visit to the emergency room or an urgent care facility for treatment of asthma-related symptoms. Nearly half (46 percent) of those currently diagnosed with asthma take daily medication to control symptoms.

Approximately eight percent of the population in the SCAG region have been diagnosed with diabetes, ranging from about seven percent in Orange County, to more than 11 percent in Imperial County. The rate of cardiovascular disease in the SCAG region ranges between four and five percent in all six counties. Similarly, the rate of hypertension (high blood pressure) in the SCAG region is about 27 percent, with only minor variations among the counties. Monitoring of the regional obesity rate is critical to the assessment of public health due its known correlation to both chronic disease incidence and to physical activity. In 2016, the obesity rate in the SCAG region was 30.5 percent, ranging from a low of 25 percent in Orange County, to a high of about 42 percent in Imperial County.

**FIGURE 15 Bicycle/Pedestrian Serious Injury/Fatality Rate per 100,000 Population**



Source: Statewide Integrated Traffic Records System (SWITRS)

## HOUSEHOLDS WITHIN 500 FEET OF HIGH VOLUME ROADWAYS

High volume roadways are defined as those with daily traffic volumes exceeding 100,000 vehicles in urban areas and 50,000 vehicles in rural areas. Generally, as diesel and other airborne particulate concentrations disperse with distance from the pollution source, such as major highways, the associated health risk also declines. ARB studies have demonstrated that air pollution levels may be significantly higher within 500 feet of high volume roadways before diminishing rapidly with increased distance. In 2016, it was estimated that five percent of households in the SCAG region were located within 500 feet of a freeway or high volume roadway.

## BICYCLE AND PEDESTRIAN MODE SHARE

Supportive of the public health goals promoted by Connect SoCal, this measure allows SCAG to monitor the relative share of regional travel that is conducted using active transportation modes. It is anticipated that through strategic

investments in active transportation infrastructure, safety, and supportive land use changes, an increasing share of commuters in the region will opt for more healthful, sustainable transportation options for getting to their destinations, including bicycling and walking.

**FIGURE 16** shows the active transportation mode share in the SCAG region as projected for the Base Year, Baseline, and Connect SoCal.

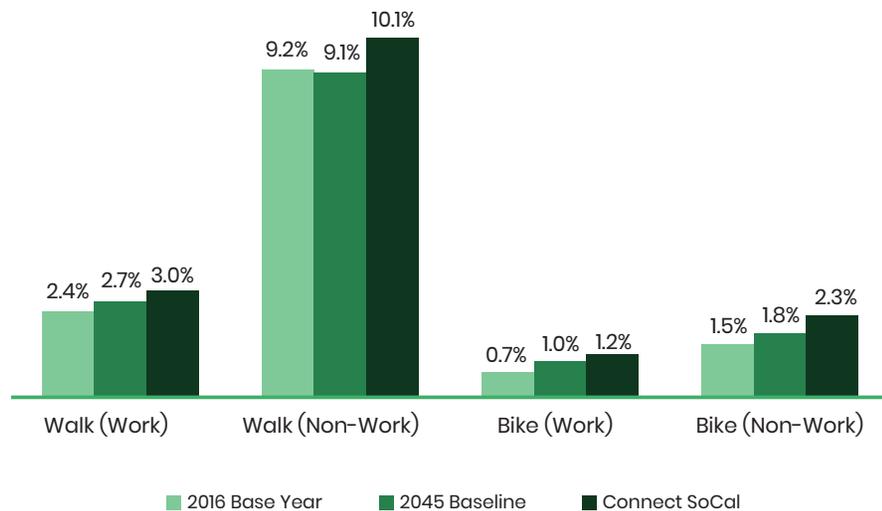
Bicycle mode share for work trips in the SCAG region is projected to be 1.0 percent in 2045 under the Baseline, modestly increasing to 1.2 percent with Connect SoCal. For non-work trips, the bicycle share increases from 1.8 percent to 2.3 percent. The pedestrian share of work trips is expected to increase from 2.7 percent under the Baseline, to 3.0 percent with implementation of the Plan. For non-work trips, the pedestrian mode share improves from 9.1 percent under the Baseline to 10.1 percent with the Plan. The combined active transportation (bicycle and pedestrian) mode share for work trips also improves under Connect SoCal, increasing from 3.7 percent under the Baseline to 4.2 percent

with the Plan. For non-work trips, the combined active transportation mode share increases significantly from 10.9 percent to 12.4 percent. As previously indicated in this report, SCAG conducted an ‘off-model’ analysis to account for additional variables that impact active transportation mode share including Safe Routes to School, first/last mile improvements, pedestrian infrastructure, bike share, and other micro-mobility investments. The results of the off-model active transportation analysis may be found in the Connect SoCal Active Transportation Technical Report.

## DAILY AMOUNT OF WALKING AND BIKING

Walking and biking (active transportation) performance measures are also used in support of the public health goals of Connect SoCal. These metrics will assess the share of our population who included trips either by walking or biking during the day. This measure will also monitor the average number of minutes residents engaged in walking and biking each day. In 2016, adults in the SCAG region averaged just over five minutes of walking and less than one minute of biking on a daily basis. It is expected that implementation of Connect SoCal will improve regional performance in these areas.

**FIGURE 16** Mode Share for Walking and Biking



Source: SCAG Regional Travel Demand Model

## SHARE OF RESIDENTS WITHIN ½ MILE OF PARKS AND NATURAL LANDS

This measure evaluates the proximity of local residents to neighborhood parks and natural lands. If there are recreational spaces available near enough for people to walk to from their homes, it is more likely they will get more daily physical exercise and improve their overall quality of life. As of 2015, 75 percent of residents in the SCAG region lived within one-half mile of a public park. Among the six counties, park access ranged from highs of 89 percent in Orange County and Ventura County at 84 percent; to lows of 59 percent in San Bernardino County and 60 percent in Riverside County. Los Angeles County (76 percent) and Imperial County (66 percent) ranked third and fourth, respectively.

## PARK ACREAGE PER 1,000 RESIDENTS

Similar to the proximity to natural lands metric described above, this measure evaluates the availability of local recreational options for residents to maximize opportunities to engage in daily physical exercise and to improve overall quality of life. In 2016, there was a total of 170 acres of parks and open space per 1,000 residents in the SCAG region (three acres of local parks and 167 acres of open space).

## 5. ENVIRONMENTAL QUALITY

The 'Environmental Quality' outcome is measured in terms of ambient air quality. Ambient air quality monitoring is performed by the California Air Resources Board and by the following local air districts:

- South Coast Air Quality Management District
- Antelope Valley Air Quality Management District
- Imperial County Air Pollution Control District
- Mojave Desert Air Quality Management District
- Ventura County Air Pollution Control District

## 6. TRANSPORTATION SYSTEM SUSTAINABILITY

Like its counterpart in the set of performance measures being used to evaluate Connect SoCal alternatives, the Transportation System Sustainability set of on-going performance metrics seeks to monitor the overall performance of our regional multimodal transportation system over time. For on-going regional monitoring, this outcome will be evaluated in regard to how well our existing transportation system infrastructure is being maintained. The two performance measures used to support this outcome include State Highway System pavement condition and local roadways pavement condition.

## STATE HIGHWAY PAVEMENT CONDITION

It is a priority of Connect SoCal to focus on the maintenance and safety of our

existing transportation infrastructure, and pavement condition is a primary factor affecting both the quality of travel and safety on our regional roadways. Using pavement condition data provided by Caltrans, this measure allows SCAG to monitor the condition of pavement on our regional freeways and highways over time. As discussed previously in this Technical Report, the Caltrans Automated Pavement Condition Survey reports State Highway System pavement condition using three categories based on surface cracking, rutting, faulting, and the International Roughness Index (IRI). Pavement classified in the 'Good' category refers to roadways that have a smooth riding surface, little or no cracking, and strong structural integrity. The 'Fair' category refers to roadways with some surface cracking and areas of roughness but not enough to substantially impact the quality of the ride. These pavements may require some capital investment for preventative maintenance. The 'Poor' category refers to pavements with substantial surface roughness, cracking, or rutting that impacts ride quality and safety. Pavements classified as being in 'Poor' condition should be prioritized for rehabilitation investment to ensure their continued viability and operational safety.

According to the most recent data (2016) from the Pavement Management System, about 50 percent of State Highway System pavement in the SCAG region is considered to be in either 'Fair' or 'Poor' condition, meaning it may require some level of investment in maintenance or rehabilitation to improve conditions. Riverside (3.1 percent) and Los Angeles (2.6 percent) counties currently have the highest share of pavement in 'Poor' condition; while Imperial (70.8 percent) and San Bernardino (58.6 percent) counties have the highest share of pavement classified as being in 'Good' condition.

## LOCAL ROADWAYS PAVEMENT CONDITION

As an on-going performance metric, this measure allows SCAG to monitor pavement condition on our locally maintained arterial roadways. As indicated previously, local pavement condition is typically assessed using the Pavement Condition Index (PCI) which rates pavement condition on a scale of 0 to 100, with 100 being the best possible score, and 0 being the worst. According to the most recent data (2016), the average PCI rating for local roadways in the SCAG region range from a low of 57 in Imperial County, to a high of 77 in Orange

County. These conditions are considered to be average to below average. However, without the transportation system preservation investments provided through Connect SoCal, pavement conditions would significantly deteriorate by 2045 to an average PCI rating of below 50, which would require substantial expenditures for major roadway rehabilitation and reconstruction projects. However, with the infrastructure preservation investments included in the Plan, roadways in the SCAG region would achieve an average PCI score of 83 by 2045.

## 7. RESOURCE EFFICIENCY

The 'Resource Efficiency' outcome is supportive of the regional and community sustainability goals promoted by Connect SoCal. The results provided by these metrics will provide an improved understanding of how well the SCAG region is performing in the conservation of our limited energy and water resources over time. With growing concern over the consequences of climate change, including periodic conditions of drought and ever-increasing wildfire risk, this outcome will help us to monitor our region's ability to effectively confront and adapt to climate-based regional challenges.

### ENERGY CONSUMPTION

Energy consumption is an important performance measure for on-going monitoring in the SCAG region because of its impact on GHG emissions and regional sustainability objectives. With SB 375 and subsequent supportive state legislation, the reduction of GHG emissions has become a focal point in the development of community sustainability strategies among state, regional, and local agencies throughout California. This measure will monitor per capita energy consumption (electricity, natural gas, vehicle fuel) in the SCAG region. The monitoring of this metric over time will help us to distinguish which strategies have proven to be most beneficial toward achievement of our regional sustainability goals. In 2016, the average household in the SCAG region consumed about 57 million British Thermal Units (BTU) of energy. With Connect SoCal, average annual household energy use in 2045 is projected to decrease to 45 million BTU, a reduction of about 22 percent.

### WATER CONSUMPTION

Along with energy consumption, the monitoring of water consumption will assist in helping to evaluate the progress the SCAG region is making toward achieving our regional sustainability goals. This measure will monitor per capita water consumption in the urban areas of the SCAG region. With periodic conditions of drought affecting our entire state, paired with escalating concern regarding the regional effects of climate change in our continually growing region, it is imperative that effective strategies be identified for reducing water consumption in the SCAG region. In 2016, the average household in the SCAG region consumed 113.8 thousand gallons of water each year. Connect SoCal will reduce household water use in the SCAG region by 26 percent in 2045, to 83.9 thousand gallons per year.

## REGULATORY FRAMEWORK

### OVERVIEW

In addition to the integral utility of performance measurement in the assessment of Connect SoCal, SCAG's regional performance monitoring program also includes state and federal performance management requirements.

### STATE PERFORMANCE REQUIREMENTS

California Senate Bill 375 (SB 375), the 'Sustainable Communities and Climate Protection Act of 2008', provided a ground-breaking statewide initiative to address the significant challenges presented by climate change through the setting of targets for reducing GHG emissions. SB 375 required ARB to establish specific GHG emission reduction targets for each region in the state. The targets refer to levels of GHG emissions reduction relative to levels generated in the year 2005. For the SCAG region, the ARB targets require a reduction in per capita GHG emissions of eight percent below levels recorded in 2005, and a 19 percent reduction by 2035. Achievement of these very challenging reduction targets will require substantial effort and resources. For this reason, the

monitoring of GHG emissions is a very high priority in the SCAG region.

One of the key mechanisms employed by SB 375 to achieve its ambitious GHG reduction goals was to require MPOs throughout the state to develop a 'Sustainable Communities Strategy' (SCS) every four years, to be included in their RTP. In 2012, SCAG produced its first SCS, as part of its 2012 RTP/SCS. The SCS serves to establish a foundation for an improved linkage between transportation and land use planning in the region, with the goal of fostering more efficient and sustainable regional land use patterns, thereby reducing GHG emissions that contribute to climate change.

The success of the SCS is dependent upon its implementation at the local level throughout the SCAG region, and a comprehensive regional performance monitoring program is essential to the SCS monitoring effort. SCAG responded to this challenge by revising the structure of its RTP performance monitoring program and introducing several new measures focused on GHG reduction for evaluating the performance of various alternative scenarios during development of the RTP/SCS, and for assessing the on-going effectiveness of the implementation of the Plan over the intervening years.

SCAG is firmly committed to reducing GHG emissions in our region, and more generally, to improving the sustainability and healthful nature of our Southern California communities. This commitment continues with renewed vigor with Connect SoCal.

## FEDERAL PERFORMANCE REQUIREMENTS

Transportation system performance management at the federal level was introduced in July 2012, with passage of the 'Moving Ahead for Progress in the 21st Century' (MAP-21) transportation authorization legislation. MAP-21 was widely heralded as a significant achievement in that it provided a legislative foundation for the establishment of a national performance-based transportation planning program, which was continued with the subsequent federal authorization program, the 'Fixing America's Surface Transportation' (FAST) Act, in 2015.

MAP-21 required FHWA to establish a uniform set of national transportation

performance measures that correspond to designated federal transportation planning goals, and to develop a standardized performance reporting protocol based on four-year cycles to be administered through State DOTs in collaboration with MPOs.

One of the requirements of MAP-21 is that MPOs include a 'System Performance Report' within its RTP. The System Performance Report provides detailed information regarding the MAP-21 performance measures and the corresponding sets of quantitative targets adopted at both the state and regional levels. The performance targets are used to assess progress being made within each of the transportation planning areas addressed by the federal performance measures. The Connect SoCal MAP-21 System Performance Report is provided in the following section of this report.

## MAP-21 SYSTEM PERFORMANCE REPORT

### FEDERAL PERFORMANCE MANAGEMENT

MAP-21 requires states and MPOs to establish performance targets focused on performance outcomes supportive of seven key national transportation goals related to transportation investment efficiency. These national performance goals include: 1) transportation system safety, 2) infrastructure condition, 3) congestion reduction, 4) system reliability, 5) freight movement and economic vitality, 6) environmental sustainability, and 7) reduced project delivery delays.

To provide a quantitative basis for evaluating progress toward achieving these seven national goals, MAP-21 also required the Federal Highway Administration (FHWA) to develop a corresponding set of performance measures and performance targets. The performance measures provide a standardized quantitative metric for evaluating progress toward meeting each of the national goals. Performance targets provide a numeric threshold by which the performance measures can be interpreted as having made acceptable progress toward achieving a specific performance goal.

As required under MAP-21, FHWA issued individual packages of rule-makings

in 2016 and 2017 to establish a set of national performance measures and guidelines for use in the setting of statewide and regional performance targets. The FHWA rule-makings establish a four-year performance target setting and reporting cycle, with a two-year mid-term progress evaluation point. As provided for in the federal rule-making, SCAG coordinated closely with Caltrans in the establishment of specific performance targets for the state and for our region in the various transportation performance areas established under MAP-21.

MAP-21 requires FHWA to establish rules for implementing transportation system performance management planning at a national level. FHWA rule-making in support of MAP-21 and the FAST Act has provided performance management and target-setting guidance through three performance management (PM) packages:

**PM 1: Transportation System Safety**

**PM 2: Pavement and Bridge Condition (National Highway System)**

**PM 3: National Highway System, Freight Movement, and CMAQ Program Performance**

In addition to the three PM packages, federal performance measures and reporting requirements have been established for Transit Asset Management (TAM) and Transit Safety. Performance metrics for TAM focus on the maintenance of our regional transit system in a state of good repair. Transit assets to be monitored under this provision include: 1) Non-revenue support equipment and maintenance vehicles; 2) Revenue vehicles (rolling stock); 3) Rail infrastructure including tracks, and signals, and guidance systems; and 3) Transit facilities including stations, parking structures, and administrative offices. Transit safety performance monitoring is focused on assessment of the number of transit incidents resulting in fatalities or serious injuries and transit system reliability.

Each of the federal performance management focus areas include an associated set of metrics for which statewide and regional targets must be set. The specific performance measures for each MAP-21 PM package include:

## TRANSPORTATION SYSTEM SAFETY (PM 1)

- Total number of motor vehicle collision fatalities
- Rate of motor vehicle collision fatalities per 100 million VMT
- Total number of motor vehicle collision serious injuries
- Rate of motor vehicle collision serious injuries per 100 million VMT
- Total number of non-motorized fatalities and serious injuries

## NATIONAL HIGHWAY SYSTEM PAVEMENT AND BRIDGE CONDITION (PM 2)

- Percentage of Interstate System pavement in 'Good' condition
- Percentage of non-interstate NHS pavement in 'Good' condition
- Percentage of Interstate System pavement in 'Poor' condition
- Percentage of non-interstate NHS pavement in 'Poor' condition
- Percentage of NHS bridges in 'Good' condition
- Percentage of NHS bridges in 'Poor' condition

## NATIONAL HIGHWAY SYSTEM (NHS) PERFORMANCE (PM 3)

- Percent of interstate system mileage reporting reliable person-mile travel times
- Percent of non-interstate NHS mileage reporting reliable person-mile travel times

## FREIGHT MOVEMENT (PM 3)

- Percent of interstate system mileage reporting reliable truck travel times

## CMAQ PROGRAM (PM 3)

- Annual hours of peak hour excessive delay per capita
- Total emissions reduction by criteria pollutant (PM10, PM2.5, Ozone, CO)
- Non-Single Occupancy Vehicle mode share

## TRANSIT ASSET MANAGEMENT (TAM)

- Equipment: Share of non-revenue vehicles that meet or exceed Useful Life Benchmark
- Rolling Stock: Share of revenue vehicles that meet or exceed Useful Life Benchmark
- Infrastructure: Share of track segments with performance restrictions
- Facilities: Share of transit assets with condition rating below 3.0 on FTA 'TERM' scale

## TRANSIT SAFETY

- Number of transit-related fatalities
- Number of transit-related injuries
- Number of transit system safety events
- Transit system reliability

## MAP-21 PERFORMANCE TARGETS

Just as the MAP-21 performance measures were selected to support the monitoring of each of the national transportation goals, performance targets are established to support the measures. The target values provide a specific and quantifiable achievement objective for each measure during the performance period. Targets act as quantitative thresholds for determining whether an acceptable level of progress has been achieved for a specific measure. MAP-21 requires that performance targets be set for each of the designated federal metrics at the statewide and regional levels. SCAG

coordinated closely with Caltrans throughout the process of developing initial statewide performance targets for each of the PM 1, PM 2, and PM 3 performance measures.

MAP-21 rule-making provides MPOs with the option to either accept the statewide performance targets or to develop a separate set of targets specific to the region. Since SCAG has been actively involved in the development of the statewide targets for all three of the MAP-21 performance management packages, SCAG opted to support the statewide targets for the initial performance monitoring period, which started on January 1, 2018, for most of the measures. MAP-21 establishes a four-year performance target setting and reporting cycle, with a two-year mid-term progress evaluation point. The initial four-year MAP-21 reporting cycle will end on December 31, 2021. The statewide and/or regional performance targets may be revised at the two-year mid-term evaluation if re-calibration is determined to be appropriate.

## TRANSPORTATION SYSTEM SAFETY (PM 1) TARGETS

While target-setting in support of PM 2 and PM 3 is required for the two-year and four-year reporting periods, the Transportation System Safety measures included under PM 1 require annual reporting. **TABLE 11** features the 2019 PM 1 transportation system safety targets for the state and for the SCAG region. For 2019, SCAG opted to adopt the statewide targets for implementation at the regional level. The SCAG regional targets shown in the table were derived using the methodology used by Caltrans in developing the statewide targets. These targets will be reviewed, reported, and updated on an annual basis at both the statewide and MPO levels.

## NHS PAVEMENT AND BRIDGE CONDITION (PM 2) TARGETS

In May, 2018 Caltrans submitted to FHWA the initial set of two-year and four-year statewide targets for the PM 2 group of MAP-21 performance measures. **TABLE 12** shows the statewide PM 2 National Highway System

**TABLE 11 Transportation Safety (PM 1) Statewide & SCAG Regional Targets**

PM 1 Performance Measure	2016 Baseline 5-Year Rolling Average*	2017 Single Year	2019 Statewide Target	2019 SCAG Regional Target
Number of Fatalities	1,403	1,505	3,445	1,467
Fatality Rate (per 100 Million VMT)	0.88	0.906	0.995	0.895
Number of Serious Injuries	5,044	6,386	12,688	5,552
Serious Injury Rate (per 100 Million VMT)	3.162	3.843	3.661	3.366
<b>Total Number of Non-Motorized Fatalities + Serious Injuries</b>	<b>2,046</b>	<b>2,118</b>	<b>3,950</b>	<b>2,133</b>

\* 2016 data was updated after establishing targets for 2018 therefore updated data was used to establish targets for 2019

Source: SCAG

Note: Figures refer to number of victims, not number of collisions

**TABLE 12 Statewide NHS Pavement and Bridge Condition (PM 2) Targets**

PM 2 Performance Measures	Baseline (2017)		2-Year Targets				4-Year Targets			
			(1/1/18 - 12/31/19)				(1/1/20 - 12/31/21)			
	Good	Poor	Good	Change	Poor	Change	Good	Change	Poor	Change
NHS Pavement (Total)	30.4%	6.1%	32.4%	+2.0%	6.3%	+0.2%	33.5%	+3.1%	6.4%	+0.3%
Interstate Pavement	47.9%	3.1%	45.1%	-2.8%	3.5%	+0.4%	44.5%	-3.4%	3.8%	+0.7%
Non-Interstate NHS Pavement	25.5%	7.1%	28.2%	+2.7%	7.3%	+0.2%	29.9%	+4.4%	7.2%	+0.1%
NHS Bridges	66.5%	4.8%	69.1%	+2.6%	4.6%	-0.2%	70.5%	+4.0%	4.4%	-0.4%

Source: SCAG

(NHS) pavement and bridge condition targets for the initial four-year reporting period, developed by Caltrans with substantial input from SCAG and the other major California MPOs.

**TABLE 13** shows the non-interstate NHS pavement and bridge condition targets for the SCAG region. The targets indicated for the SCAG region are supportive of the statewide targets.

## NHS, FREIGHT, AND CMAQ PROGRAM PERFORMANCE (PM 3) TARGETS

In May, 2018 Caltrans submitted to FHWA its initial set of two-year and four-year statewide targets for the PM 3 group of performance measures. PM 3 includes three separate sets of metrics corresponding to each of the three performance areas.

**TABLE 14** provides the initial statewide targets for the metrics for the PM 3 'NHS Performance' category. **TABLE 15** shows the statewide performance targets supporting the PM 3 'Freight' performance category.

**TABLE 13 SCAG Region NHS Pavement and Bridge Condition (PM 2) Targets**

PM 2 Performance Measures	Baseline (2017)		2-Year Targets				4-Year Targets			
			(1/1/18 - 12/31/19)				(1/1/20 - 12/31/21)			
	Good	Poor	Good	Change	Poor	Change	Good	Change	Poor	Change
Non-Interstate NHS Pavement	3.7%	14.4%	4.0%	+0.3%	13.8%	-0.6%	4.7%	1.0%	12.7%	-1.7%
NHS Bridges	36.1%	14.8%	37.9%	+1.8%	14.0%	-0.8%	41.4%	+5.3%	12.4%	-2.4%

Source: SCAG

**TABLE 14 Statewide PM 3 National Highway System Performance Targets**

PM 3 NHS Performance Measure	2017 Baseline	2-Year Target		4-Year Target	
		Target	Change from Baseline	Target	Change from Baseline
Percent of Reliable Person-Miles Traveled on the Interstate System	64.6%	65.1%	+0.5%	65.6%	+1.0%
Percent of Reliable Person-Miles Traveled on the Non-Interstate NHS	73.0%	N/A	N/A	74.0%	+1.0%

Source: SCAG

The third PM 3 category, 'CMAQ Program Performance' includes two distinct sets of metrics. The first of these is used to assess progress being made toward achieving improved air quality by measuring the quantity of five specific criteria pollutants being emitted each day. The second CMAQ Program metric is designed to provide information on improvements in traffic congestion through monitoring the percentage of commuters using a mode of travel other than driving alone. **TABLE 16** provides the set of statewide performance targets for daily total criteria air pollutant emissions.

use of any mode of transportation other than driving alone in a motor vehicle. For the initial reporting period, SCAG has opted to support the statewide PM 3 targets for the SCAG region. Please note that the Non-SOV mode share performance metric applies only to the two U.S. Census-designated Urban Areas within the SCAG region that had 2010 populations exceeding one million. The Los Angeles/Long Beach/Anaheim Urban Area had a population of 12.2 million in 2010, while the Riverside/San Bernardino Urban Area had a 2010 population of about 1.9 million.

**TABLE 17** features the statewide targets for the Non-Single Occupancy (Non-SOV) Mode Share performance measure. Non-SOV mode share refers to the

**TABLE 15 Statewide PM 3 Freight Performance Targets**

PM 3 Freight Performance Measure	2017 Baseline	2-Year Target		4-Year Target	
		Target	Change from Baseline	Target	Change from Baseline
Percent of Interstate System Mileage Providing Reliable Truck Travel Time	1.69	1.68	-0.01	1.67	-0.02

Source: SCAG

**TABLE 16 PM 3 CMAQ Program Performance Targets: Criteria Pollutant Emissions Reduction**

Total Emissions by Applicable Pollutant	2017 Baseline	2-Year Target		4-Year Target	
		Target	Change from Baseline	Target	Change from Baseline
VOC (kg/day)	951.83	961.35	+1.0%	970.87	+2.0%
CO (kg/day)	6,863.26	6,931.90	+1.0%	7,000.54	+2.0%
NOx (kg/day)	1,753.36	1,770.89	+1.0%	1,788.43	+2.0%
PM <sub>10</sub> (kg/day)	2,431.21	2,455.52	+1.0%	2,479.83	+2.0%
PM <sub>2.5</sub> (kg/day)	904.25	913.29	+1.0%	922.34	+2.0%

Source: SCAG

**TABLE 17 PM 3 CMAQ Program Performance Targets: Non-SOV Mode Share**

Non-SOV Mode Share (by Urban Area)	2017 Baseline	2-Year Target		4-Year Target	
		Target	Change from Baseline	Target	Change from Baseline
Los Angeles/Long Beach/Anaheim	25.6%	26.1%	+0.5%	26.6%	+1.0%
Riverside/San Bernardino	22.7%	23.2%	+0.5%	23.7%	+1.0%

Source: SCAG

## TRANSIT ASSET MANAGEMENT (TAM) TARGETS

The Federal Transit Administration (FTA) issued the TAM Final Rule (49 CFR §625 et seq.), effective October 1, 2016, to implement the asset management provisions of MAP-21. This Final Rule mandates the development of a National TAM System, defines ‘State of Good Repair’ (SGR), and requires transit providers to develop TAM plans. The Metropolitan Transportation Planning Final Rule (23 CFR §450.206), outlines the timelines and processes by which states, MPOs, and transit providers must coordinate in target setting. The TAM targets presented in Connect SoCal were produced collaboratively with regional transit agencies and the County Transportation Commissions (CTCs), based on their agency TAM plans and local targets. In developing the targets, SCAG reviewed and considered the transit operators’ TAM plans (including identified goals, objectives, measures and targets), thereby incorporating them into the metropolitan planning process.

The Connect SoCal TAM targets are provided in **TABLE 18**. The targets reflect a desire to maintain current (2019) conditions through the Connect SoCal horizon period through 2045. This is an aspirational target, as it is unlikely the region would meet all of these targets unless substantial additional funding is identified or cuts are made in other areas such as operations. Connect SoCal is the first RTP for which TAM targets were developed, and SCAG will continue to work with the region’s transit operators and CTCs to seek ways to improve

the methodology, data collection and analysis for future RTP updates, and to continue engaging in a regional discussion about transit state of good repair and the need for additional funding.

Further discussion regarding the TAM Final Rule and targets is included in the Connect SoCal Transit Technical Report.

## TRANSIT SAFETY TARGETS

On July 19, 2018, the FTA published the Public Transportation Agency Safety Plan Final Rule (49 CFR §673.15) regulating how Chapter 53 grantees would have to implement federally mandated safety standards. The effective date of the rule is July 19, 2019 and the compliance date is July 20, 2020. The Final Rule specifically requires transit agencies employing federal funds to develop a safety plan and annually self-certify compliance with that plan. The National Public Transportation Safety Plan identifies four performance measures that must be included in the transit agency safety plans: fatalities, injuries, safety events, and system reliability. Each transit agency must make its safety performance targets available to MPOs to assist in the planning process, and coordinate to the maximum extent practicable with the MPO in the selection of regional safety targets. The Final Rule will not take effect until after Connect SoCal is formally adopted. The 2024 RTP/SCS will be the first plan update to comply with this mandate.

**TABLE 18 Transit Asset Management (TAM) Targets**

County (Agency)	Rolling Stock	Equipment	Facilities	Infrastructure
	Share of revenue vehicles that meet or exceed ULB*	Share of non-revenue vehicles that meet or exceed ULB*	Share of facilities rated below 3 on TERM scale**	Share of track segments with performance restrictions
Imperial	0.0 percent	N/A	N/A	N/A
Los Angeles	16.0 percent	27.7 percent	6.4 percent	1.5 percent
Orange	11.7 percent	18.6 percent	0.0 percent	N/A
Riverside	3.8 percent	17.9 percent	22.1 percent	N/A
San Bernardino	22.2 percent	27.7 percent	26.3 percent	N/A
Ventura	6.3 percent	25.0 percent	0.0 percent	N/A
Metrolink	10.0 percent	22.7 percent	33.3 percent	15.0 percent
SCAG Region	14.8 percent	26.1 percent	10.3 percent	11.5 percent

\* ULB = Useful Life Benchmark

\*\* TERM = Transit Economic Requirements Model (FTA)

Source: SCAG

# CONCLUSION

As demonstrated throughout this Technical Report, the performance of Connect SoCal yields substantial beneficial results for the SCAG region over a wide range of measurable categories, all of which contribute meaningfully toward achieving our regional goals of sustainability, transportation equity, improved public health and safety, and enhancement of the overall quality of life in Southern California.

**TABLE 19** provides an overview of some of the significant regional co-benefits that would be generated through full implementation of Connect SoCal. As indicated in the table, the transportation system investments and land use strategies presented in the Plan produce very clear and positive results in regard to making progress toward achieving our regional sustainability and livability goals.

**TABLE 20** provides a summary of the results of the Connect SoCal performance measures. As indicated throughout this report, progress is demonstrated through implementation of the Plan for nearly every outcome. An important function for developing these performance measures is to monitor how well our region responds over time to the transportation system improvements and regional growth strategies promoted through the Plan. Our objective through the monitoring of these performance measures will be to identify areas where we are experiencing success toward achieving our regional goals and those areas where additional efforts or new strategies may be needed.

**TABLE 19 Connect SoCal Co-Benefits**

Benefit Category	Comparative Benefit Performance			
	2045 Baseline	Connect SoCal	Savings	% Savings
Local Infrastructure and Services Costs: Capital, operations, and maintenance costs to support new housing growth: 2016-2045	\$40.3 billion	\$36.4 billion	\$3.9 billion	9.7%
Household Costs: Annual transportation and home energy/water use: 2045	\$13,953	\$13,272	\$681	4.9%
Land Consumption: New (greenfield) land consumed to accommodate new growth: 2016-2045	100 square miles	71 square miles	29 square miles	29.2%
Building Energy Use: Residential and commercial buildings: Cumulative 2016-2045 (British Thermal Units)	15,546 trillion	15,396 trillion	149 trillion	1.0%
Building Energy Costs: Residential and commercial buildings: Cumulative 2016-2045	\$671.4 billion	\$666.4 billion	\$5.0 billion	0.8%
Building Water Use: Residential and commercial buildings: Cumulative 2016-2045 (Acre Feet)	89.7 million	88.1 million	1.6 million	1.8%
Building Water Costs: Residential and commercial buildings: Cumulative 2016-2045	\$122.5 billion	\$120.4 billion	\$2.2 billion	1.8%
Total Annual Vehicle Miles Traveled (VMT): 2045	483.5 million	459.1 million	24.4 million	5.0%

Source: SCAG Scenario Planning Model

**TABLE 20 Connect SoCal Performance Measures Results**

Outcome Group	Performance Measure	Category	2045 Performance Results		
			Baseline	Connect SoCal	Trend
Location Efficiency	Share of Households and Employment Growth in High Quality Transit Areas (HQTA)	HQTA household share	45.2%	51.2%	+6.0%
		HQTA employment share	44.8%	59.7%	+14.9%
	Land Consumption	Greenfield lands converted to urban use	100 square miles	71 square miles	-29.2%
	Vehicle Miles Traveled (VMT) per capita	Automobiles & light-duty trucks	21.8 miles	20.7 miles	-5.0%
	Average distance traveled	Work Trips	17.9 miles	17.7 miles	-1.1%
		Non-Work Trips	5.8 miles	5.7 miles	-1.7%
	Percent of trips less than 3 miles	Work Trips	14.0%	14.3%	+0.3%
		Non-Work Trips	40.5%	41.4%	+0.9%
	Work trip length distribution	Trip Length: 10 miles or less	42.3%	42.4%	+0.1%
		Trip Length: 25 miles or less	76.6%	76.6%	0.0%
Mobility and Accessibility	Person delay per capita	Automobiles & light-duty trucks	11.3 mins	8.4 mins	-25.7%
	Person delay by facility type	Highway	1,648,575 hrs	1,224,572 hrs	-25.7%
		HOV	127,650 hrs	31,740 hrs	-75.1%
		Arterial	2,006,711 hrs	1,523,701 hrs	-24.1%
	Truck delay by facility type	Highway	186,276 hrs	144,744 hrs	-22.3%
		Arterial	32,027 hrs	23,492 hrs	-26.6%
	Percentage of trips less than 45 minutes by mode (PM peak period)	Transit	46.7%	47.2%	+0.5%
		High Occupancy Vehicle (HOV)	78.3%	83.9%	+5.6%
		Single Occupancy Vehicle (SOV)	80.1%	85.4%	+5.3%
	Transit mode share	All Trips	3.6%	4.9%	+1.3%
Work Trips		4.0%	6.1%	+2.1%	
Mean commute time (all modes)	Average commute time (minutes)	32.1	30.2	-5.9%	

**TABLE 20 Connect SoCal Performance Measures Results – Continued**

Outcome Group	Performance Measure	Category	2045 Performance Results		
			Baseline	Connect SoCal	Trend
Safety and Public Health	Collision rates per 100 million vehicle miles (by severity)	Serious injuries	N/A	1.97	N/A
		Fatalities	N/A	0.12	N/A
	Air pollution-related health measures (annual)	Pollution-related health incidences	192,400	182,200	-5.4%
		Pollution-related health costs	\$3.34 billion	\$3.16 billion	-5.4%
	Physical activity-related health measures	Daily per capita walking	5.8 mins	6.7 mins	+16.5%
		Daily per capita biking	0.5 mins	0.7 mins	+32.0%
		Daily per capita driving	48.4 mins	43.2 mins	-10.6%
		Obesity rate	30.3%	30.1%	-0.7%
		Hypertension rate	26.4%	26.3%	-0.4%
		Heart disease rate	4.37%	4.36%	-0.2%
		Diabetes (Type 2) rate	8.1%	7.9%	-2.9%
	Active transportation mode share (by trip type)	Walk share (work trips)	2.7%	3.0%	+0.3%
		Bike share (work trips)	1.0%	1.2%	+0.2%
		Walk share (all trips)	7.8%	8.7%	+0.9%
		Bike share (all trips)	1.7%	2.1%	+0.4%

**TABLE 20 Connect SoCal Performance Measures Results – Continued**

Outcome Group	Performance Measure	Category	2045 Performance Results		
			Baseline	Connect SoCal	Trend
Environmental Quality	Greenhouse gas (GHG) emissions reduction from 2005 levels (per capita by target year)	2020	N/A	8%	N/A
		2035	N/A	19%	N/A
	Criteria pollutant emissions (tons per day)	Reactive organic gases (ROG)	46.5 tons	44.1 tons	-5.2%
		Carbon monoxide (CO)	325.8 tons	307.3 tons	-5.7%
		Oxides of nitrogen (NOx)	82.9 tons	79.5 tons	-4.2%
		Particulate matter (PM10)	31.7 tons	30.4 tons	-4.1%
		Particulate matter (PM2.5)	12.9 tons	12.4 tons	-4.1%
	Non-single occupancy vehicle (SOV) mode share	All Trips	62.8%	64.9%	+2.1%
		Work Trips	30.9%	33.3%	+2.4%
	Economic Opportunity	Annual number of new jobs generated	Result of improved regional economic competitiveness	N/A	264,500
Result of Connect SoCal transportation investments			N/A	168,400	N/A
Investment Effectiveness	Benefit/Cost Ratio	Benefit ratio received per \$1 investment	N/A	\$2.06	N/A

**TABLE 20** Connect SoCal Performance Measures Results – Continued

Outcome Group	Performance Measure	Category	2045 Performance Results		
			Baseline	Connect SoCal	Trend
Transportation System Sustainability	Cost to preserve multimodal system to current state of good repair	Annual per capita cost	N/A	\$562	N/A
Environmental Justice	See Table 3: Environmental Justice Performance Measures				

Source: SCAG

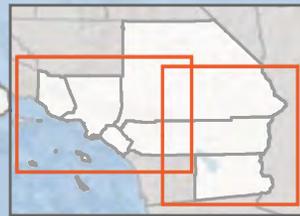
**EXHIBIT 2 Freeway PM Peak Speed Map: Base Year 2016**



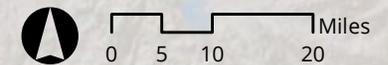
**Speed in Miles Per Hour**

-  Less than 35
-  36 to 50
-  Greater than 50

**EXHIBIT 3 Freeway PM Peak Speed Map: Baseline 2045**



Pacific Ocean



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**Speed in Miles Per Hour**

-  Less than 35
-  36 to 50
-  Greater than 50

Source: SCAG, 2019

**EXHIBIT 4 Freeway PM Peak Speed Map: Plan 2045**



Speed in Miles Per Hour

↘ Less than 35  
 ↘ 36 to 50  
 ↘ Greater than 50

Source: SCAG, 2019



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## TECHNICAL REPORT

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PERFORMANCE MEASURES

PROPOSED FINAL

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