

SOUTHERN CALIFORNIA ASSOCIATION OF GOVERNMENTS

2008

REGIONAL TRANSPORTATION PLAN

Making the Connections

**Performance
Measures Report**



PERFORMANCE MEASURES

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This technical memorandum is an update to the efforts undertaken in 2003 and 2004 by SCAG, its staff and consultants, and the Regional Transportation Plan (RTP) Technical Advisory Committee (TAC) in 2003 and 2004 to identify and develop RTP Goals and associated performance measures.

Back in 2002, the study team under the direction of the RTP Update TAC revised the goals and performance measures used to guide the update of the 2004 RTP. The SCAG Transportation and Communications Committee (TCC) approved the goals and objectives, and these were subsequently adopted by the Regional Council (RC) in December 2002. The performance measures to be used to assess whether the goals and objectives were being met were adopted by the RC in March 2003.

These same goals will be used for the 2008 RTP and are listed in Table 1. The only changes compared to the 2004 RTP relates to the new security goal. Table 2 shows how the goals and performance measures are related. Note that the security goal does not have a specific transportation performance measure related to it.

Table 3 defines each of the performance measures, presents benchmarks for performance, and identifies how each is to be calculated. These measures were designed to meet the following criteria as closely as possible:

- modally blind
- measurable - for both monitoring and forecasting to the extent possible
- consistent with subregional and state-wide indicators where possible
- linked to revised RTP goals

TABLE 1 RTP GOALS

RTP Goals
Maximize mobility and accessibility for all people and goods in the region
Ensure travel safety and reliability for all people and goods in the region
Preserve and ensure a sustainable regional transportation system
Maximize the productivity of our transportation system
Protect the environment, improve air quality and promote energy efficiency
Encourage land use and growth patterns that complement our transportation investments
Maximize the security of the regional transportation system through improved system monitoring, rapid recovery planning, and coordination with other security agencies

TABLE 2 RTP GOALS AND RELATED PERFORMANCE MEASURES

RTP Goals	Mobility	Accessibility	Reliability	Productivity	Safety	Sustainability	Preservation	Cost-Effectiveness	Environmental	Environmental Justice
Maximize mobility and accessibility for all people and goods in the region	✓	✓						✓		✓
Ensure travel safety and reliability for all people and goods in the region	✓		✓	✓						
Preserve and ensure a sustainable regional transportation system						✓	✓		✓	✓
Maximize the productivity of our transportation system	✓			✓						
Protect the environment, improve air quality and promote energy efficiency						✓			✓	✓
Encourage land use and growth patterns that complement our transportation investments and improves the cost-effectiveness of expenditures	✓	✓							✓	
Maximize the security of our transportation system through improved system monitoring, rapid recovery planning, and coordination with other security agencies*										

* SCAG does not yet have an agreed-upon security performance measure. Therefore, it is not included in this table.

Description of Performance Measures

This section provides detailed information on each of the performance measures approved by the Regional Council for inclusion in the 2008 RTP. There is one section for each measure:

- Mobility
- Accessibility
- Reliability
- Productivity
- Safety
- Sustainability
- Preservation
- Cost Effectiveness
- Environmental
- Environmental Justice

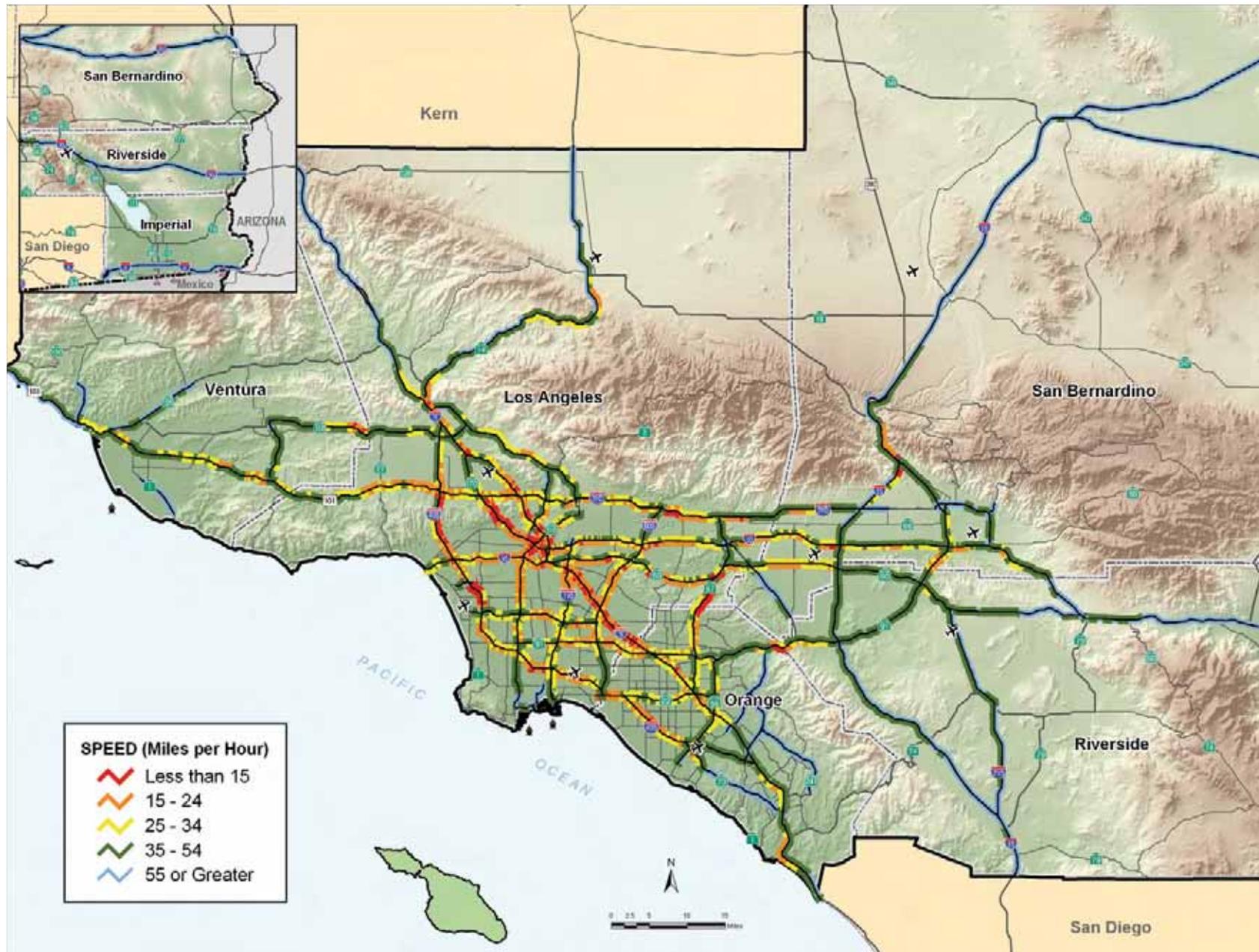
MOBILITY

The mobility performance measure relies on two commonly used measures, speed and delay. Speed is the average speed experienced by travelers regardless of mode in miles per hour (mph). Delay is the difference between the actual travel time and the travel time at some pre-defined reference or “optimal” speed for each mode alternative under analysis. It is measured in vehicle-hours of delay (VHD), which can then be used to derive person hours of delay.

TABLE 3 PERFORMANCE MEASURES

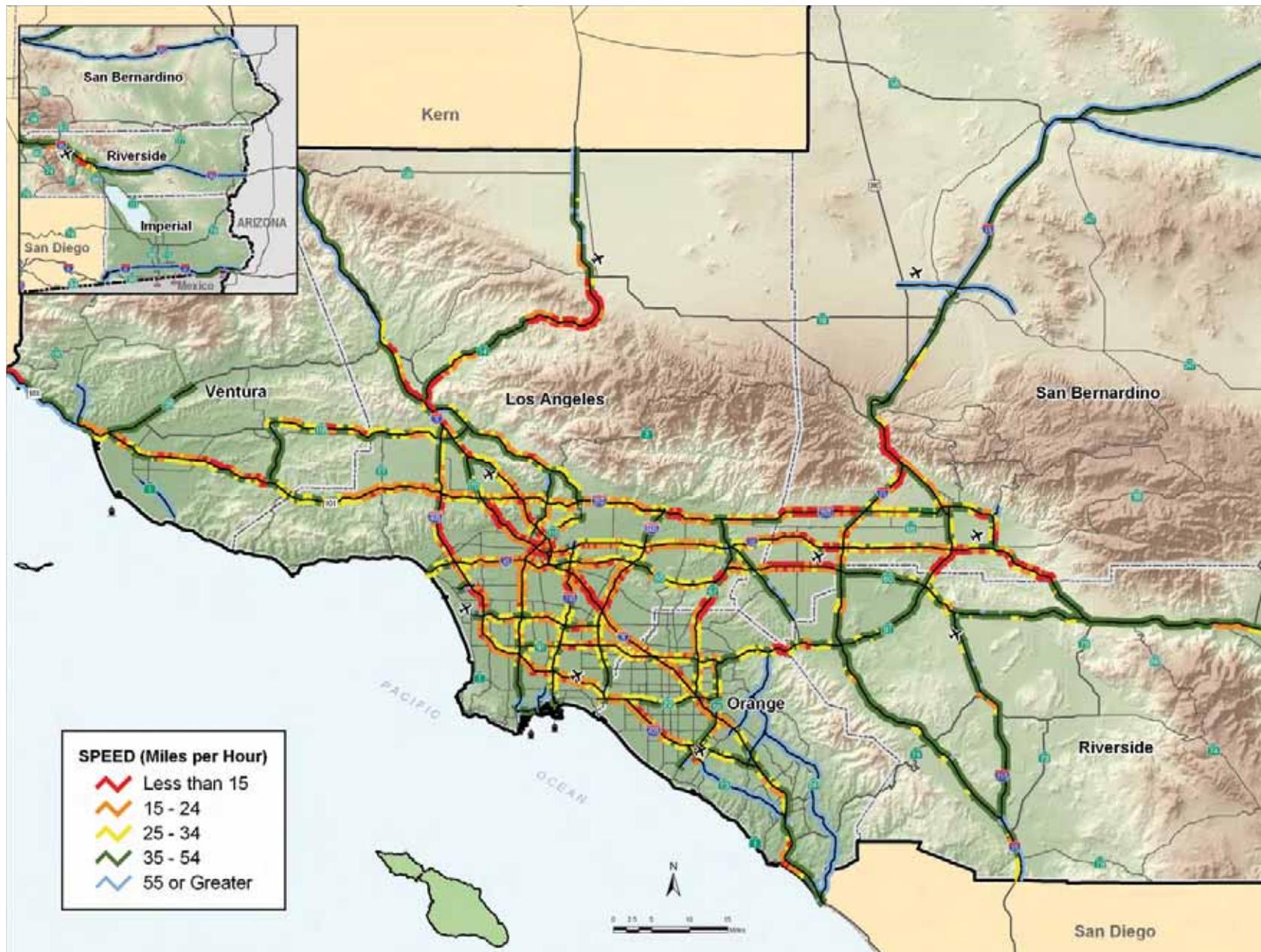
Performance Measure	Measure(s)	Definition	Performance Target	Calculation Data Sources
Mobility	Speed Delay	Speed – experienced by travelers regardless of mode Delay – excess travel time resulting from the difference between a reference speed and actual speed Delay per capita can be used as a supplemental measure to account for population growth impacts on delay.	Improvement over Base Year	Travel demand model outputs AM peak, PM peak, Off-peak, Daily Link speeds, travel times, trips
Accessibility	Percent PM peak period work trips within 45 minutes of home Distribution of work trip travel times		Improvement over Base Year	Travel demand model outputs • PM peak • OD travel times • OD person trips
Reliability	Percent variation in travel time	Day-to-day change in travel times experienced by travelers. Variability results from accidents, weather, road closures, system problems and other non-recurrent conditions.	Improvement over Base Year	Highways – PeMS Transit – National Transit Database or triennial audit reports
Productivity	Percent capacity utilized during peak conditions	Transportation infrastructure capacity and services provided. Roadway Capacity – vehicles per hour per lane by type of facility Transit Capacity – seating capacity by mode	Improvement over Base Year	Highways – PeMS Transit – National Transit Database or triennial audit reports
Safety	Accident rates	Measured in accidents per million vehicle miles by mode for: • Fatalities • Injuries • Property	“0” for all accident types and modes	Highways – freeway accident rates from Caltrans Transit – National Transit Database or triennial audit reports
Sustainability	Total cost per capita to sustain system performance at Base Year levels	Focus is on overall performance, including infrastructure condition. Preservation measure is a subset of sustainability.	Improvement over Base Year	Sub-regional submittals Regional population forecast
Preservation	Maintenance cost per capita to preserve system at Base Year conditions	Focus is on infrastructure condition. Subset of sustainability.	Improvement over Base Year	Sub-regional submittals Regional population forecast
Cost-Effectiveness	Benefit to Cost (B/C) Ratio	Ratio of benefits of travel alternatives to the costs of travel including infrastructure, maintenance, travel time, environmental, accident, and vehicle operating costs. This can be used to evaluate impacts of mode split changes resulting from RTP investments.	Improvement over Base Year	Travel demand model outputs Revenue forecasts RTP project expenditures Other cost estimates
Environmental	Emissions generated by travel	Measured/forecast emissions include CO, NOX, PM2.5, PM10, SOX, and VOC. CO2 as secondary measure to reflect greenhouse gas emissions.	Meet SIP Emission Budgets & Transportation Conformity requirements	Travel demand model outputs EMFAC2007
Environmental Justice	Distribution of benefits and costs Accessibility Environmental Emissions Noise	Share of net benefits and costs by mode, household income, race/ethnicity: • RTP expenditures • Taxes paid (e.g., income, sales & use, gas) • Access to jobs (See “Accessibility”) • Travel time savings by mode • Environmental impacts from PEIR	Equitable distribution of benefits and costs	Travel demand model outputs Revenue forecasts RTP project expenditures PEIR

EXHIBIT 1 BASE YEAR 2003 FREEWAY SPEED | PM PEAK



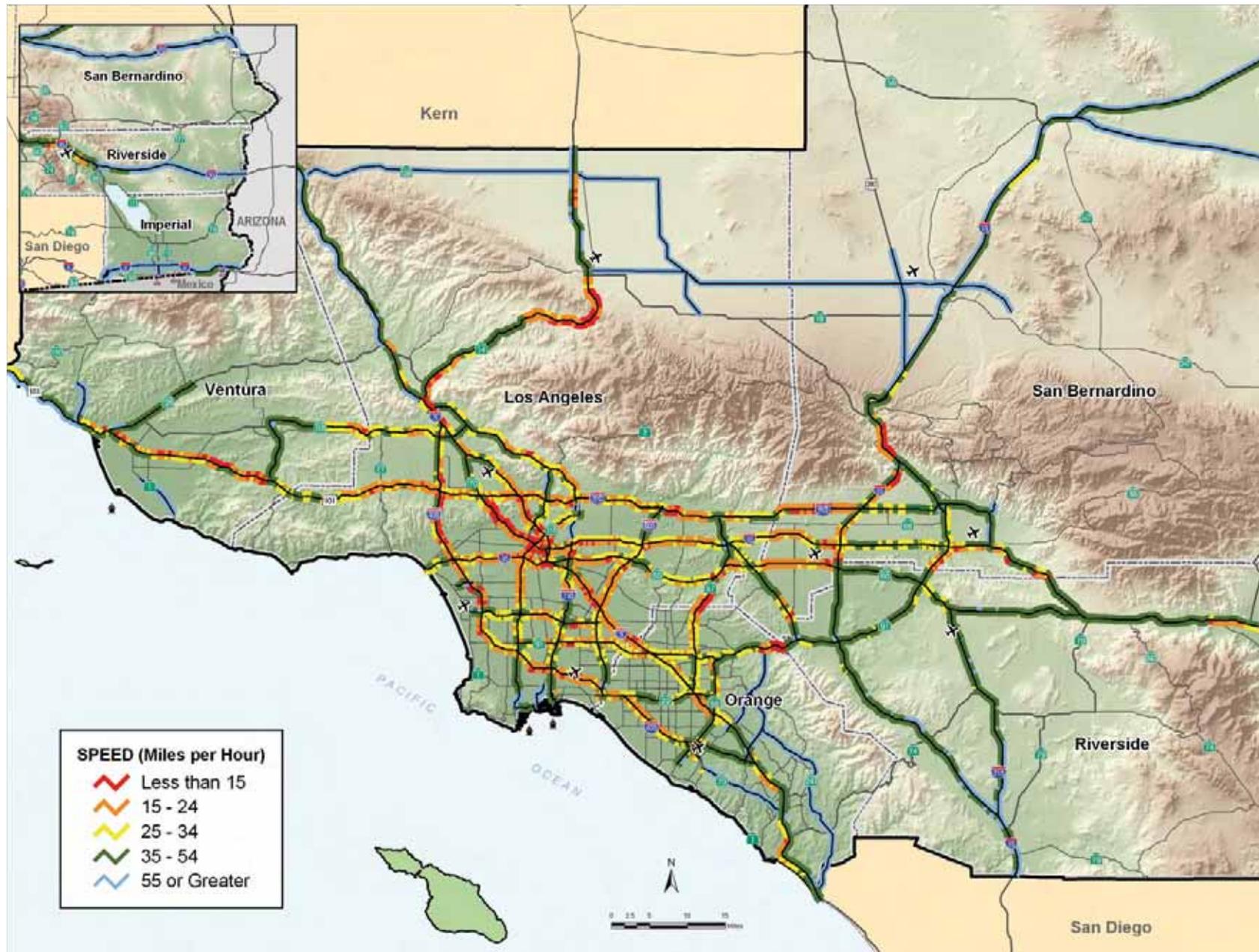
Source: Southern California Association of Governments, ESRI StreetMap USA, Teleatlas

EXHIBIT 2 BASELINE 2035 FREEWAY SPEED | PM PEAK



Source: Southern California Association of Governments, ESRI StreetMap USA, Teleatlas

EXHIBIT 3 PLAN 2035 FREEWAY SPEED | PM PEAK

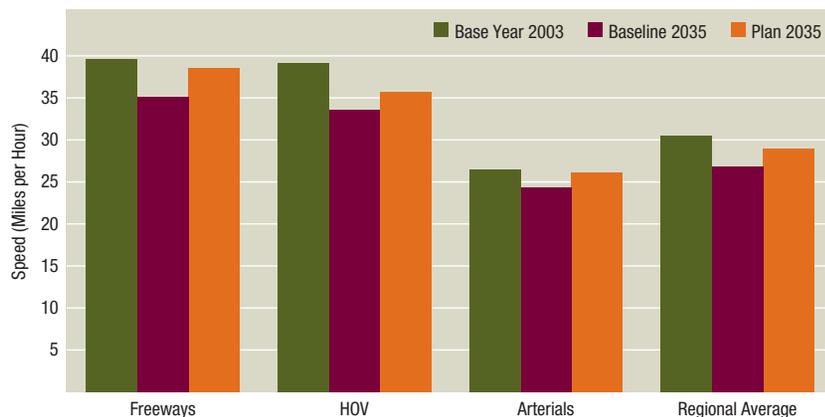


Source: Southern California Association of Governments, ESRI StreetMap USA, Teleatlas

It is important to note that the reference speed for a mode does not need to be “perfect,” but should be defensible and consistent over time. It is important that the reference speed be set high enough to account for improvements in operational speeds over time. As an example, express bus service may never reach roadway posted speeds over the length of a route because of traffic, stops, wait times at traffic signals, among other reasons. However, if an operational improvement occurs, signal pre-emption for example, then the delay performance measure will show an improvement. If for some reason the improvement causes actual speeds to equal or exceed the reference speed, then the delay will be zero.

Speed and delay can be monitored and forecasted for all modes. These measures can also be measured at any geographic scale: street or route, corridor, subregion, county, and regionally. Speed is a common output of travel demand models and can be easily measured. Speed is calculated by dividing Vehicle-Miles Traveled (VMT) by Vehicle-Hours Traveled (VHT). Figure 1 shows average daily speeds by facility type. Exhibits 1 and 2 are maps showing this information for the 2003 Base Year and 2035 Plan, respectively.

FIGURE 1 AVERAGE DAILY SPEEDS BY FACILITY TYPE



Vehicle-Hours of Delay is calculated by the following formula:

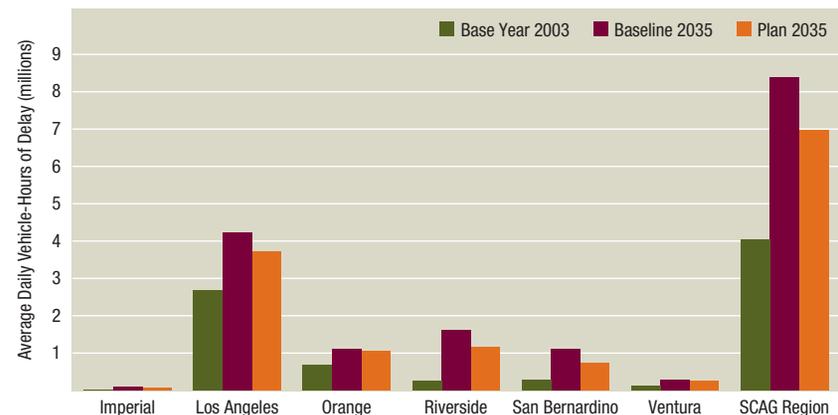
$$([\text{Actual Travel Time}] - [\text{Travel Time at Reference Speed}]) \times \text{Volume}$$

or

$$\left(\frac{[\text{Distance}]}{[\text{Actual Speed}]} - \frac{[\text{Distance}]}{[\text{Reference Speed}]} \right) \times \text{Volume}$$

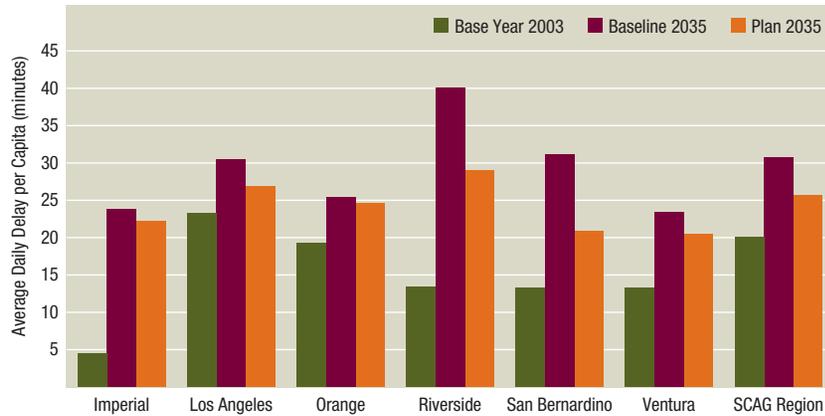
Figure 2 is a chart showing how highway vehicle-hours of delay can be presented by county and the SCAG region as a whole. Average vehicle occupancies (AVOs) are another variable that is used by the SCAG regional travel demand model. Applying this variable to average vehicle-hours of delay can be used to derive average “person” hours of delay by county and region.

FIGURE 2 AVERAGE DAILY DELAY BY COUNTY (VEHICLE HOURS)



Delay can also be normalized by population to account for changes in regional growth, or to see how different geographic areas compare under different transportation alternatives. Delay per capita is therefore a more accurate representation of delay trends. Total delay can be increasing, but if delay per capita stays constant, then the individual traveler experiences the same performance. Figure 3 presents an example of person-hours of delay per capita results for different model scenarios.

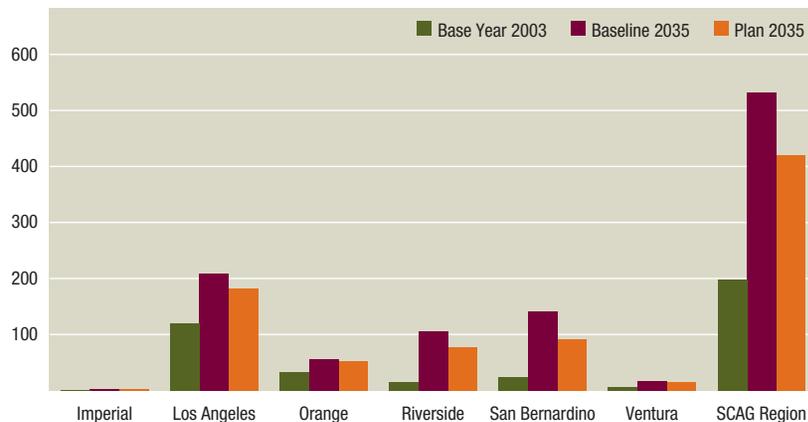
FIGURE 3 AVERAGE DAILY DELAY PER CAPITA (MINUTES)



For transit modes, the difference between scheduled travel times and reference travel times is delay and accounts for stops, wait times at traffic signals, operational problems, wait times at railroad grade crossings, and other “delays” to meeting the optimal schedule.

Finally, the model also produces heavy truck vehicle hours of delay as shown in Figure 4.

FIGURE 4 AVERAGE DAILY HEAVY DUTY TRUCK DELAY BY COUNTY



ACCESSIBILITY

Accessibility is used to capture how well the transportation system performs in terms of providing people access to opportunities. Opportunities can include anything from jobs, education, medical care, recreation, shopping, or other activity that helps improve a person’s life.

For the 2008 RTP Update accessibility is defined as the percentage of the population who can travel between work and home (or between home and work) within 45 minutes during the afternoon (PM) peak period. It is believed that access to employment is a reasonable proxy for access to all opportunities, and home-to-work travel is a trip type that is readily forecast in travel demand models.

Accessibility is measured by taking PM peak period travel demand model results for the base and forecast years. The outputs used are travel time between origin and destination (OD) pairs and the model “trip tables” (i.e., number of trips between OD pairs), both being routine outputs of a travel demand model. Results are tabulated for both transit and automobile travel, again with both modes represented in the model.

Figure 5 shows an example of automobile accessibility for each of the RTP time periods. Figure 6 shows the distribution of trips for transit. Figure 7 summarizes the results by comparing the base year to the plan and baseline for both automobile and transit.

FIGURE 5 HOME-BASED WORK AUTO PERSON TRIP PM PEAK PERIOD DISTRIBUTION

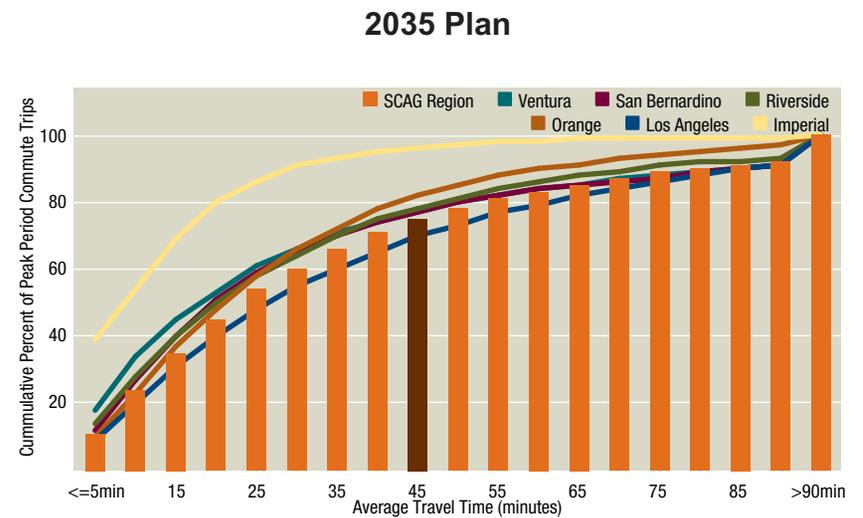
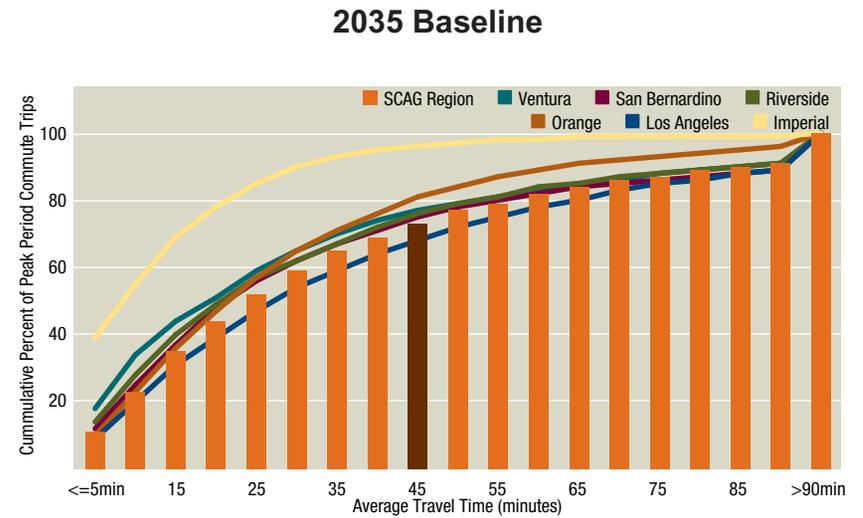
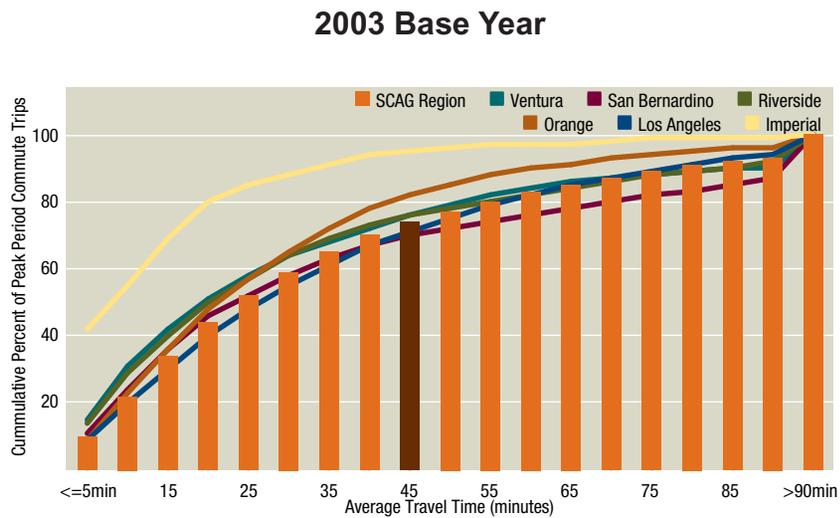


FIGURE 6 TRANSIT TRIP PEAK PERIOD TRIP DISTRIBUTION

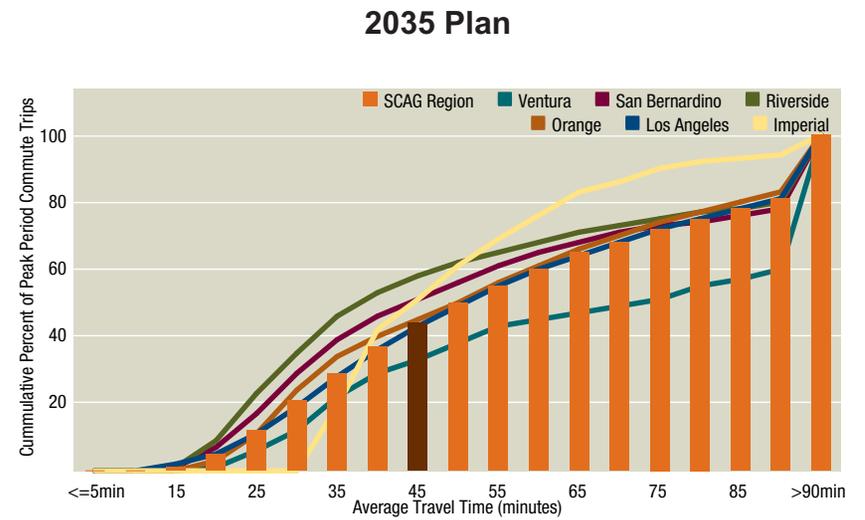
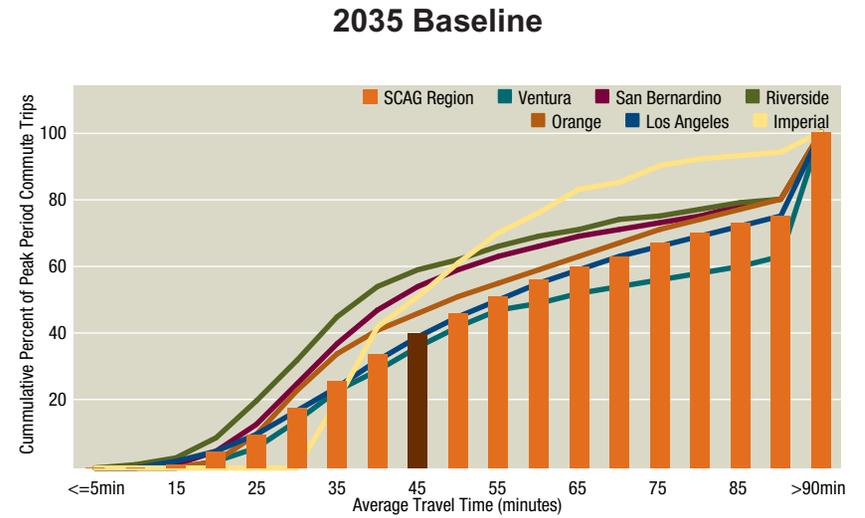
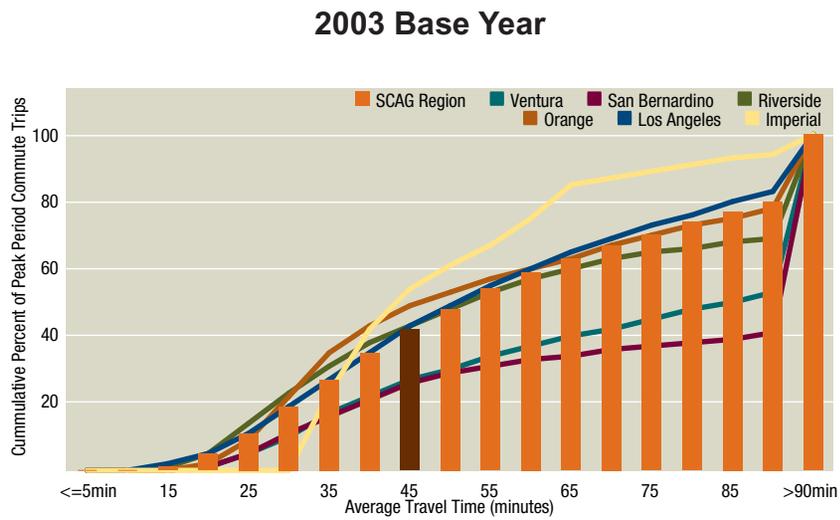
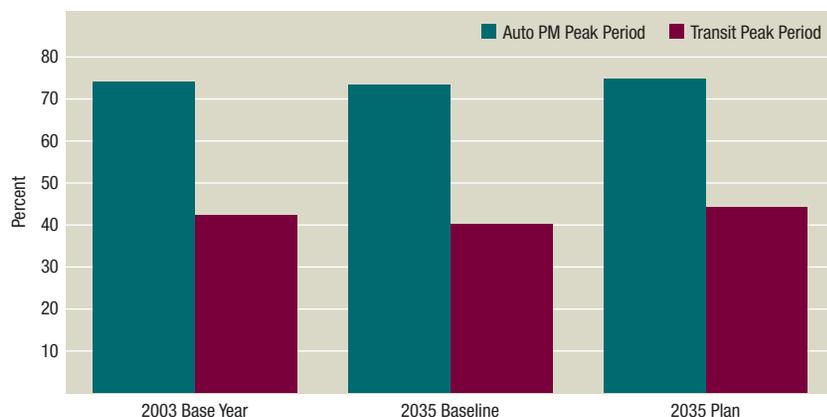


FIGURE 7 AUTO AND TRANSIT ACCESSIBILITY



RELIABILITY

Reliability captures the relative predictability of the public’s travel time. Unlike mobility, which measures how fast the transportation system is moving people and accessibility which addresses how long the system must work to move people, reliability focuses on how much mobility and accessibility vary from day to day. This variability is illustrated in Figure 8.

In Figure 8, Highway “A” and Highway “B” both have the same average travel time meaning that they experience the same level of mobility. However, when each day’s travel time is taken into account, one sees that Highway “A” has lower variability than Highway “B”.

Reliability is the level of variability in transportation service between the expected travel time and the actual travel time between OD pairs. Reliability can be calculated by using statistical tools. The standard deviation is one such tool that provides an estimate of how much the travel time on any given day will “deviate” from the average travel time. It provides the probable range of time that a motorist will arrive within his or her scheduled time. Dividing the standard deviation by the average time spent traveling produces the percent variability for an OD pair. Reliability can only be monitored and not forecast-

ed. This is because travel demand models cannot evaluate variations in travel times, but can only estimate average travel times and delay (i.e., mobility). Therefore, reliability is a measure that is not useful for forecasting.

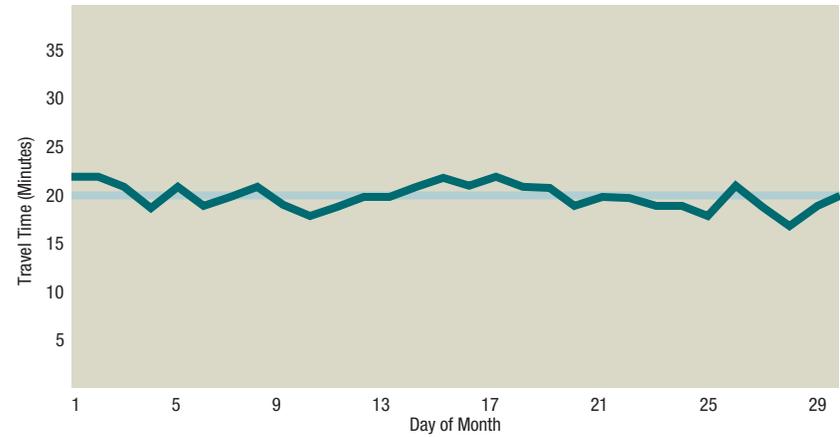
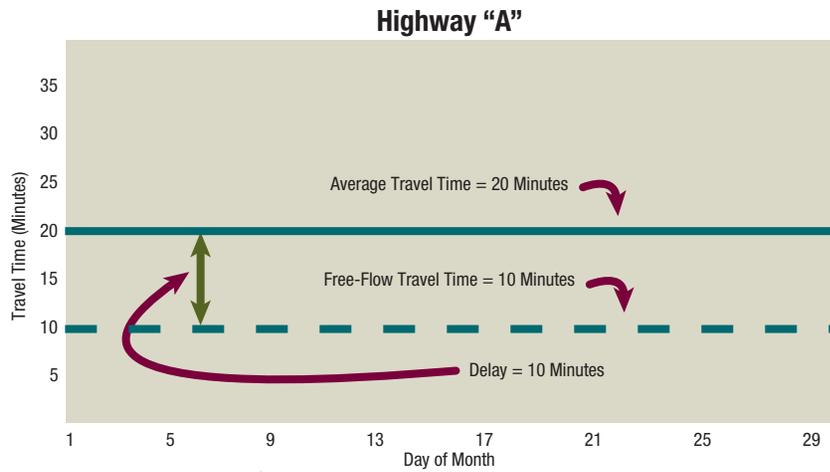
PRODUCTIVITY

Productivity is a system efficiency measure. Productivity is generally defined as the ratio of output (or service) per unit of input. In the case of transportation it is the amount of people served divided by the level of service provided. In the case of highways, the input to the system is the capacity of the roadways; in transit it is the number seats provided. Specifically, productivity is defined as the percent utilization of a facility or mode under peak conditions. The highway productivity performance measure is calculated as actual volume divided by 2,000 vehicles per hour per lane. For transit, percent utilization is calculated as peak load factor.

Peak load factor is used in the industry, and peak period boarding counts (required for FTA reporting) can be used to aggregate results. Travel demand models do not generally project load factors for transit or capacity loss for highways, but detailed micro-simulation tools can forecast productivity, but are too resource intensive to use for the entire region.

For highways, productivity is particularly important because when we need capacity the most, we often get the lowest “production” from our system. On some corridors throughput can decline as much as 50% during peak periods, and most congested urban corridors typically lose 25% of their capacity during rush hour. This loss productivity is shown in Figures 9 and 10. The first chart shows how much vehicle throughput declines (i.e., productivity is lost) during rush hour, while Figure 10 is a chart showing where and how much productivity is lost in the SCAG region.

FIGURE 8 DIFFERENCE BETWEEN RELIABILITY AND MOBILITY



Highway "A" is More Reliable

Same Mobility, but...

Highway "B" is Less Reliable

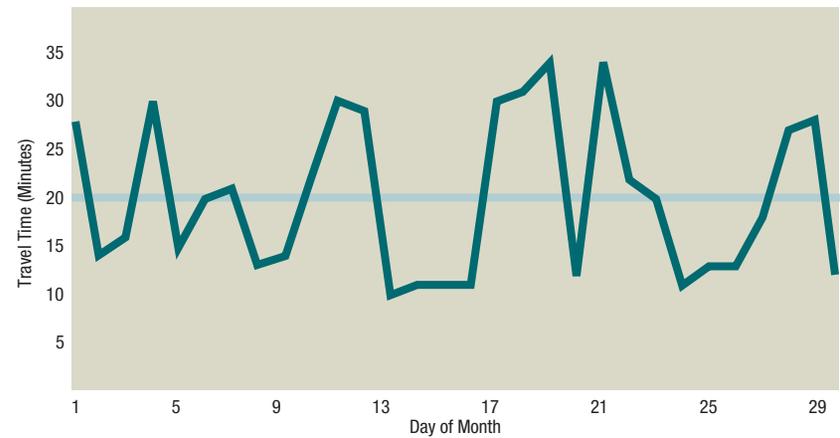
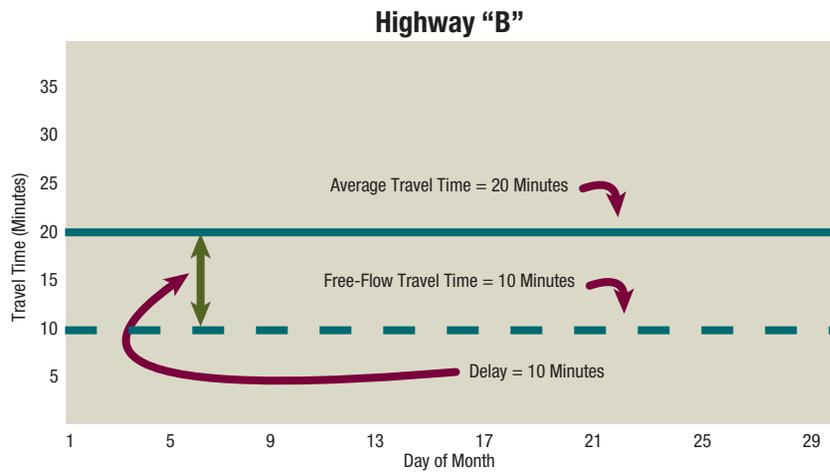


FIGURE 9 ILLUSTRATIVE HIGHWAY PRODUCTIVITY LOSS

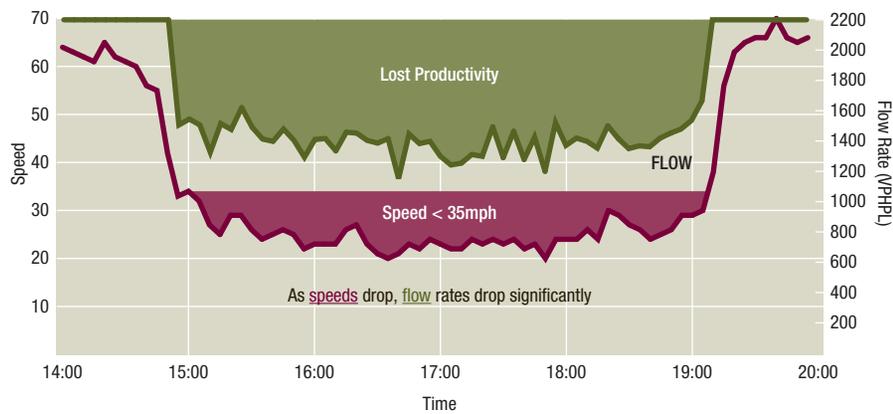
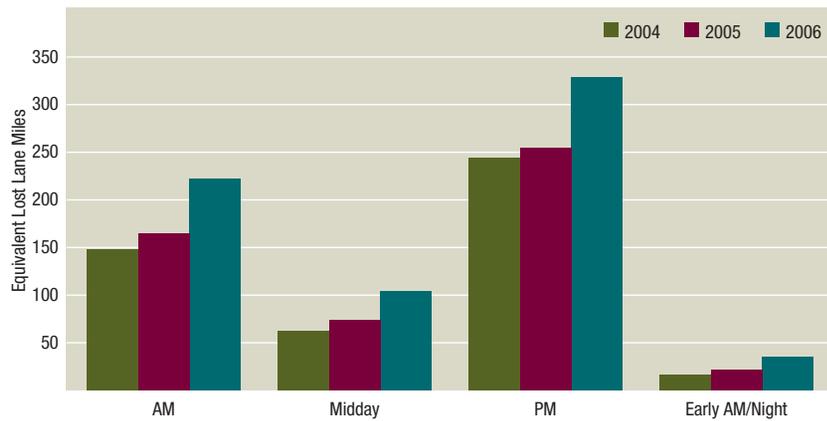


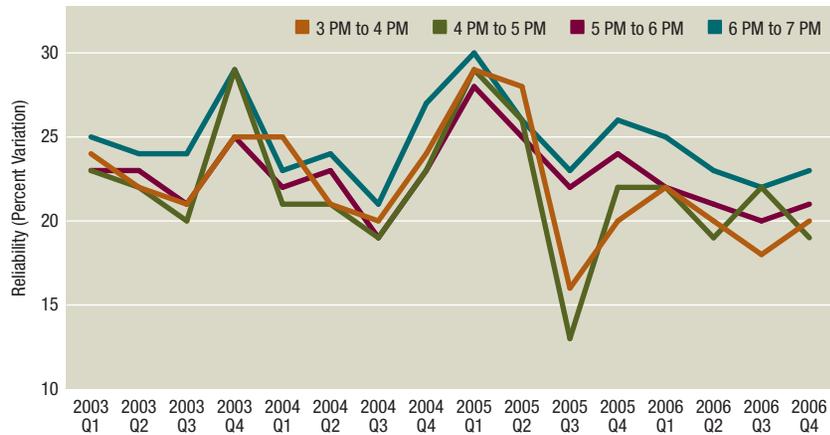
FIGURE 10 PRODUCTIVITY LOSSES BY PERIOD



Reliability analysis is done between OD pairs much like the accessibility analysis in order to capture the individual's travel experience. Figure 11 shows one way that this analysis can be applied for RTP updates. The x-axis is the quarter of the year from 2003 through 2006 for Caltrans District 7 representing Los Angeles and Ventura Counties. Each line on the chart represents a PM peak hour for the "Top Ten" travel OD pairs by volume in the region. The y-axis shows the percent variability for each hour of the peak period.

From 2003 through the end of 2004, the variability of travel time varied between 20 and 25 percent, although the third quarter of 2003 saw a spike in variability as did the first two quarters of 2005. The third quarter of 2005 saw a dramatic decline in variability of travel time to below 15 percent between 3:00 and 5:00 in the afternoon. Since that time, average PM peak period travel times reliability has been stable, varying between 17 to 25 percent depending on the season and the hour of the day. That is, if a person's afternoon commute home from work or school usually takes about 30 minutes, they can typically expect that it may take anywhere from 22 to 37 minutes depending on when they leave.

FIGURE 11 DISTRICT 7 PM PEAK PERIOD RELIABILITY ANALYSIS

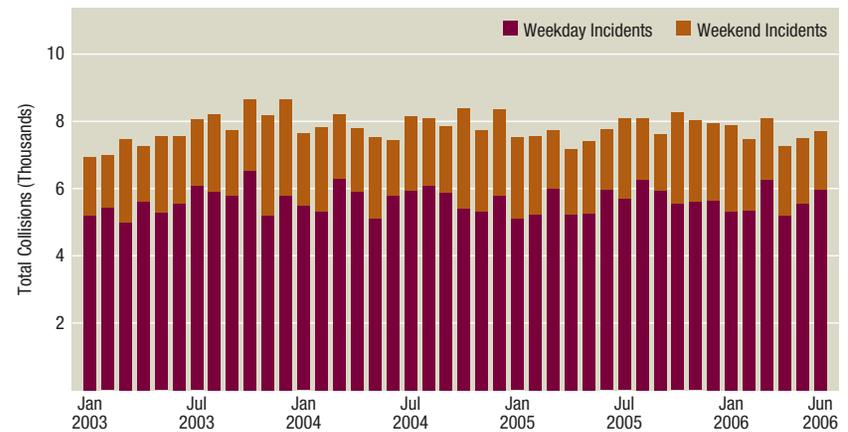


SAFETY

Safety measures how well the transportation system minimizes accidents. Safety is measured in fatalities, injuries, and property damage accidents per million vehicle miles by mode. Safety data is routinely collected by the California Highway Patrol, Caltrans, and local transit agencies.

Safety cannot be forecast, but total accidents can show a reduction in future years if people shift modes from higher accident modes to lower accident modes. Figure 12 shows the number of monthly collisions for Caltrans Districts 7, 8, and 12 (Los Angeles, Orange, Riverside, San Bernardino, and Ventura Counties) for weekdays and weekends from 2003 to 2006.

FIGURE 12 NUMBER OF MONTHLY COLLISIONS FOR SCAG REGION (EXCEPT IMPERIAL COUNTY)



SUSTAINABILITY

A transportation system is sustainable if problems with the system generated by current users are not passed on for future generations to maintain. The sustainability performance measure is defined as the total costs to maintain overall system performance at current conditions are divided by the total population. As such, preservation can be viewed as a subset of sustainability.

Inflation adjusted cost per capita to maintain the current level of performance of our multi-modal transportation system is how sustainability will be calculated. This measure and its trend over time will tell us whether our decisions are placing burdens on future generations.

If the indicators grow over time, that means that our current resource limitations and decisions are creating a situation where future generations will have to pay more to get the same performance (or live with reduced performance)

Sustainability results will not be developed until we have a plan. Then we can compute how much more we need to bring future performance in line with current performance.

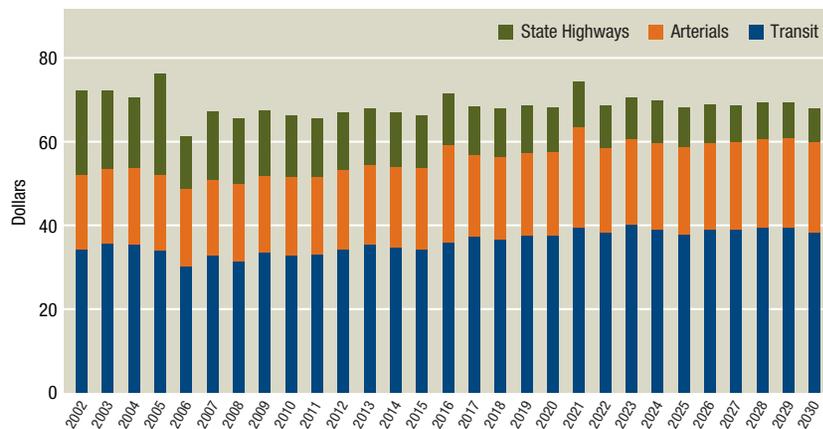
PRESERVATION

Preservation is a sub-set of sustainability. Preservation is measured as the total costs to maintain the system at current conditions per person in the region.

If the indicator grows over time, this means that our current resource limitations and decisions are creating a situation where future generations will have to pay more to get the same performance or “make do” with reduced performance.

Inflation adjusted cost per capita to maintain the current transportation system at current conditions. Over time, this measure and its trend will reflect whether we are taking care of our existing infrastructure. If the measure shows a substantial increase over time, it would mean that we are not taking care of our existing system and therefore the costs to get the system to current conditions is increasing over time. An example of system preservation is shown in Figure 13:

FIGURE 13 SYSTEM PRESERVATION COSTS PER CAPITA



One of the challenges in calculating the sustainability and preservation performance measures is that information on current conditions is somewhat limited. Cross-checking results are needed to compute the measure (e.g., local condition assessments, needs/preservation studies, SR-8 surveys). For transit,

costs and needs are derived from costs were derived based on short range transit plans and revenue trends. Technical difficulties make it impossible to estimate needs beyond the plans and trends, but if transit agencies can identify and define additional unmet needs, the results can be incorporated into the analysis. Currently it is assumed that projections meet needs.

COST-EFFECTIVENESS

Cost effectiveness attempts to measure how much “bang for the buck” is received for transportation investments. The measure for cost effectiveness is Return on Investment (ROI). ROI is estimated by using the economic tool of the Benefit-Cost Ratio.

Caltrans has developed one such model called the Cal-B/C. This tool (available online at http://www.dot.ca.gov/hq/tpp/offices/ote/benefit_cost.htm) is designed to measure, in real dollar terms, four primary categories of benefits that result from highway and transit projects:

- Travel Time Savings
- Vehicle Operating Cost Savings
- Safety Benefits (Accident Cost Savings)
- Emission Reductions

Users have the option of including or excluding the valuation of vehicle emission impacts and induced demand in the analysis. Analysis results can be summarized for the life of the project basis using several measures:

- Life-cycle costs (in \$ million)
- Life-cycle benefits (in \$ million)
- Net present value (in \$ million)
- Benefit-cost ratio (benefits/costs)
- Rate of return on investment (in % return/year)
- Project pay back period (in years).

The cost effectiveness performance measure needs to use methodologies and inputs and produce outputs that are consistent with other organizations (e.g., State, subregions). This is true for the current SCAG methodology except that the SCAG methodology does not account for vehicle operating costs (VOC), whereas other models do.

VOC can be a major factor in transportation benefit cost analysis since they reflect the costs incurred by travelers under different conditions. For instance, improvements that increase vehicle speeds also reduce gasoline consumption and therefore reduce out of pocket expenses. Improvements that lead to higher transit usage also have a reduction in VOC (and incremental fare costs that are part of the transit operating costs).

ENVIRONMENTAL IMPACTS

SCAG, as the federally mandated MPO, has to meet federal and state environmental requirements for the 2008 RTP Update to be approved. Therefore, the environmental performance measure is for the 2008 RTP Update to meet State Implementation Plan (SIP) Emission Budget & Transportation Conformity requirements. Measured emissions for these requirements include: Carbon Monoxide (CO), Nitrous Oxide (NOX), particulate matter (PM10), Sulfur Oxide (SOX), and Volatile Organic Compounds (VOC). Carbon Dioxide (CO2) can be used as a secondary measure to reflect greenhouse emissions.

The Transportation Conformity Analysis covers all federally required analyses for conformity determination of the 2008 RTP Update. All transportation and air quality conformity analyses must be in compliance with the Environmental Protection Agency (EPA) Transportation Conformity Rule (40 CFR Parts 51 and 93, published on August 15, 1997). Additionally, the conformity analyses must be consistent with all court cases.

Federal transportation and air quality regulations are outlined in TEA-21 and the Federal Clean Air Act (CAA). TEA-21 authorizes Federal funding for highway, highway safety, transit, and other surface transportation programs. The CAA establishes air quality standards for various health-hazardous pollutants.

California State requirements for air quality management are incorporated into the SIP for those pollutants stipulated in the CAA. The SIPs set forth the goals and objectives for achieving CAA air-quality standards.

The EPA may make a Federal “non-attainment area” designation to any area that has not met CAA health standards for one or more pollutant. A non-attainment area designation may require additional air quality controls for transportation plans, programs, and projects.

To comply with the CAA in achieving the National Ambient Air Quality Standards (NAAQS), the California Air Resources Board (ARB) develops SIPs for Federal non-attainment areas. In California, SIP development is a joint effort of the local air agencies and ARB working with Federal, State, and local agencies (including the MPOs). Local Air Quality Management Plans (AQMPs) are prepared in response to Federal and State requirements.

The SIP includes two important factors for transportation and air quality conformity analysis – emissions budgets and Transportation Control Measures (TCM). Emissions budgets set an upper limit which transportation activities are permitted to emit. TCMs are strategies to reduce emission from on-road mobile sources.

ARB recommends the federal non-attainment area boundaries to EPA for final designations. Subsequently, the EPA finalizes and defines the boundaries of the federally designated non-attainment areas for each criteria pollutant (as defined below). In general, each Federal non-attainment area should be in one air basin. However, in the SCAG region, one Federal non-attainment area may cover portions of several air basins. In California, the ARB or State legislature defines the air basins.

In compliance with the CAA requirements, the Transportation Conformity Rule establishes regulatory provisions for processing transportation plans, programs, and projects in non-attainment areas under Title 23 U.S.C., the Federal Transit Act, and Section 176(c) of the 1990 CAA Amendment. The Rule also regulates conformity to the SIPs.

For the 2008 RTP conformity determinations, the applicable emissions budgets and TCMs are established in the following SIPs:

- Ozone SIPs - The emissions budgets established in the 1994 Ozone (1-hour standard) SIPs for the Antelope Valley of MDAB, the portion of San Bernardino County of MDAB, the Coachella Valley of SSAB, and the Ventura County portion of SCCAB function as the applicable emissions budgets for conformity analysis. The emissions budgets established in the 1997 Ozone SIP (1-hour standard) for SCAB function as the applicable emissions budgets for conformity analysis.
- Nitrogen Dioxide (NO₂) SIP - The emissions budgets established in the 1997 NO₂ SIP (Maintenance Plan) for SCAB function as the applicable emissions budgets for conformity analysis.

ENVIRONMENTAL JUSTICE

Environmental Justice is an analysis that assesses how fairly SCAG administers federal funds. Title VI of the Civil Rights Act of 1964 requires this by stating:

“No person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving Federal financial assistance.”

In the 1990's, the federal executive branch issued orders on environmental justice that amplified Title VI, in part by providing protections on the basis of income as well as race. These included President Clinton's Executive Order 12898 (1994), a U.S. Department of Transportation order (1997), and a Federal Highway Administration order (1998). SCAG is expected to conduct environmental justice analyses, as well as public outreach, to comply with these orders and with federal planning regulations.

SCAG uses the environmental justice analyses to help its elected officials make transportation planning decisions fairly. The analyses are designed to assure that benefits and burdens are not distributed unfairly across populations in the region. However, the goal of federal environmental justice policy is not to

guarantee entitlements but rather to prevent discriminatory effects. Federal environmental justice guidance documents require the analysis of impacts on “minority” populations, and defines “minority” specifically to mean all ethnic and racial groups other than white.

The 2008 RTP will analyze the share of net benefits and costs by mode, household income, and race/ethnicity; and will include the following analyses:

- RTP expenditures
- Taxes paid (e.g., income, sales & use, gasoline)
- Travel time savings (overall, transit, auto)
- Access to jobs
- Environmental impacts from PEIR

For the last analysis above, the recommendation is to work with the South Coast Air Quality Management District (SCAQMD) to include their Urban Airshed Model (UAM) in the environmental justice analysis. UAM is a three-dimensional photochemical grid model mainly used to study the photochemical air quality pertaining to ambient ozone concentrations. High ozone concentrations lead to adverse health effects. Ozone is primarily formed in the atmosphere through a complex chemical mechanism involving oxides of nitrogen (NO) and volatile organic compounds (VOCs) in the presence of sunlight. Since UAM accounts for spatial and temporal changes, it can be used to evaluate the effects of emission control scenarios on urban air quality.¹

¹ The first regulatory use and practical applications of the UAM were done for the Denver area on behalf of the Colorado Division of Highways and EPA's Region VII in 1978. UAM was used to evaluate whether various transportation plans and programs were consistent with the SIP and to evaluate the effects on Denver's air quality of urban growth and development that might result from the construction of proposed wastewater treatment facilities. In the late 1970s, EPA's OAQPS initiated a program to examine the applicability and practicality of the UAM in routine ozone attainment demonstrations required by the SIP process. Data collection, emission inventory development, model performance evaluation and application were major elements of this nation-wide program. Building off the St. Louis UAM applications and an extensive series of UAM sensitivity studies designed to provide guidance concerning the types and amounts of data required to support the UAM application, data for an application of the UAM, supported by OAQPS, were collected in Tulsa, Philadelphia/New Jersey, Baltimore/Washington and New York.

