



SCAG REGIONAL TRAVEL MODEL ENHANCEMENT PROGRAM AND 2008 MODEL VALIDATION PEER REVIEW #4 REPORT (DRAFT)



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SCAG REGIONAL TRAVEL MODEL ENHANCEMENT PROGRAM AND 2008 MODEL VALIDATION PEER REVIEW #4 REPORT

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The contents of this report reflect the views of the author who is responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of SCAG or DOT. This report does not constitute a standard, specification, or regulation.

Chapter I: Executive Summary

This chapter will be added as the model validation is finalized.



Chapter 2: Background / Overview

Introduction

This Peer Review Report summarizes the Peer Review of the model development program and validation of the 2008 Regional Travel Demand Model for southern California. The model is being updated for use in preparing the 2012 Regional Transportation Plan (RTP). This was the fourth in a series of peer reviews conducted for the Southern California Association of Governments (SCAG) regional travel model. The meetings for the fourth Peer Review were held on June 27-28, 2011 in the Los Angeles offices of SCAG. An Introductory Teleconference among Peer Review panel members was conducted on May 26, 2011. Presentations from these meetings are included in the Appendix.

The Peer Review panel's primary objective was to review the model development program, validation tests and results, expert panel discussions, and overall model enhancement effort for validity with regard to state of the practice so that the model can be applied with sufficient reliability in the regional transportation planning process. The panel's recommendations for: 1) short-term enhancements related to the use of the model in developing the 2012 RTP and 2) longer-term model enhancements for the next RTP in 2016 are summarized at the conclusion of this report.

The model is managed and operated by SCAG with development assistance from private consulting firms and academic institutions. Expert panels have overseen the development and enhancement of specific modeling components. The Peer Review panel was assembled to review the overall model enhancements and validation.

Model Enhancements

SCAG's model improvement program has been driven by the need to inform policy discussions emerging within the region, including the evaluation of regional goods movement and pricing strategies. Another key factor behind the model update is California Senate Bill 375 (SB375) which calls for the integration of transportation, land use, and housing planning. SB375 requires SCAG to prepare a Sustainable Communities Strategy (SCS) as part of the 2012 Regional Transportation Plan that will meet a State-determined regional greenhouse gas emission reduction target, if it is feasible to do so.



SOUTHERN CALIFORNIA ASSOCIATION OF GOVERNMENTS

SCAG has evolved over the past four decades into the largest of nearly 700 councils of government in the United States. SCAG functions as the Metropolitan Planning Organization (MPO) for six counties in southern California: Los Angeles, Orange, San Bernardino, Riverside, Ventura, and Imperial. The region encompasses a population exceeding 18 million persons in an area of more than 38,000 square miles.

SCAG is the primary agency responsible for the development and maintenance of travel demand forecasting models for the SCAG region. SCAG has been developing and improving these travel demand forecasting models since 1967. SCAG applies the models to provide state of the practice quantitative analysis for the Regional Transportation Plan (RTP), the Federal Transportation Improvement Program (FTIP), and Air Quality Management Plans (AQMPs). The model is also used to evaluate other transportation proposals within the region. The model is based on Caliper Corporation's TransCAD modeling software.

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SCAG's model improvement program, shown in Figure 1, is an ongoing process. The model enhancements that the Peer Review Panel examined have been conducted over the past 3 years and are currently in the final stages of validation/refinement. These enhancements include:

1. Updates and improvements to SCAG's trip-based, multi-modal, travel demand model include (Picado I):
 - a. Reformulated household income trip market stratification;
 - b. Updated auto ownership model, sensitive to transit and non-motorized accessibility, multi-dwelling family housing, and residential and employment mixed use densities;
 - c. Updated HBW trip production cross-classification model;
 - d. Destination choice model, replacing the previous gravity models for all purposes except home-based college and school trips;
 - e. Re-designed and re-calibrated mode choice model;
 - f. Multi-tiered zone system, consisting of approximately 11,267 zones used through mode choice, and 4,109 zones used for time of day choice and assignment;
 - g. Addition of a binary toll/no toll choice model to the mode choice model;
 - h. Enhanced sensitivity to housing and employment density, mixed land use development, and accessibility to destinations by transit and non-motorized travel in trip distribution and mode choice models; and
 - i. Ability to forecast intra-regional high-speed rail ridership and its impact on the region's other transit systems.
2. Updates to the Heavy-Duty Truck Model.
3. Refinement of congestion and pricing components in the model.

Other items that were discussed at the Peer Review included:

1. Continued development and integration of the land use forecasting model;
2. Progress towards regional activity-based modeling; and
3. Development of other tools to help local jurisdictions in land use and transportation planning.

Completed tasks to date include:

- Development of a Tiered Zone System (July 2010)
- Regional Highway Network Inventory (June 2009)
- Base Year Highway Network (Sept. 2010)
- Transit LOS Data Collection (June 2010)
- Base Year Transit Network (Sept. 2010)
- Arterial Speed Study (Feb. 2010)
- Screenline Traffic Count database (March 2010)
- Sustainability Tool (June 2010)
- Activity-Based Model - Phase I (January 2010), Phase II (January 2011)
- Trip-Based Model Update / Validation (June 2011)

- Heavy Duty Truck Model Updates / Validation (June 2011)
- Congestion Pricing Study and Model Updates / Validation (June 2011)
- Land Use Model - Phase I (June 2011)
- California Household Travel Survey (June 2011)
- Peer Review (June 2011)

California Senate Bill 375 and Sustainable Communities Strategies

Senate Bill (SB) 375 became law in California effective January 1, 2009. This new law requires California’s Air Resources Board (ARB) to develop regional greenhouse gas emission reduction targets for passenger vehicles for 2020 and 2035 for each region covered by one of the State’s 18 metropolitan planning organizations (MPO), including SCAG. SB 375 was adopted as an “implementation mechanism” for California’s Assembly Bill (AB) 32, the Global Warming Solutions Act, which requires 2020 greenhouse gas emissions statewide to be no higher than 1990 levels.

Each MPO is required to develop a Sustainable Communities Strategy (SCS) that demonstrates how the region will meet the greenhouse emission reductions specified by the ARB targets through an integrated process that combines land use, housing, and transportation planning. The SCS becomes part of the Regional Transportation Plan.

SCAG’s SCS scenarios comprise seven elements:

- Land Use and Growth
- Highways and Arterials
- Transit
- Travel Demand Management
- Non-Motorized Transportation System
- Transportation System Management
- Pricing

SCAG’s website for SB 375 is located at:
www.arb.ca.gov/cc/SB_375/SB_375.htm

Proposed Technical Methodology for Estimating GHG Emissions

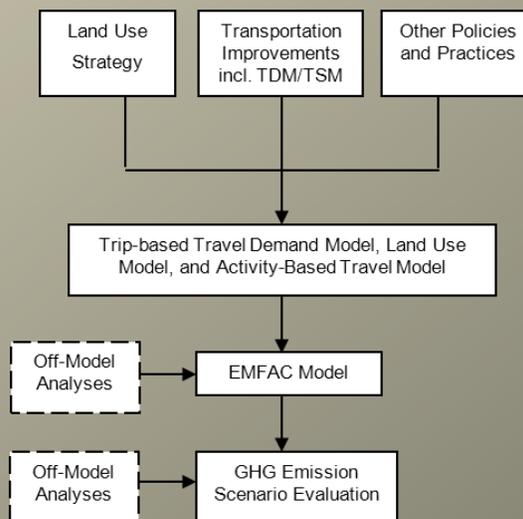
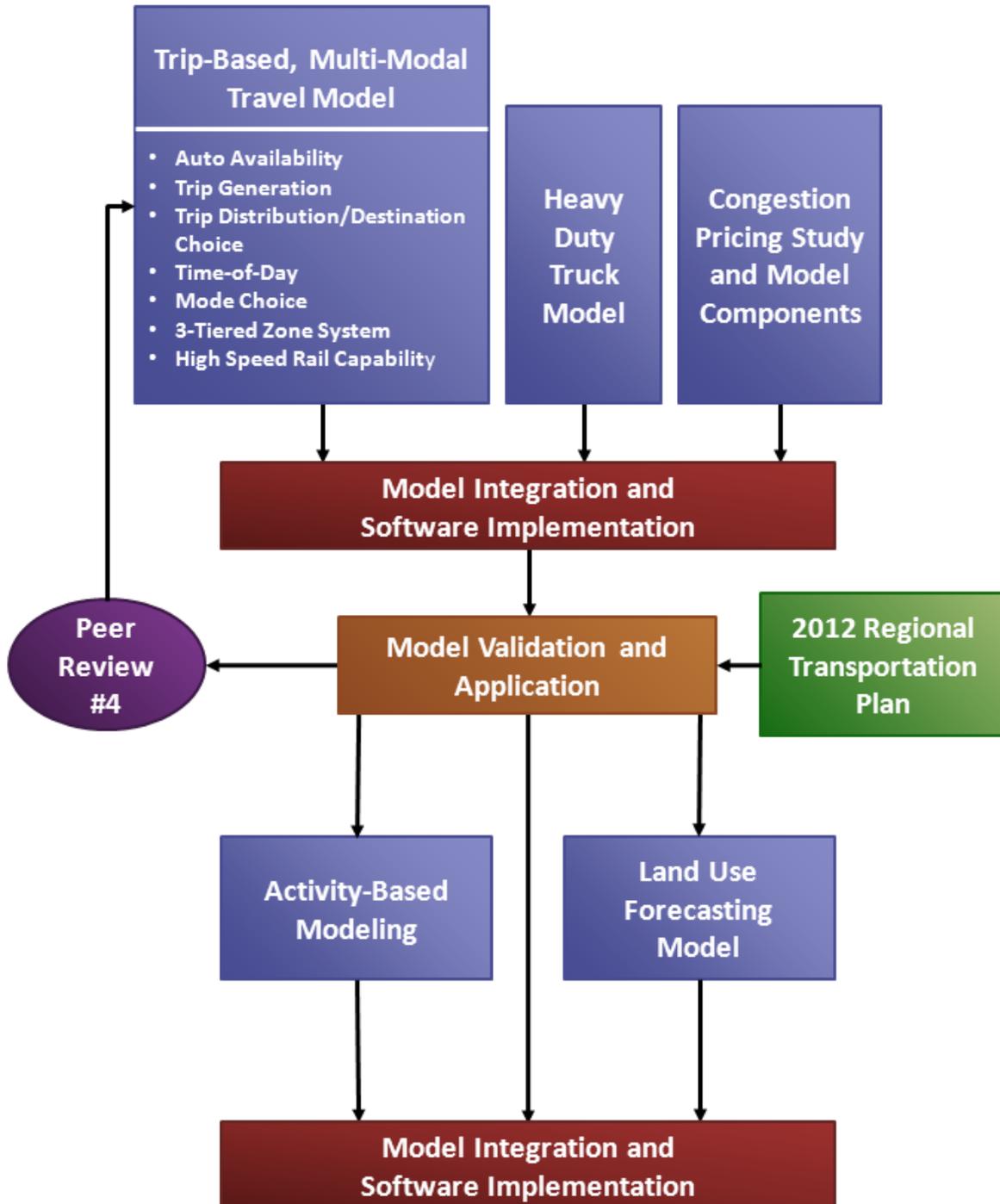


Figure I: SCAG Model Enhancement Program



Purpose / Objectives

Model validation is defined as the process by which base year model results are compared to known sources of data such as traffic counts and transit ridership data. SCAG performs a validation of its transportation model at the beginning of each planning cycle for the southern California region. A planning cycle is typically four years, corresponding to the update of the RTP. The base year for the current planning period and model is 2008; and 2035 is the forecast year.

Model validation is a regular and essential modeling process that supports the development of the RTP, FTIP, and AQMPs. In the past, SCAG has prepared a model validation report for each of the previous planning cycle model base years: 1980, 1984, 1987, 1990, 1994, 1997, 2000, and 2003.

Model Validation Peer Reviews were conducted in:

- January 2002 for the 1997 base year model;
- November 2003 for the 2000 base year model;
- January 2006 for the 2003 base year model; and
- most recently in June 2011 for the 2008 base year model.

The purpose of the Year 2008 Model Validation program is to develop a base year model for the analysis of the 2012 RTP and related programs, including the conformity analysis (Title 40 CFR Part 93.122), and development of the Sustainable Communities Strategy (SCS) (Huang 3).

To highlight, the model will be:

- Validated against observed data (40 CFR 93.122(b)(1)(i));
- Sensitive to changes in the time(s), cost(s), and other factors affecting travel choices (40 CFR 93.122(b)(1)(vi));
- In compliance with other validation requirements of 40 CFR 93.122(b); and
- Able to measure the benefits of land use strategies aimed at reducing GHG emissions.

Note: 40 CFR 93.122 describes the Environmental Protection Agency's (Title 40) regulations for determining conformity of federal actions to state or federal air quality implementation plans (Part 93, Section 122).

The objectives of model validation are to incorporate the latest model input data, update model parameters using recent census/travel survey information, include additional modeling capabilities, and check base year model outputs against traffic counts, transit ridership, and vehicle miles of travel (VMT) estimates. In addition, extensive sensitivity testing is being performed to ensure proper model performance. A major emphasis of the Year 2008 Model Validation relates to the validation of new and enhanced model components including: mode choice, high-speed rail, pricing, heavy-duty truck model, and sensitivity to smaller geographic levels (Aguilar 7).

If the modeling process is reasonable with respect to the state of the practice and if the model produces reasonable results in the sensitivity testing and validation process, it should be expected to provide reasonable travel demand forecasts.

The primary objective of the Peer Review Panel is to review the model development program, validation tests and results, expert panel discussions, and overall model enhancement effort for validity with regard to state of the practice so that the model can be applied with sufficient reliability in the RTP, FTIP, and

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AQMP planning processes. The panel was asked to provide recommendations for future short-term and long-term model enhancements.

History of the Peer Review Process

As stated previously, this is the fourth in a series of Peer Review panels convened by SCAG for regional travel model validations. Previous efforts occurred in January 2002 for the 1997 base year model; November 2003 for the 2000 base year model; and January 2006 for the 2003 base year model.

In 2002, SCAG initiated an effort to use new data to update and recalibrate its travel simulation model. In January of that year, the first peer review of SCAG’s model was conducted. At that time, the panel concluded that SCAG’s model was at the leading edge of the state of the practice. The panel recommended several changes, including adding trip purpose, creating a vehicle availability model, and modifying the mode choice model. SCAG has implemented most of these recommendations.

The second peer review was held in November 2003. Topics reviewed during this meeting included validation targets, the revised vehicle availability model, trip generation, external trips, and the selection of variables for the mode choice model. At this same time, Cambridge Systematics was awarded a contract to improve the current travel demand model (Volpe 2).

The third peer review in January 2006 focused on the previously updated model components, especially trip distribution, mode choice, and trip assignment. The panel determined that SCAG had developed a “state-of-the-practice” four-step model. The panel highlighted several strengths, including the freight model, the strategic work trips, and the use of four time periods in assignment. The panel felt that SCAG had done a particularly good job with data collection, and that the planned speed study was a good next step.

Peer Review Panel #4

SCAG’s 2008 Regional Travel Model Peer Review Panel is comprised of nationally-recognized experts in the fields of travel demand modeling and data collection and analysis. The panel members are shown in Table I. The list of attendees at the Peer Review meetings is included in Appendix A.

**Table I: 2011 Regional Travel Model Peer Review Panel #4
(January 27-28, 2011)**

No.	Name	Organization
1	Guy Rousseau (Chair)	Atlanta Regional Commission
2	Chaushie Chu, Ph.D.	Los Angeles County Metropolitan Transportation Authority (Metro)
3	Chris Forinash	Environmental Protection Agency (EPA)
4	David Levinson, Ph.D.	University of Minnesota
5	David Ory, Ph.D.	Metropolitan Transportation Commission (MTC)
6	Eric Pihl	Federal Highway Administration (FHWA)
7	Kara M. Kockelman, P.E., Ph.D.	University of Texas, Austin; Expert Panel – Congestion Pricing
8	Ken Cervenka	Federal Transit Administration (FTA)
9	Mark Bradley	Mark Bradley & Associates



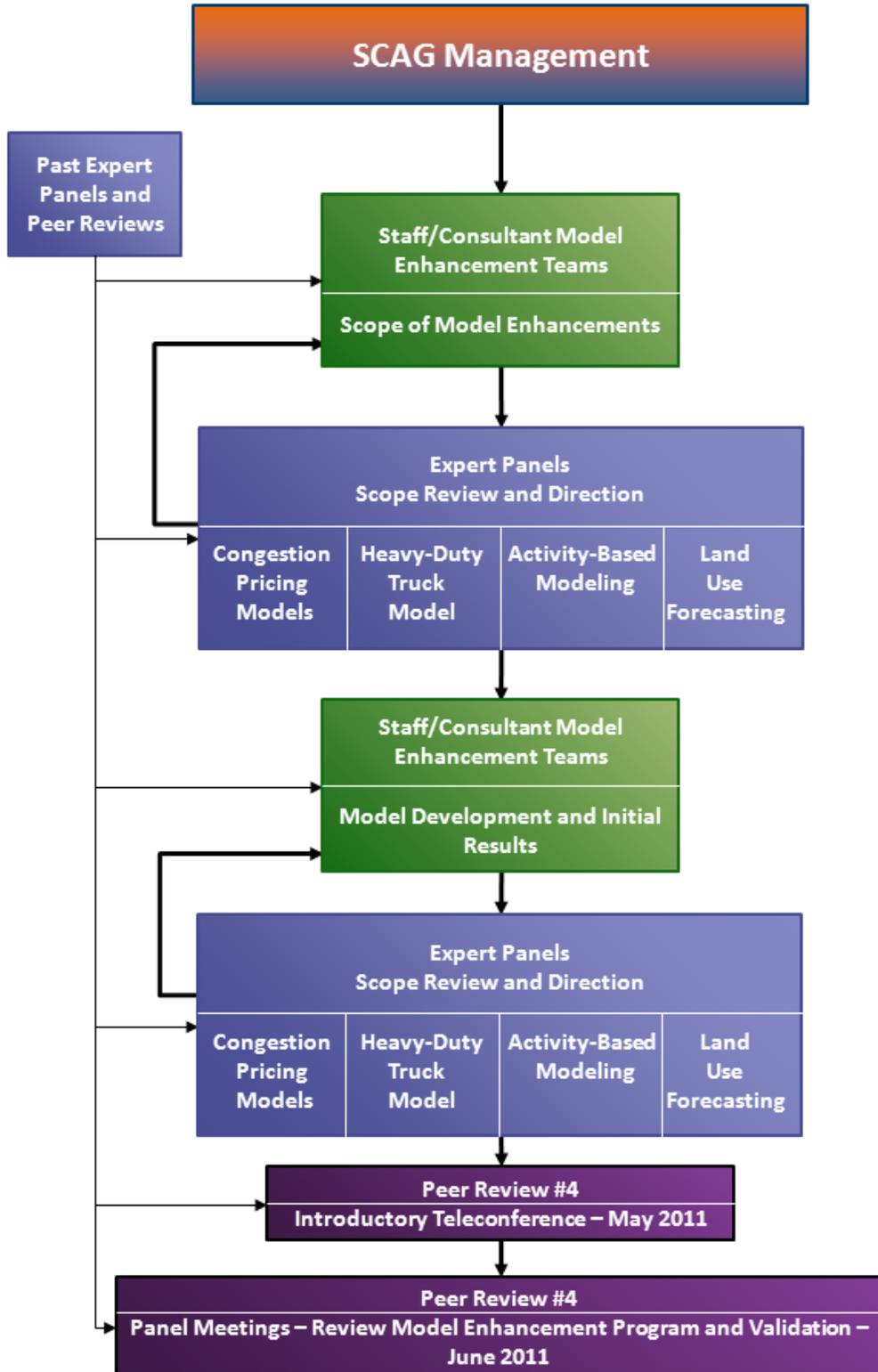
Model Development Process for the 2012 RTP

The Panel assembled for this fourth Peer Review was tasked with reviewing the overall model development program and validation with regard to state-of-the-practice for use in the transportation planning process. This broad assignment for the Peer Review panel is in contrast to the detailed data collection efforts, technical analysis, and detailed model performance reviews made by the individual Expert Panels and staff/consultant model enhancement teams over the three years prior.

Expert Panels were convened to conduct detailed technical reviews for the congestion pricing models, heavy duty truck model enhancements, and activity-based modeling progress. The Expert Panels were comprised of local and national modeling and data experts. In addition, the SCAG Modeling Task Force, comprised of local modeling professionals, participated in the model review process. The SCAG Model Management and Oversight Team provides the leadership of scoping and managing the model enhancements and data collection efforts, coordinating the multiple staff/consultant model enhancement teams, and reviewing model results.

The graphic in Figure 2 outlines the extensive efforts of the model review process prior to and including the Expert Panels and the June 2011 Peer Review.

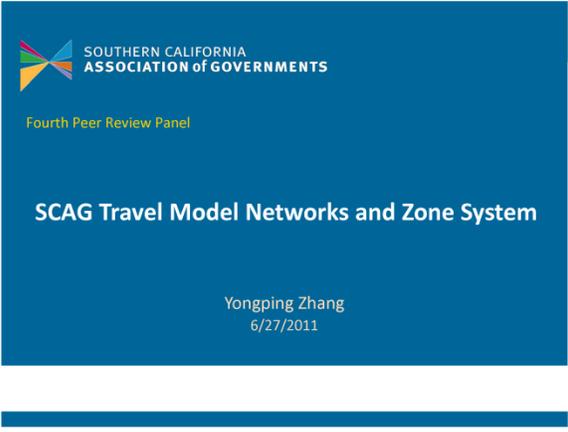
Figure 2: SCAG Model Review Process

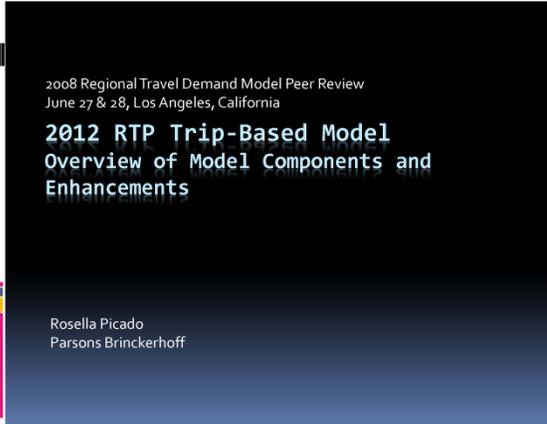
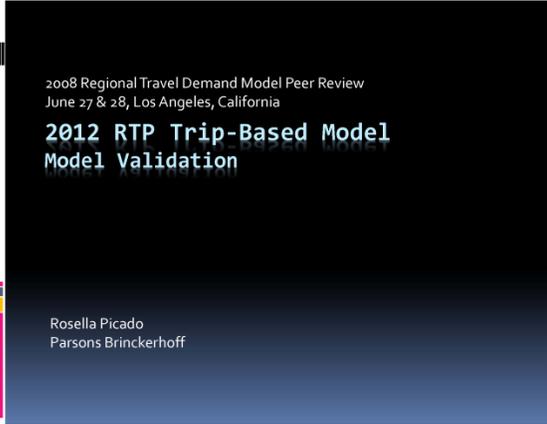


Chapter 3: Peer Review Presentations

Table 2 summarizes the discussion topics and presentations for the Peer Review meetings on June 27-28, 2011. The meeting Agenda is included in Appendix B. The presentations are contained in Appendices C to M.

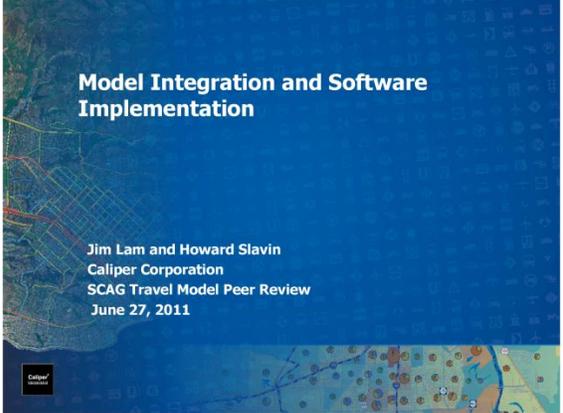
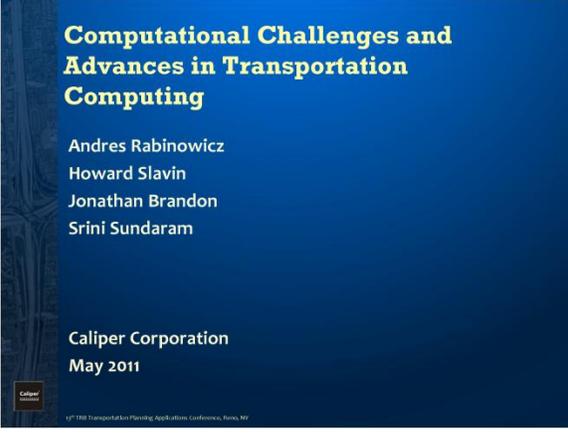
Table 2: Peer Review Meeting Topics and Presentations

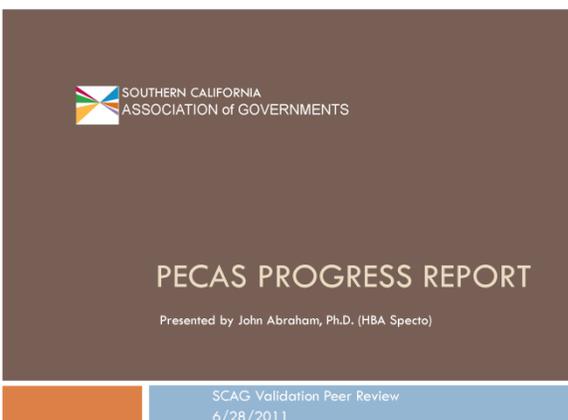
Introductory Peer Review Teleconference – May 26, 2011		
<p><i>Appendix C</i></p> <p>SCAG Travel Model Improvement Program</p>	<p>Guoxiong Huang of SCAG presented an overview of the model development program, 2008 model validation, and preparation for the 2012 RTP. The presentation also summarized recommendations from the previous peer review panel and the recent expert panels.</p>	 <p>The slide features the SCAG logo at the top left, followed by the text 'SOUTHERN CALIFORNIA ASSOCIATION of GOVERNMENTS'. Below this is 'Fourth Peer Review Panel' in blue. The main title is 'SCAG Travel Model Improvement Program' in white. At the bottom, the presenter's name 'Guoxiong Huang' and the date '5/26/2011' are listed in white. The slide has a dark green background with a light orange footer bar.</p>
Peer Review Meetings – June 27-28, 2011		
<p><i>Appendix D</i></p> <p>Model Inputs and Assumptions</p>	<p>In this presentation, Yongping Zhang of SCAG summarized information and assumptions for the modeling domain/region, zone structure, and regional highway and transit networks.</p>	 <p>The slide features the SCAG logo at the top left, followed by the text 'SOUTHERN CALIFORNIA ASSOCIATION of GOVERNMENTS'. Below this is 'Fourth Peer Review Panel' in yellow. The main title is 'SCAG Travel Model Networks and Zone System' in white. At the bottom, the presenter's name 'Yongping Zhang' and the date '6/27/2011' are listed in white. The slide has a blue background with a white footer bar.</p>

Peer Review Meetings – June 27-28, 2011		
<p>Appendix E</p> <p>Socio-Economic Input Variables</p>	<p>Simon Choi of SCAG summarized information, assumptions, data, and methodologies for developing the socio-economic datasets for the 2008 base year model.</p>	
<p>Appendix F</p> <p>Overview of Model Components and Enhancements</p>	<p>Rosella Picado of Parsons Brinkerhoff presented topics related to several enhancements of SCAG's trip-based model.</p>	
<p>Appendix G</p> <p>Model Validation</p>	<p>Rosella Picado of Parsons Brinkerhoff summarized data sources, performance measures, and sensitivity testing related to the validation of SCAG's trip-based model to 2008 conditions.</p>	



Peer Review Meetings – June 27-28, 2011

<p>Appendix H</p> <p>Model Integration and Software Implementation</p>	<p>Jim Lam and Howard Slavin of Caliper Corporation summarized the integration of the various model components within the TransCAD software.</p>	
<p>Appendix I</p> <p>Computational Challenges and Advances in Transportation Computing</p>	<p>Howard Slavin of Caliper Corporation presented information related to increasing computational demands as regional travel models are enhanced, the state of hardware development, and techniques to reduce model run times.</p>	
<p>Appendix J</p> <p>Congestion Pricing Models</p>	<p>Ed Regan and Kazem Oryani of Wilbur Smith Associates summarized data collection and analysis, behavioral aspects of personal travel, and time-of-day issues related to the congestion pricing components of the model.</p>	

Peer Review Meetings – June 27-28, 2011		
<p>Appendix K</p> <p>Heavy Duty Truck Model</p>	<p>Michael Fischer, Arun Kuppam, and Dan Beagan of Cambridge Systematics presented information, assumptions, and validation results related to the enhancement of SCAG's Heavy-Duty Truck Model.</p>	 <p>The slide features a blue and white design with a map of the region. Text includes: 'SCAG HDT Model Development', 'Presented to: Peer Review Panel Members', 'Presented by: Arun Kuppam, Dan Beagan, Michael Fischer', 'June 28, 2011', and the SCAG logo with the tagline 'Transportation leadership you can trust.'</p>
<p>Appendix L</p> <p>Activity-Based Modeling</p>	<p>Dr. Ram Pendyala of Arizona State University summarized the progress to date in developing an activity-based travel demand model for SCAG.</p>	 <p>The slide has a blue background with red and green text. It reads: 'SimAGENT', 'A Report on the Development of An Activity-Based Travel Demand Model for SCAG', 'June 28, 2011'. It lists presenters: 'Kostas Goulias & Yali Chen + others' (University of California Santa Barbara), 'Chandra Bhat & Rajesh Paleti + others' (The University of Texas Austin), 'Ram Pendyala & Karthik Konuri + others' (Arizona State University Tempe), and 'Guoxiong Huang, Hsi-Hwa Hu + others' (SCAG Los Angeles). It also includes the SCAG logo and two maps of the region.</p>
<p>Appendix M</p> <p>Land Use Forecasting Model</p>	<p>Dr. John Abraham of HBA Specto summarized the development of SCAG's land use forecasting model.</p>	 <p>The slide has a dark brown background with white and orange text. It reads: 'SOUTHERN CALIFORNIA ASSOCIATION of GOVERNMENTS', 'PECAS PROGRESS REPORT', 'Presented by John Abraham, Ph.D. (HBA Specto)', and 'SCAG Validation Peer Review 6/28/2011'.</p>

Chapter 4: Major Conclusions and Recommendations

The primary objective of the Peer Review Panel is to review the model development program, validation tests and results, expert panel discussions, and overall model enhancement effort for validity with regard to state of the practice so that the model can be applied with sufficient reliability in the RTP, FTIP, and AQMP planning processes. The panel was asked to provide recommendations for future short-term and long-term model enhancements. Their major conclusions and recommendations are described in this Chapter.

OVERALL FINDINGS OF THE PEER REVIEW PANEL

The current SCAG travel demand model is an advanced 4-step model that meets and in many cases exceeds the state of the practice – with the exception of the lack of zero-vehicle ownership sensitivity in the destination and mode choice models. With this one change properly addressed, the model is suitable for use in preparing 2012 RTP, conformity analysis, and SCS.

Model Strengths

The Panel feels that the level of effort for the SCAG model is impressive and ambitious. SCAG should continue to manage and coordinate the overall model enhancement program and individual consultant work efforts. The Panel encourages SCAG to continue to explore and implement as practical activity-based modeling and land use forecasting models.

There are a number of new features in the model that in all cases meet and in many instances are an improvement over the typical state of the practice, including:

- the multi-level geographic zone structure, particularly the “Tier 2” zone system with over 11,000 zones,
- a truck model that includes all classes of commercial vehicles, as well as a special generator model for the Ports of L.A and Long Beach (San Pedro Bay ports),
- grade-based passenger car equivalent (PCE) adjustments for heavy-duty trucks,
- the modeling of secondary truck trips associated with transload facilities,
- an auto ownership model that includes a number of different land use and accessibility variables,
- origin zone income model,
- the use of destination choice models with logsums from mode choice, instead of gravity models,
- the use of a time of day choice model, instead of fixed factors,
- the congestion pricing model’s ability to analyze user benefits with regard to delay and mobility performance perspectives,
- the use of a nested mode choice model with a large number of competing modes, and
- the use of advanced models for congestion pricing.

Recommendations for Model Validation and 2012 RTP Process (Short-Term)

The major conclusions and recommendations of the Peer Review Panel for short-term consideration by the SCAG and consultant modeling team are listed in this section. The recommendations described herein are intended for short-term implementation in the model prior to using the model for developing the 2012 RTP. In some cases, the recommendations do not require additional efforts on the part of the model development team.

- Auto Ownership Sensitivity – The Peer Review Panel suggests adding auto ownership sensitivity in the destination choice and mode choice models. Along with travel time and cost, auto availability is one of the most significant explanatory variables. For example, there may be zero-car households in higher income categories that are not captured by household income groups. Furthermore, there are single people and couples in high accessibility areas that choose to own less than one vehicle per driver. The California Transportation Commission’s 2010 RTP Guidelines specifically mention auto availability per household as an important quantifiable variable for describing travel behavior. This could potentially be a significant issue in forecast years; and there may be significant cultural/immigrant differences that should be considered. In updating the model, the calibrated constant for zero-car household transit riders should be closely reviewed.

Note: The 2001 onboard transit survey data does not include auto ownership information. The upcoming 2011 onboard survey being conducted by Metro will include this information.

- Response / Follow-Up – SCAG has processed a consultant contract to address the Peer Review Panel’s recommendation regarding auto ownership sensitivity.
- Sensitivity Testing – The Panel suggests doing sensitivity testing on a single-county version of the model, or something similar, since model run times limit opportunities for extensive testing. The sensitivities to longer travel by medium and high density areas should be reviewed.
- Traffic Count Averaging – SCAG might consider averaging traffic counts over 3 or so years instead of using single year counts.
 - Response / Follow-Up - The traffic counts on screenlines were closely reviewed against historical and current data on the specific link or adjoining links. This was done in an attempt to verify the quality of each screenline traffic count as well as to replicate 2008 conditions as closely as possible. If the desire is to replicate conditions before 2008 (i.e., before the economic downturn), this could be accomplished with geo-spatial (e.g., district, county, etc.) adjustment factors.
- Heavy-Duty Truck Model Validation – The Panel suggests comparing model results and observed data grouped by percent of trucks on roadway links to look at the model results in a different way.
- Validation of Speeds/Travel Times - SCAG should try to match observed travel times (speeds) on links as part of validation.
- Reporting - Add basic demographic profiles including maps of the SCAG region to the Validation Report.

Recommendations for Model Enhancement Program (Long-Term)

The major conclusions and recommendations of the Peer Review Panel for longer-term consideration by the SCAG and consultant modeling team are listed in this section. The recommendations described herein are intended for exploration or implementation in the model after the 2008 model validation is final. These longer-term recommendations would be anticipated prior to using the model for developing the 2016 RTP. In some cases, the recommendations do not require additional efforts on the part of the model development team.

- Model Inputs and Assumptions

- Consider the use of actual speeds as free-flow speeds in the model rather than artificially capping them at the speed limit.
- Review the potential for better enforcement of speeds through technology in the future and how this may impact assumptions in the model. Or, consider using the model to test the impacts of policy scenarios such as more comprehensive speed enforcement.
- Incorporate the most recent Census data (e.g., SF-1) into the model assumptions, recognizing that it will not be available for the 2012 RTP analysis.
- SCAG may wish to explore the use of the US Census LEHD (Longitudinal Employer - Household Dynamics) data for validation. There are some concerns that the LEHD data does not contain realistic home to work data.

Note #1: Longitudinal Employer-Household Dynamics (LEHD) is an innovative program within the U.S. Census Bureau. Modern statistical and computing techniques are used to combine federal and state administrative data on employers and employees with core Census Bureau censuses and surveys while protecting the confidentiality of people and firms that provide the data (Source: US Census LEHD website).

Note #2: The Atlanta Regional Commission has worked with LEHD data and is available for consultation.

- Area types and densities may not be the best variables for determining roadway attributes (e.g., capacities, speeds, etc.). SCAG may wish to explore the use of roadway widths and intersections per mile surrogate variables to augment this approach.
- The model should include attributes that allow for the specific quantification of benefits from ramp metering.
- Toll-choice models in both mode choice and assignment may increase model run times unnecessarily. SCAG may wish to consider turning off one of these processes to reduce run times.

- Trip-Based Model Enhancements
 - Consider reversing the order of destination / mode choice nesting when the 2011 onboard transit survey data is available so that the mode choice logsum coefficient in the destination / mode choice model does not need to be constrained, or allow the inclusive value coefficient to be the estimated value even if it is greater than 1 (one).
 - Conduct rigorous performance checks of model results once the 2011 onboard transit survey data is available. These may include trip-based and activity-based district-to-district transit rider flows by mode, market segment, and mode of access, etc.
 - Run the model with observed travel times and review results.
 - The SCAG model uses a 5-option multi-nomial logit choice model used for auto ownership. Some have argued that this is an ordered choice. SCAG may wish to explore the use of negative binomial or ordered probit models for auto ownership.
 - The workplace allocation component of the destination choice model has room for improvement according to some panel members based on calibration/validation results. SCAG should review its methodology and ensure that the upcoming activity-based modeling will address these issues.
 - Consider the use of stochastic user equilibrium in traffic assignment to reduce the effects of all travelers taking the shortest path. This may however increase model run times.
 - The SCAG model currently runs the time of day choice model runs after mode choice. Some panel members suggested that SCAG consider reviewing the processing order.
 - SCAG should consider improving the integration between the time of day model and the congestion pricing model components.
- Model Integration and Software Implementation
 - SCAG should invest in the appropriate computer technology (e.g., servers with sufficient storage and processing power and/or multiple computers to run separate model components) to meet the demands of their ambitious modeling needs in the future.
 - Identify which modeling steps are scalable and where additional computers could reduce model run times through parallel processing.
- Congestion Pricing
 - Stated Preference survey results should be studied and validated to the extent possible before using them in the model for future applications such as the 2016 RTP.
 - The trip suppression model component appears ad hoc and should be better integrated with the model.

- Societal equity is often a political concern for any type of road pricing. A process (similar to the FTA SUMMIT program) to identify benefits/dis-benefits for users as well as non-users resultant from road pricing alternatives would be a helpful tool to address the equity concerns that may be raised by elected officials and interest groups.
- Heavy-Duty Truck Model
 - Review the assumption that the trucks per employee stay constant over time. Possibly use historical trends and commodity flow information to augment this part of the truck forecast assumptions.
 - Review and possibly update the assumptions for forecasting transload facilities.
 - Compare model results using the grade-adjusted passenger car equivalent (PCE) factors against model results without the PCE adjustment.
- Activity-Based Modeling
 - Model results should be compared at the 2035 future scenario level and fully understood before using ABM for the 2016 RTP.
 - SCAG should investigate how well the ABM results are matching journey to work data.
 - Next steps in developing the ABM modeling should be considered in the context of the weaknesses of the trip based model. For example, the workplace location choice, mode/destination choice order, capacity representation, etc. should be revisited.
- Land Use Forecasting
 - Consider utilizing the PECAS / Land Use model to inform the heavy duty truck model. It is well-suited for this task.