Overview of
“Improved Data and Tools for Integrated
Land Use-Transportation Planning in California”
Caltrans’ “Planning Horizons” program
November 7, 2012
Presentation Outline

Part 1. Overview - Terry Parker, Caltrans HQ Planning
   A. Integrated Land Use-Transportation Scenario Planning
   B. Tools commonly used
   C. The need for and goals of this Project
   D. Introduce other speakers

Part 2. Data & Results
   A. Areas Included in Data Collection - Nathaniel Roth, UCD
   B. Analysis of Data, & Results - Jerry Walters, Fehr & Peers

Part 3. Application of Results with -
   A. Scenario/Sketch Planning Tools - Nathaniel Roth; Raef Porter (SACOG)
   B. Travel Demand Models - Jerry Walters

Part 4. Q & A
1A. What is “Scenario” Planning?

- **Scenario**: Internally consistent view of a potential future.
- **Scenario Planning**: considers various future possibilities.
- **Goal**: identify and evaluate appropriate actions.
- **Many entities conduct “scenario planning”** –
  - Private businesses and individuals.
  - Federal agencies, such as the Pentagon, etc.
  - State Departments of Transportation (DOTs) (e.g., Caltrans).
  - Regional agencies: “Metropolitan Planning Organizations” (MPOs) and “Rural Transportation Planning Agencies” (RTPAs).
  - Local governments: cities and counties.
In the late 1990s and early 2000s, “integrated” land use-transportation scenario planning became more widespread.

- It considers various land use and transportation alternatives.
- Uses terms such as: “vision,” “blueprint,” “livable,” “sustainable,” “smart growth,” “transit-oriented development,” etc.
- Projected the effects of various land use patterns and transportation systems regarding selected indicators.

One was the Sacramento Area Council of Governments (SACOG) “Blueprint” Plan - adopted in December 2004.

- It resulted from an extensive three-year public involvement effort.
- Will guide land use and transportation decisions regionally thru 2050
In 2005, the Caltrans’ HQ Transportation Planning Division (DOTP) began providing funding to regional agencies for integrated land use-transportation scenario planning.

- From 2005 to 2011, the Caltrans Blueprint Planning Grant Program provided nearly $22 million to a variety of regional agencies.

- The Blueprint Planning program has resulted in local and regional plans and projects that increase the efficiency and effectiveness of infrastructure and land use changes.
In 2009, California’s “Sustainable Communities and Climate Protection Act of 2008” (SB 375) became law.

- Its goal is reducing per-capita rates of greenhouse gas (GHG) emissions via integrated land use and transportation planning.

SB 375 requires California MPOs to develop and adopt “Sustainable Communities Strategies” (SCS) projected to meet per-capita GHG reduction targets.

- The California Air Resources Board (ARB) sets targets for each MPO.

In 2010, the California Transportation Commission (CTC) updated the “Regional Transportation Planning (RTP) Guidelines” to address SB 375 implementation.

- Recommend using scenario planning tools and travel models capable of assessing land use/transportation relationships.
Recommendations & Guidelines re: SB 375 implementation

Chapter 3 re: Tools & Models
– Recommended the use of software tools with sensitivity to land use and transportation for SB375 –required scenario planning.

2009 Regional Targets Advisory Committee’s Recommendations - to the CARB

2010 RTP Guidelines - California Transportation Commission (CTC)
1.B. Tools & Models used in Land Use-Transportation Planning

- Effective scenario planning requires estimating the effects of potential alternatives re: selected indicators.
  - Quantitative or qualitative values used to compare scenarios re: agreed-upon goals, values, or objectives.

- Two main types of tools/models often used in integrated land use-transportation planning are:
  
  i. **Scenario Planning/Visioning Tools** -
  
  - Provide information to meeting participants re: potential effects of their choices, and collect their input.

  ii. **Travel Demand Forecasting Models** –
  
  - Used to evaluate transportation land use-transportation scenarios regarding selected “performance indicators.”
What are Scenario Planning Tools and What Do They Do?

Scenario “Sketch” Planning Tools:

- Software used in creating various “scenarios.”
- Help gather input during workshops and meetings.
- Provide information and estimates regarding selected “indicators” (e.g., VMT, GHG, etc.)

Two Main Types:

GIS: map-based

& Spreadsheet
(e.g., “Excel”)

More information later in presentation.
ii. Travel Demand Forecasting (TDF) Models

Used to evaluate various land use & transportation scenarios regarding selected “performance indicators.”

- The Federal Highway Administration (FHWA) requires that agencies use travel demand models to analyze Regional Transportation Plans (RTPs).
Traffic Analysis Zones (TAZ)

- Models’ basic geographic unit
  - # of Households
  - # and types of Employment
  - Other Zone Data

How Do Travel Demand Models Operate?

- 4-Step Modeling Process:
  1. Trip Generation
  2. Trip Distribution
  3. Mode Split (e.g., driving, transit, walk or bike)
  4. Trip Assignment
## Typical Transportation Model “Blind Spots”

<table>
<thead>
<tr>
<th>e.g., Factors:</th>
<th>Reality</th>
<th>Model’s View</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Circulation Network</td>
<td><img src="image1.png" alt="Image" /></td>
<td><img src="image2.png" alt="Image" /></td>
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<td>• Walking Environment</td>
<td><img src="image3.png" alt="Image" /></td>
<td><img src="image4.png" alt="Image" /></td>
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<tr>
<td>• Density, Clustering</td>
<td><img src="image5.png" alt="Image" /></td>
<td><img src="image6.png" alt="Image" /></td>
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*Slide #12*
Land Use factors that influence travel

“Ds”

- **Density** - dwellings, jobs per acre
- **Diversity** - mix of housing, jobs, retail
- **Design** - connectivity, walkability
- **Destinations** - regional accessibility
- **Distance to Transit** - bus, rail station
- **Development Scale** - population, jobs
- **Demographics** - household size, income, age (etc.)
Recommended: Add “Ds” land use sensitivity to scenario planning tools and travel models.

Tools:
- Travel Demand Models
- Scenario Planning Tools – e.g., UPlan, iPLACE3S, etc.
MPOs’ travel model sensitivities to built environment & transportation (SCS)

<table>
<thead>
<tr>
<th>Major Metro MPOs*</th>
<th>“Macro” Scale</th>
<th>“Micro” Scale</th>
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<tr>
<td></td>
<td>Location</td>
<td>Density</td>
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<tr>
<td>SCAG</td>
<td></td>
<td></td>
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<tr>
<td>MTC/ABAG</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SANDAG</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SACOG</td>
<td></td>
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</table>

* MPOs “self-reported” in 2009.
<table>
<thead>
<tr>
<th>Small &amp; Medium MPO Areas:</th>
<th>MACRO-Scale</th>
<th>MICRO-Scale</th>
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<td></td>
<td>Location</td>
<td>Mix</td>
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<tr>
<td>FRESNO COG</td>
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<td>KERN COG</td>
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<td>AMBAG</td>
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<td>SJ COG</td>
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<tr>
<td>STAN COG</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TULARE CAG</td>
<td></td>
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<tr>
<td>SBCAG</td>
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<tr>
<td>SLO COG</td>
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<td>MERCED CAG</td>
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<td>BUTTE CAG</td>
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<td>SHASTA CO. RTPA</td>
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<tr>
<td>KING CAG</td>
<td></td>
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<tr>
<td>MADERA CTC</td>
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</table>
In 2009, Caltrans initiated this “Improved Data and Tools for Integrated Land Use-Transportation Planning in California” effort with SACOG and other partners.

**Goal:** Obtain and analyze California-specific data and provide results to tools and models used in integrated land use-transportation scenario planning.

**These uses include:**

- Regional “Blueprint” plans.
- SB375-required “Sustainable Communities Strategies” (SCS)/Regional Transportation Plans.
- Local Govt. General & Specific Community Plans.
Introductions –

- Nathaniel Roth – UC Davis ULTRANS
- Jerry Walters - Fehr & Peers Consultants
Part 2 of Presentation

A. Data Collection - Nathaniel Roth, UC Davis ULTRANS

B. Analysis of Data and Results – Jerry Walters, Fehr & Peers
Areas of CA Included -- & Why?

- The project team identified available data throughout California.*
- **Selected areas that had:**
  1. Available **GIS land use & travel survey data of sufficient detail & quality**;
  2. that was **collected during roughly the same time period for each area**.

*Note: the Southern CA Assoc. of Governments (SCAG) conducted a similar effort during the same timeframe.*
Note: light brown areas were **not** included in this project.  
(A similar study was conducted for Southern CA.)
1. Travel surveys
2. “Built Environment” data includes:
   - Parcels
   - Land Uses
   - Roads, Blocks, and Intersections
   - Transit Stations
   - Etc.
Travel Survey Data

   - California ‘Add-on’ - funded by Caltrans
   - Used for smaller MPO areas in study & SANDAG.

2. For SACOG and MTC – Used 2000 regional travel survey data.

*National Household Travel Survey
Data Collection & Preparation

- Eight “focus” Regions
- Travel survey data
- Land Use data
  - Parcels
  - Land Use
- Schools/other institutions
- Roads, Blocks & Intersections
- Transit Stops
- Open spaces
- Summarization
Parcel Data

Data Issues:
- Availability
- Land use coding
- Quality
- Geometry
- Privacy

“Crosswalk” Land Use Codes –
- for “naming” consistency among jurisdictions
Transit – Bus & Rail

- **Bus Stops**
  - All stops (where possible)
  - Timed stops (where available)

- **Passenger Rail Stations:**
  - Amtrak, BART, Metrolink; light-rail systems; etc.
Data compiled for 1/2-mile areas surrounding >200,000 travel survey “trip ends”!
2B. Analysis of Data & Results

Jerry Walters, Principal – Fehr & Peers Consultants
2B. Data Analyses & Results

PRODUCED: “Ds Analysis Modules”

- Equations representing quantitative relationships between various “built environments” and travel patterns.

- Modules for 3 types of regions:
  1. Small/medium-sized MPOs
  2. Larger metro MPOs: SACOG & SANDAG
  3. S.F. Bay Area rail station areas

- Modules can be used within existing scenario planning tools, and can also be customized to travel demand models.
### Ds Modules - 2009 NHTS Survey Data

<table>
<thead>
<tr>
<th>County</th>
<th>Households</th>
</tr>
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<tbody>
<tr>
<td>Monterey County</td>
<td>167</td>
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<tr>
<td>San Benito County</td>
<td>16</td>
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<tr>
<td>San Luis Obispo County</td>
<td>173</td>
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<tr>
<td>Santa Barbara County</td>
<td>201</td>
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<tr>
<td>Santa Cruz County</td>
<td>178</td>
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<tr>
<td>Imperial County</td>
<td>48</td>
</tr>
<tr>
<td>Riverside County</td>
<td>802</td>
</tr>
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<td>San Bernardino County</td>
<td>764</td>
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<tr>
<td>Butte County</td>
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<tr>
<td>Glenn County</td>
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<tr>
<td>Shasta County</td>
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<tr>
<td>Tehama County</td>
<td>61</td>
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<tr>
<td>Fresno County</td>
<td>381</td>
</tr>
<tr>
<td>Kern County</td>
<td>309</td>
</tr>
<tr>
<td>Kings County</td>
<td>63</td>
</tr>
<tr>
<td>Madera County</td>
<td>64</td>
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<tr>
<td>Merced County</td>
<td>89</td>
</tr>
<tr>
<td>San Joaquin County</td>
<td>306</td>
</tr>
<tr>
<td>Stanislaus County</td>
<td>262</td>
</tr>
<tr>
<td>Tulare County</td>
<td>173</td>
</tr>
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</table>

**TOTAL HOUSEHOLDS:** 4,435
### ii. 2-Step “Ds Module” for the Sacramento region (SACOG)

<table>
<thead>
<tr>
<th>Density</th>
<th>VT Probability</th>
<th>VMT</th>
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<tbody>
<tr>
<td>Residential Dwelling Unit Density</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diversity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Household/Employment Ratio</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intersection Density</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Destinations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Destination Accessibility</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## 3-Step “Ds Module” for San Diego region

### Density
- **Home-End Residential Dwelling Unit Density**
- **Home-End Employment Density**

### Diversity
- **Home-End Household/ School Employment Ratio**
- **Non-Home-End Retail/Non-Retail Employment Diversity Score**
- **Non-Home-End Household/ Employment Diversity Score**
- **Non-Home-End Household/ School Employment Ratio**

### Design
- **Home-End Intersection Density**
- **Home-End Walkability Score**
- **Non-Home-End Roadway Density**
- **Non-Home-End Walkability Score**

### Destination Accessibility
- **Home-End Destination Accessibility**

### Distance to Transit
- **Home-End Distance to Transit Stop**

### Demand Management (Parking)
- **Non-Home-End Parking Charges**
### Rail Station Areas “Ds Module” - S.F. Bay Area

#### SAN FRANCISCO BAY AREA

<table>
<thead>
<tr>
<th>Variables</th>
<th>Household Vehicle Trip Generation Model</th>
<th>Household Vehicle Miles Traveled Model</th>
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</thead>
<tbody>
<tr>
<td><strong>Demographics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Household Size</td>
<td>+++</td>
<td>+++</td>
</tr>
<tr>
<td>Low Income Household</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Owner-Occupied Household?</td>
<td>+</td>
<td>--</td>
</tr>
<tr>
<td>Zero Vehicle Household?</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td># of HH Vehicles</td>
<td>+++</td>
<td></td>
</tr>
<tr>
<td>Multi-Family Dwelling</td>
<td>-</td>
<td></td>
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<tr>
<td><strong>Density</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Activity Density at Home End (Pop. + Jobs / Acre)</td>
<td>-</td>
<td>--</td>
</tr>
<tr>
<td><strong>Diversity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Households/ Employment Diversity at Home End</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Design</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intersection Density at Non-Home End</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td><strong>Destinations</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Destinations Accessibility by Auto</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Destinations Accessibility by Transit</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Ratio of Auto Accessibility / Transit Accessibility</td>
<td>++</td>
<td></td>
</tr>
<tr>
<td><strong>Distance to Transit</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trains per day at nearest station</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Distance to rail Transit from household</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>
Part 3: Application of Results

A. in GIS Planning Tools:
   - Nathaniel Roth, UCD ULTRANS

B. VMT Estimation Spreadsheet Tool:
   - Raef Porter, SACOG
This project incorporated “Ds” into:

- *UCD’s “UPlan” & SACOG’S “iPLACE3S” tools*
- May also be used in other GIS tools
  - *e.g., Envision Tomorrow, Urban Footprint, etc.*
Scenario Planning

➢ To address **uncertainty**
  ▶ Through evaluating a range of scenarios
  ▶ Recognize that the future is uncertain

➢ Public involvement
  ▶ Early engagement
  ▶ Active outreach to various communities
  ▶ Shared vision

➢ Analysis and comparison of alternatives
  ▶ Quantitative
  ▶ Qualitative
"UPlan" GIS Scenario Planning Tool

Pop. Growth

Housing Units

Emp. Space

Land Use Demand

Ind

CH

RH

CL

RM

RL

RVL

General Plan

“Masks”

Attractors & Discouragers
“Python” Modules

The Important Part:

- Make the “Ds” modules produced by this project available for use in GIS scenario planning tools.
- Building blocks for other computer programs to use.

Technical Details:

- Written in the “open source” programming language “Python”
- It’s a calculator:
  - The user prepares the data
  - Hands it to the module
  - Tells it to run the calculations
  - Is handed the results
“Base Line” Scenario
“Smart Growth” Scenario
"Infill & Redevelopment" Scenario
Indicator: Existing av. Daily VMT per Household
"Base Line" Scenario: Av. Daily VMT per Household
“Smart Growth” Scenario: Av. Daily VMT per Household
**“Bringing the Message Home”**

**ESTIMATES re: SELECTED INDICATORS** *(note: travel modeling is still needed)*

<table>
<thead>
<tr>
<th>Scenario:</th>
<th>Vehicle Miles Traveled</th>
<th>Household Count</th>
<th>Average daily VMT per Household</th>
<th>Percent difference from current conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current conditions</td>
<td>7,117,036</td>
<td>125,997</td>
<td>56.5</td>
<td>0</td>
</tr>
<tr>
<td>“Base case”</td>
<td>16,738,000</td>
<td>313,622</td>
<td>53.4</td>
<td>-5.5%</td>
</tr>
<tr>
<td>“Smart Growth”</td>
<td>16,583,883</td>
<td>313,892</td>
<td>52.8</td>
<td>-6.5%</td>
</tr>
<tr>
<td>“Intensive Infill”</td>
<td>12,776,831</td>
<td>313,829</td>
<td>40.7</td>
<td>-27.9%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Traffic Analysis Zones (TAZ):</th>
<th>Current VMT/HH</th>
<th>“Base case” Scenario</th>
<th>% Change from current</th>
<th>“Smart Growth” Scenario</th>
<th>% Change from current</th>
<th>“Intensive Infill” Scenario</th>
<th>% Change from current</th>
</tr>
</thead>
<tbody>
<tr>
<td>392</td>
<td>41.4</td>
<td>35.6</td>
<td>-13.9</td>
<td>35.4</td>
<td>-14.5</td>
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<td>813</td>
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<td>65.6</td>
<td>-10.2</td>
<td>72.1</td>
<td>-1.3</td>
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</table>
3B. Spreadsheet “sketch” planning Tool

- Raef Porter, SACOG
- VMT Estimation Tool “Sketch 7”
  - produced via this project
  - Potentially others
  - e.g., “Rapid Fire”, etc.

Base → Scenario → Results
Web map tool for Base & Scenario

Sketch 7

Selected Parcel Attributes

<table>
<thead>
<tr>
<th>TAZ</th>
<th>Acres</th>
<th>Employment</th>
<th>Dwelling Units</th>
<th>Landuse Type</th>
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<td>1</td>
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<td>3</td>
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<td>12.51</td>
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<td>Blank Place Type</td>
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</table>
“Dials“ for Land Use Scenario Refinement (“Sketch 7”)
Final estimation and adjustment of travel is conducted and reported.
How RESULTS can be used –

3c. Travel Demand Forecasting Models

Jerry Walters - Add “Ds” to Regional & Local Travel Demand Forecast (TDF) Models –

- Used to analyze land use & transportation scenarios.
- Make up for “missing” model sensitivities to built environment-travel (smart growth/SCS) factors.
- Must be custom-built for each agency’s TDF model.

VS.

What a travel model “sees”  vs.  Reality
<table>
<thead>
<tr>
<th>MPO Areas:</th>
<th>Location</th>
<th>Mix</th>
<th>Density</th>
<th>Mix</th>
<th>Ped Env</th>
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3C. “Ds” Post-Processors for use with Travel Demand Forecasting Models

- Project provided post-processors for eight MPOs:
  - Six San Joaquin Valley MPOs
  - San Luis Obispo COG (Central Coast)
  - Butte CAG (Northern Sacramento Valley)
  - Other agencies in California (outside this study’s scope).
Travel Model Improvement Process for Regional SB 375 RTP/SCS Plans

SCS Guidance

Model Assessment/Enhancement

SCS Review

Statistical ‘Ds’ Modules

Sensitivity Tests

Model Post-Processor
Results: Provide Consistent Estimation of Land Use/Travel Effects

Household Travel Survey

Land Use “D” Characteristics

Statistical Relationships: ‘Ds’ >> Vehicle Ownership
‘Ds’ >> Vehicle Trips
‘Ds’ >> VMT

Statistical ‘D’ Modules
VO, VT, VMT

Scenario Planning Tools & Travel Models can incorporate similar quantitative relationships.
Conclusion: **Benefits of This Project**

- **Regional agencies, Caltrans, and cities & counties throughout California** can use the tools from this project for “integrated” land use-transportation planning:
  - **Regional** Blueprint Plans, Sustainable Communities Strategies (SCS)/Regional Transportation Plans (RTPs)
  - **Local** governments’ General and Specific Plan updates

- **Overall**: Contributes to better-informed decisions resulting in more efficient land use and transportation systems with fewer impacts and greater benefits; and more “livable” and “sustainable” communities for all!
Thank you for your time, attention, and interest!
For more information, please go to Caltrans’ DOTP Office of Community Planning’s “Land Use/Transportation Data & Tools” page:
http://www.dot.ca.gov/hq/tpp/offices/ocp/projects.html