SCAG PECAS Land Use Model Development

Sungbin Cho, SCAG

SCAG Modeling Task Force Meeting
1/26/2011

Contents

- Project Status (end of 2010)
- Scenario Test
  - Baseline
  - Gas price, VMT Fee
  - TOD
- Short & Mid Term Action Items
Status

The Land Use Model is running for multi-year
- With SCAG regional data
- With sensitivity parameters from the statewide model
- With a version of Space Development module that limits demolition

Model Outputs
- Floor space for the year 2035
- Rent increase
- Transit oriented development capacity
- Households and Jobs

Status

By Task
- Design Knowledge Transfer Framework
- Design SCAG PECAS Model
- Statewide PECAS Model Transfer
- Knowledge Transfer
  - Based on the Statewide Mode and Data
  - Staff follows the Model Development Process
  - Workshops and weekly conference
  - Model runs by staff, review with consultant
- Calibration and Scenario Test … under process
Status

Yr 2009

- 10 Workshops over 28 days at SCAG or UCD
- Covered Topics are
  - Model structure, Source Code, Data Structure
  - Synthesizing Missing Information
  - Model Runs and Scenario Development
  - Calibration Strategy and Method

Yr 2010

- Weekly Conference Calls
- Major thrust in Data Development
- Currently, Scenario Test and Calibration stage

PECAS Progress Report

By PECAS Modeling Process

<table>
<thead>
<tr>
<th>Not started</th>
<th>Statewide Model</th>
<th>Initiated</th>
<th>Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Establish Space Rates and Rent Modifier Equations</td>
<td>Develop Commodity Production Zonal Level Targets</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Establish Space Transition Cost System</td>
<td>Develop Commodity Consumption Zonal Level Targets</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Establish Space Maintenance Cost Equations</td>
<td>Develop Commodity Spatial Flow Targets</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Establish Base Year Parcel Database</td>
<td>Develop Imports and Exports Targets by External Zone</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Establish Base Year Space Quantities by Zone</td>
<td>Establish Imports and Exports Equation Parameters</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Establish All-Year Parcel Inputs for Calibration Period</td>
<td>Develop Skim Matrices From Transport Model</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Establish Pseudo-Peak Settings and Space Transition Constants</td>
<td>Establish X-Vector Attribute Values</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Establish Transport Utility Equations</td>
<td>Establish Buying and Selling Utility Equation Parameters</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Establish Floor Space Short-Run Supply Curves</td>
<td>Establish Size Terms for Import and Exports Commodities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Identify Household Technology Option Points</td>
<td>Establish Technology Allocation Utility Equation Parameters</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Identify Industrial Technology Option Points</td>
<td>Establish Location Allocation Utility Sensitivity Parameters</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Identify Accounts Categories Technology Option Points</td>
<td>Establish Location Allocation Utility Equation Zone Constants</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Develop Labor Production Zonal Level Targets</td>
<td>Develop Transport Model Inputs From PECAS Outputs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Develop Labor Consumption Zonal Level Targets</td>
<td>Conduct Semi-Automated Stage 3 Calibration</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Develop Labor Spatial Flow Targets</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Test Scenarios

- Baseline
  - Compare model estimated HH/Job allocation by county to forecast
- Scenarios
  - $3.00/gallon @ 2010 to $4.72/gallon @ 2020
  - $0.02/mile VMT Fee
  - Transit Oriented Development

From the Scenario Tests...

- Compares to official forecast (Aug 2010 version)
  - Calibrated with separate space supply (transition) for each county to prevent even growth distribution
  - No transition to ‘Vacant’ is allowed
- Model shows significant travel impedance sensitivity to VMT, yet limited sensitivity to household and job reallocation
- Limited sensitivity of development capacity to household and job reallocation
- Little variation in wage and commodity price spatially as well temporally
  - imports and exports are controlling the markets
Baseline

- Region total control input to model
  - Trend + Local Input (2010 August version)
  - Ratio to 2007 total
  - HH

Baseline

- Region total control input to model
  - Trend + Local Input (2010 August version)
  - Ratio to 2007 total
  - Job
Baseline  

Floor space (relative to 2007)

[Graph showing floor space comparison for Residential and non-Residential across different years for various regions]

Baseline  

Labor Flow Distances (proxy to working trip VMT)

[Graph showing labor flow distances over different years for Region Total and Per Job]
Baseline

- Model predicts the same large growth in Imperial, Riverside and San Bernardino as the official forecasts.
- The model predicts more growth in Orange County than the official forecast.

Scenario: $4.72/gallon

- Scenario Implementation
  - $3.00/gal @ 2010 to $4.72/gallon @ 2020, then stay same after
  - Assume same MPG, increase to $4.72/gal is equivalent to 13% increase of driving cost increase.
  - Uniform increase rate between 2007 and 2020, 1% in each year
Scenario: $4.72/gallon

- Household Allocation – ratio to baseline

![Household Allocation Chart](chart)

- Job Allocation – ratio to Baseline

![Job Allocation Chart](chart)
Scenario: $4.72/gallon

- Total Labor Flow Distances

- Labor Flow Distance / Job

PECAS Progress Report

10
Scenario: $4.72/gallon

- Small shift of households and job between Counties
- Working trip distance directly related to the increase travel cost.
- Intra-county rearrangement of workplaces and residences is important.

Scenario: VMT Fee

- Scenario Implementation
  - $0.453 /mile driving cost (2009, AAA)
  - $0.02 /mile addition equivalents to 4.42% increase in driving cost
  - Increase travel-distance cost factor accordingly
Scenario: VMT Fee

- Household by County (Difference from Baseline, %)

![Graph showing household differences by county over time.]

- Difference of Households from Baseline

![Map showing household differences by county and year.]
Scenario: VMT Fee

Job by County (Difference from Baseline, %)

- 0.50%
- 0.40%
- 0.30%
- 0.20%
- 0.10%
- 0.00%
- 0.10%

2005 2010 2015 2020 2025 2030 2035

-scenario: vmt fee

Difference of Jobs from Baseline

Difference Year 2035

-1.318295 -1.175761
-1.175760 -0.608382
-0.608381 -0.100232
-0.100231 -0.025096
-0.025095 0.005481
0.005482 0.028505
0.028506 0.081489
0.081490 0.197206
Scenario: VMT Fee

- Total Labor Flow – ratio to baseline

![Graph showing Total Labor Flow – ratio to baseline]

- Labor Flow / Jobs

![Graph showing Labor Flow / Jobs]
Scenario: VMT Fee

- Model shows similar allocation pattern to high-gas price scenario
- Imperial county losses jobs, while other counties gains.

Scenario: TOD

- TOD1
  - 0.5-mile from the major transit stops on the high quality transit corridor
  - Identify parcels designated as residential and commercial in the general plan
  - Increase 50% of allowable Floor-Area-Ratio from general plan for parcels currently zoned for multi-family.
  - Increase 50% of current Floor-Area-Ratio as allowable density for parcels currently zoned for commercial.

- TOD2
  - Allow 20 times density in LA county in 0.5 mile.
  - No change in other counties
Scenario: TOD

<table>
<thead>
<tr>
<th>County</th>
<th>Total Land (10^6 SQFT) (A)</th>
<th>Parcel Land * (10^6 SQFT) (B)</th>
<th>HQTC Land Area (0.5 mile radius) (10^6 SQFT) (C)</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMP</td>
<td>124,921.14</td>
<td>782.11</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>LA</td>
<td>110,198.31</td>
<td>24,323.80</td>
<td>14,189.04</td>
<td>12.88%</td>
</tr>
<tr>
<td>ORA</td>
<td>22,260.39</td>
<td>9,125.39</td>
<td>2,815.65</td>
<td>12.65%</td>
</tr>
<tr>
<td>RIV</td>
<td>203,497.98</td>
<td>5,588.20</td>
<td>1,378.51</td>
<td>0.68%</td>
</tr>
<tr>
<td>SBN</td>
<td>560,257.01</td>
<td>5,057.47</td>
<td>1,608.61</td>
<td>0.29%</td>
</tr>
<tr>
<td>VEN</td>
<td>51,116.74</td>
<td>2,601.89</td>
<td>109.50</td>
<td>0.21%</td>
</tr>
</tbody>
</table>

*) Mountain/desert area excluded (except already developed parcels)
**Scenario: TOD**

### Development Capacity

<table>
<thead>
<tr>
<th>Type-County</th>
<th>Parcel Land 106 SQFT (A)</th>
<th>FAR %</th>
<th>Capacity 106 SQFT (B)</th>
<th>FAR to Capacity 106 SQFT (C)</th>
<th>Scenario TOD1</th>
<th>Capacity Increment % (D/(C)-1)</th>
<th>Increment 106 SQFT (D)</th>
<th>Scenario TOD2</th>
<th>Capacity Increment % (D/(C)-1)</th>
<th>Increment 106 SQFT (D)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NonR - IMP</td>
<td>260.1</td>
<td>65.3</td>
<td>133.4</td>
<td>49.0</td>
<td>133.4</td>
<td>0.00</td>
<td>133.4</td>
<td>0.00</td>
<td>NonR - IMP</td>
<td>0.00</td>
</tr>
<tr>
<td>NonR - LA</td>
<td>0.793.1</td>
<td>43.9</td>
<td>5.076.0</td>
<td>85.5</td>
<td>5.376.0</td>
<td>5.84</td>
<td>11.921.0</td>
<td>118.52</td>
<td>NonR - LA</td>
<td>0.00</td>
</tr>
<tr>
<td>NonR - ORA</td>
<td>3.451.5</td>
<td>4.13</td>
<td>1.703.9</td>
<td>84.6</td>
<td>1.794.2</td>
<td>2.08</td>
<td>1.703.9</td>
<td>0.00</td>
<td>NonR - ORA</td>
<td>0.00</td>
</tr>
<tr>
<td>NonR - RIV</td>
<td>2.802.7</td>
<td>32.5</td>
<td>1.354.3</td>
<td>87.7</td>
<td>1.375.1</td>
<td>1.54</td>
<td>1.354.3</td>
<td>0.00</td>
<td>NonR - RIV</td>
<td>0.00</td>
</tr>
<tr>
<td>NonR - SBK</td>
<td>2.441.5</td>
<td>33.3</td>
<td>1.288.0</td>
<td>65.6</td>
<td>1.297.0</td>
<td>0.58</td>
<td>1.288.0</td>
<td>0.00</td>
<td>NonR - SBK</td>
<td>0.00</td>
</tr>
<tr>
<td>NonR - VEN</td>
<td>1.385.2</td>
<td>36.4</td>
<td>518.1</td>
<td>74.2</td>
<td>519.0</td>
<td>0.18</td>
<td>518.1</td>
<td>0.00</td>
<td>NonR - VEN</td>
<td>0.00</td>
</tr>
</tbody>
</table>

**Scenario TOD2**

<table>
<thead>
<tr>
<th>Type-County</th>
<th>Parcel Land 106 SQFT (A)</th>
<th>FAR %</th>
<th>Capacity 106 SQFT (B)</th>
<th>FAR to Capacity 106 SQFT (C)</th>
<th>Scenario TOD1</th>
<th>Capacity Increment % (D/(C)-1)</th>
<th>Increment 106 SQFT (D)</th>
<th>Scenario TOD2</th>
<th>Capacity Increment % (D/(C)-1)</th>
<th>Increment 106 SQFT (D)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NonR - IMP</td>
<td>260.1</td>
<td>65.3</td>
<td>133.4</td>
<td>49.0</td>
<td>133.4</td>
<td>0.00</td>
<td>133.4</td>
<td>0.00</td>
<td>NonR - IMP</td>
<td>0.00</td>
</tr>
<tr>
<td>NonR - LA</td>
<td>0.793.1</td>
<td>43.9</td>
<td>5.076.0</td>
<td>85.5</td>
<td>5.376.0</td>
<td>5.84</td>
<td>11.921.0</td>
<td>118.52</td>
<td>NonR - LA</td>
<td>0.00</td>
</tr>
<tr>
<td>NonR - ORA</td>
<td>3.451.5</td>
<td>4.13</td>
<td>1.703.9</td>
<td>84.6</td>
<td>1.794.2</td>
<td>2.08</td>
<td>1.703.9</td>
<td>0.00</td>
<td>NonR - ORA</td>
<td>0.00</td>
</tr>
<tr>
<td>NonR - RIV</td>
<td>2.802.7</td>
<td>32.5</td>
<td>1.354.3</td>
<td>87.7</td>
<td>1.375.1</td>
<td>1.54</td>
<td>1.354.3</td>
<td>0.00</td>
<td>NonR - RIV</td>
<td>0.00</td>
</tr>
<tr>
<td>NonR - SBK</td>
<td>2.441.5</td>
<td>33.3</td>
<td>1.288.0</td>
<td>65.6</td>
<td>1.297.0</td>
<td>0.58</td>
<td>1.288.0</td>
<td>0.00</td>
<td>NonR - SBK</td>
<td>0.00</td>
</tr>
<tr>
<td>NonR - VEN</td>
<td>1.385.2</td>
<td>36.4</td>
<td>518.1</td>
<td>74.2</td>
<td>519.0</td>
<td>0.18</td>
<td>518.1</td>
<td>0.00</td>
<td>NonR - VEN</td>
<td>0.00</td>
</tr>
</tbody>
</table>

### Household by County (Difference from Baseline, %)

- Imperial
- Los Angeles
- Orange
- Riverside
- San Bernardino
- Ventura

**Scenario: TOD1**

### Household by County (Difference from Baseline, %)

**PECAS Progress Report**

Page 33
Scenario: TOD1

- Difference of Household from Baseline

<table>
<thead>
<tr>
<th>Difference Year 2035</th>
<th>0.112447</th>
<th>0.446637</th>
<th>0.889611</th>
<th>1.576637</th>
</tr>
</thead>
<tbody>
<tr>
<td>-0.142574</td>
<td>-0.293531</td>
<td>-0.477761</td>
<td>-1.474569</td>
<td>-1.541748</td>
</tr>
</tbody>
</table>

Scenario: TOD1

- Job by County (Difference from Baseline, %)

- Imperial
- Los Angeles
- Orange
- Riverside
- San Bernardino
- Ventura
Scenario: TOD1

- Difference of Job from Baseline

- Residential space increment (Difference from Baseline, %)
Scenario: TOD1

- Non-Residential space increment (Difference from Baseline, %)

Scenario: TOD2 (20X in LA)

- Household by County (Difference from Baseline, %)
**Scenario: TOD2 (20X in LA)** 12/13

- Job by County (Difference from Baseline, %)

![Graph showing job by county over time with percentage differences for Imperial, Los Angeles, Orange, Riverside, San Bernardino, and Ventura counties.]

**Scenario: TOD** 13/13

- 50% density increase results 3,000 additional households in LA county, 20X causes 30,000 additional households

- Model responses to capacity through general plan

- Market response (development) is less than the zoning input – model starting to show that developers do not necessarily do what you wish they would.
Benefit Measures 1/5

- Consumer Surplus” and “Producer Surplus”
- Value of all options and choices in the model
  - Location
  - Technology
  - Exchange Location for each commodity
- Relative measure only
  - Compare to base scenario to understand benefits of different policies

Benefit Measures 2/5

- Full Integrated Model, combined effect of many items, including:
  - More supply of space leads to lower prices/rent
    - Supply-demand balance
  - Closer locations (less sprawl) leads to lower travel costs
    - Example of lowest level choice in AA
  - Wealthier households are less willing to choose multifamily housing
    - Example of medium level choice in AA
  - Best zones can expand more; more people can live in attractive areas
    - Example of highest level of choice in AA
- Other considerations/enhancements: Owner occupied rent, construction capacity, more technology/location response.
General observations from the scenarios

- Model responds in appropriate directions
- We can see in the magnitude of the model responses which parameters have not yet been adequately calibrated
- Integration of PECAS with the travel model will make the whole modeling program at SCAG more valuable in policy analysis
- Combined land use policies and transportation policies likely necessary to achieve VMT reduction targets
Action Items – Short Term

- Adjust selected parameters that came from the statewide model
  - Location choice dispersion factors
  - Technology Option choice dispersion factors
  - Calibrate import and export treatment
- Rerun calibration scripts
  - Buying / Selling dispersion parameters
  - Floor space quantity (match prices with new demand elasticity)
- Deliver By End of March 2011
  - Version 1 model (model data, set up, code)
  - Documents
  - Scenario Test Results
- June 2011 Peer Review

Action Items – Mid Term

- By End of 2012
- Review the initial model specifications and parameters from the state-wide model
- Possible design changes based on
  - SCAG priorities
  - SCAG data
  - Ongoing development of the Statewide model
- Integration with regional transportation model
  - 4-step model or Activity-based model
- Selective ongoing calibration
  - Identify parameters, especially the ones from the state-wide model, that had not been updated in phase 1
  - Identify most efficient improvements
    - cost vs benefit vs risk
Action Items – Mid Term

- Model Validation
  - With multi-year parcel databases, sub-county zonal validation (TAZ and LUZ)

- Scenario Tests
  - Re-run scenarios that have been previously setup, compare results between scenarios.

- Outreach
  - Start planning within SCAG for model use in currently relevant policy analysis
  - Member agency
    - Technical staff, partnerships
  - Other stakeholders

Q/A

- Question?