

Developing a Local Planning Model for Measuring the Impacts of Land Use Scenarios on Transportation

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SOUTHERN CALIFORNIA ASSOCIATION OF GOVERNMENTS

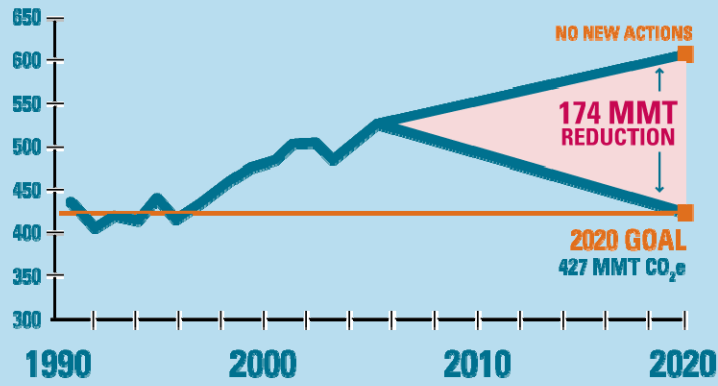
Background: CA Climate Change Legislation
Conceptual Model and Data
Model Variables
Model Results and Analysis
Model Test and Analysis
Summary and Conclusion



CA Climate Change Legislation

The Global Warming Solutions Act of 2006: Assembly Bill 32

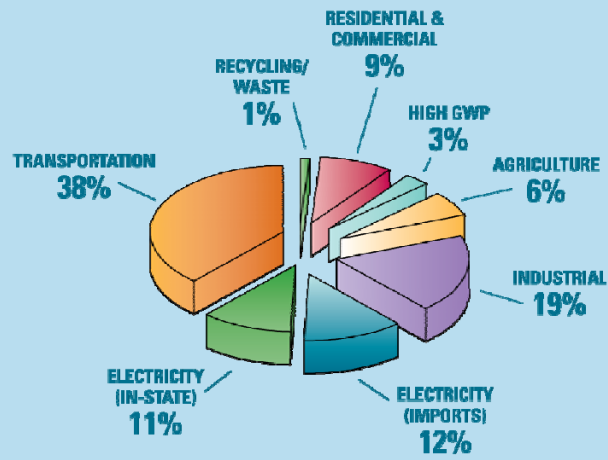
MMT CO₂e



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Greenhouse Gas Emissions by Sector

Passenger vehicles are the largest single source of greenhouse gas emissions in California

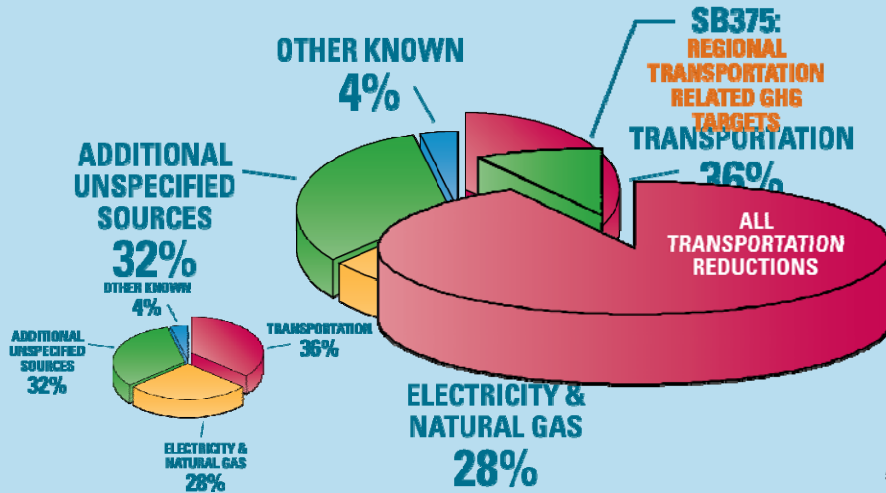


SOURCE: CALIFORNIA AIR RESOURCES BOARD, GREENHOUSE GAS STORAGE AND EMISSIONS, NOVEMBER 2011

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CA AB32 GHG Reduction Estimates by Measure

Regional transportation planning targets are one portion of the transportation reductions under AB32



5

Anticipating the Target

- Statewide reduction **5 million metric tons** through land use and transportation planning by 2020
- Estimated SCAG portion **2.5 million metric tons**

STATEWIDE GHG REDUCTION GOAL
5 MMT

CA POPULATION SCAG REGION COMPARED TO THE REST OF THE STATE

SCAG REGION
18.6 MILLION

49%

POPULATION OUTSIDE SCAG REGION

ESTIMATED SCAG GHG REDUCTION GOAL
≈ 2.5 MMT

6

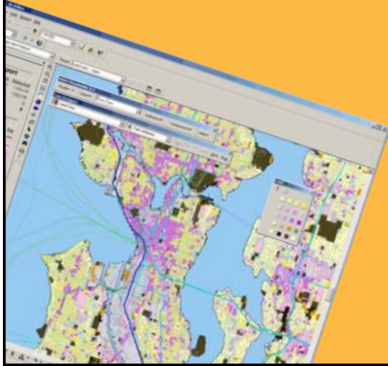
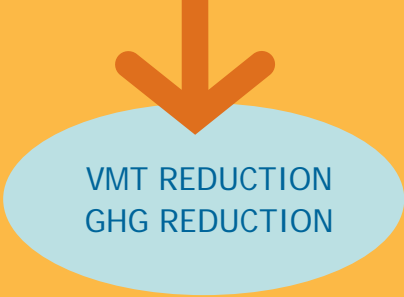
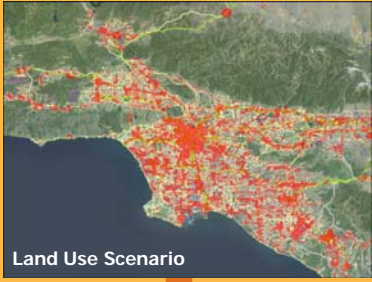
How SB 375 Addresses GHG Reductions

- ✓ Requires regional Sustainable Communities Strategy (SCS)
- ✓ Includes these three related approaches
 - Land use planning
 - Transportation policies
 - Transportation investments
- ✓ Requires “bottom-up” approach
 - Public participation plan
 - Simulation modeling



Analytical Models and Tools

- ✓ Sensitive to local land use changes
 - e.g., 4D elasticity models



Conceptual Model and Data

$$Y_i = f(SE_i, TC_i, LU_i)$$

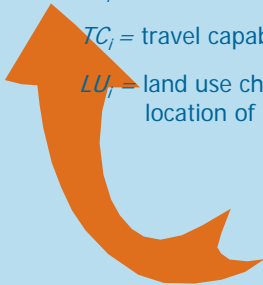
where Y_i = travel indicator of individual i
 SE_i = socioeconomic attributes of individual i
 TC_i = travel capabilities of individual i
 LU_i = land use characteristics of the residential location of individual i

HOUSEHOLD BASED

PASSENGER VEHICLE

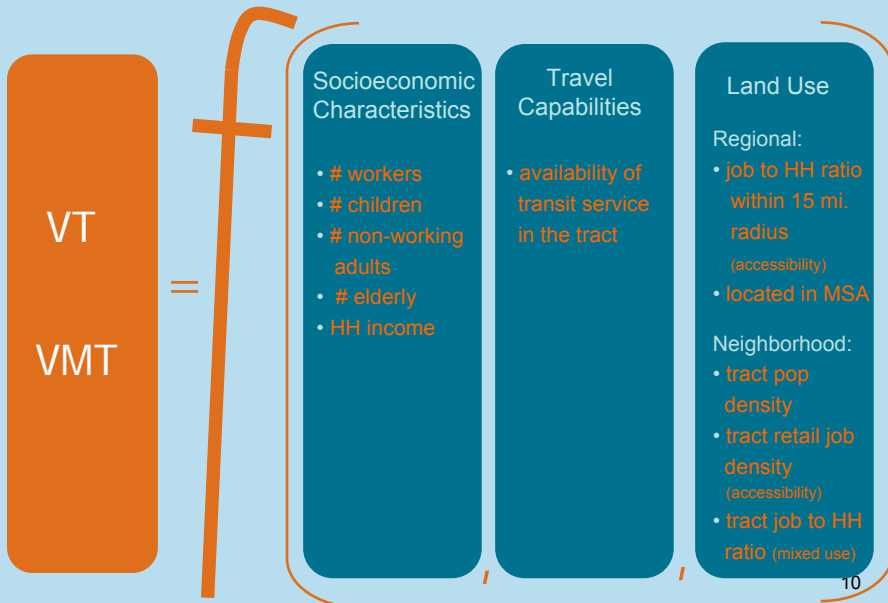
PRODUCED FROM HOME

WEEKDAY TRAVEL



2001 National Household Travel Survey (NHTS): 45,126 HH
 2000 Census
 2000 Census for Transportation Planning Package (CTPP)

Model Variables



Model Results and Analysis I

- ✓ Socioeconomic
 - # worker ↑ 1.9
 - # non-working adult ↑ 1.2
 - # elderly ↑ 1.1
 - # kid ↑ 0.6
 - HH income ↑ 0.2
- ✓ Travel Capabilities
 - No transit ↑ 0.3
- ✓ Land Use
 - Reg. accessibility N.S.
 - Outside MSA ↑ 0.2
 - Pop density ↑ ↓
 - Local accessibility ↓ ↑
 - Mixed use ↓ 0.1

VEHICLE TRIPS (VT) MODEL

VARIABLES	DESCRIPTION	Coeff.	t value	Pr > t
Constant		0.683	7.15	<.0001
Worker	Number of household workers	1.911	74.85	<.0001
Kid	Number of household children, age 5-15	0.56	23.86	<.0001
Adult	Number of non-working adults, age 16-64	1.167	35.84	<.0001
Elderly	Number of elderly, 65 and older	1.092	28.6	<.0001
HHICN	Total annual household income	0.189	48.31	<.0001
No_Transit	No transit services	0.324	6.82	<.0001
R_ACC	Regional accessibility	0.008*	0.13	0.8942
OutMSA	Outside MSA	0.186	3.07	0.0021
PD1-3k	Population density, 1-3k/mi ²	0.096*	-1.54	0.1237
PD3-5k	3-5k/mi ²	-0.278	-3.77	0.0002
PD5-7k	5-7k/mi ²	-0.763	-8.74	<.0001
PD7-10k	7-10k/mi ²	-1.053	-10.88	<.0001
PD10-15k	10-15k/mi ²	-1.726	-15.46	<.0001
PD15-25k	15-25k/mi ²	-2.525	-19.56	<.0001
PD25-40k	25-40k/mi ²	-3.054	-18.63	<.0001
PD40k+	Higher than 40k/mi ²	-4.583	-28.98	<.0001
L_ACC1	Local accessibility; 10-100 retail jobs/mi ²	0.295	5.1	<.0001
L_ACC2	100-300 jobs/mi ²	0.352	4.7	<.0001
L_ACC3	300-1000 jobs/mi ²	0.149	1.71	0.0867
L_ACC4	Higher than 1000 jobs/mi ²	-0.267	-2.04	0.0417
MIX	Local mixed use	-0.112	-2.36	0.0184
N	45,126			
F-value	892.6			
Adj. R square	0.2932			

* P < 0.1

Model Results and Analysis II

- ✓ Socioeconomic
 - # worker ↑ 19.3
 - # non-working adult ↑ 10.3
 - # elderly ↑ 3
 - # kid ↑ 2.5
 - HH income ↑ 2.2
- ✓ Travel Capabilities
 - No transit ↑ 3.2
- ✓ Land Use
 - Reg. accessibility ↓ 7.8
 - Outside MSA N.S.
 - Pop density ↓
 - Local accessibility ↓
 - Mixed use ↓ 4.5

VEHICLE MILES TRAVELED (VMT) MODEL

VARIABLES	DESCRIPTION	Coeff.	t value	Pr > t
Constant		23.326	15.2	<.0001
Worker	Number of household workers	19.263	46.99	<.0001
Kid	Number of household children, age 5-15	2.486	6.59	<.0001
Adult	Number of non-working adults, age 16-64	10.289	19.69	<.0001
Elderly	Number of elderly, 65 and older	3.931	6.41	<.0001
HHICN	Total annual household income	2.211	35.27	<.0001
No_Transit	No transit services	3.218	4.22	<.0001
R_ACC	Regional accessibility	-7.821	-8.36	<.0001
OutMSA	Outside MSA	0.647*	0.67	0.5056
PD1-3k	Population density, 1-3k/mi ²	-6.885	-6.89	<.0001
PD3-5k	3-5k/mi ²	-10.782	-9.09	<.0001
PD5-7k	5-7k/mi ²	-16.931	-12.07	<.0001
PD7-10k	7-10k/mi ²	-14.89	-9.58	<.0001
PD10-15k	10-15k/mi ²	-23.956	-13.36	<.0001
PD15-25k	15-25k/mi ²	-31.152	-15.03	<.0001
PD25-40k	25-40k/mi ²	-39.088	-14.85	<.0001
PD40k+	Higher than 40k/mi ²	-47.761	-18.81	<.0001
L_ACC1	Local accessibility; 10-100 retail jobs/mi ²	-5.091	-5.48	<.0001
L_ACC2	100-300 jobs/mi ²	-6.309	-5.26	<.0001
L_ACC3	300-1000 jobs/mi ²	-3.869	-2.77	0.0056
L_ACC4	Higher than 1000 jobs/mi ²	-9.615	-4.57	<.0001
MIX	Local mixed use	-4.472	-5.87	<.0001
N	45,126			
F-value	456			
Adj. R square	0.175			

* P < 0.1

Model Test and Analysis I

- ✓ Mean observed values from the study model vs. mean observed values from the NHTS data
 - show high consistency

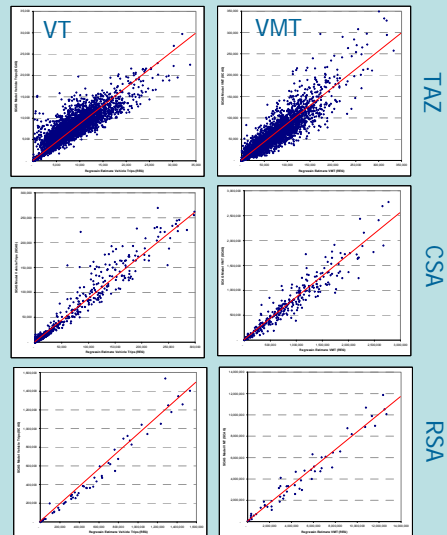
OBSERVED VS. PREDICTED

	VT		VMT		Number of Sample	
	Observed	Predicted	Observed	Predicted	Observed	Predicted
Total	5.6	5.7	51.5	52.8	50,751	45,126
Household Size						
1-person	3	3.1	24.1	25.9	11,530	9,975
2-person	5.4	5.5	50.6	51.2	19,688	17,136
3-person	6.7	6.7	65.4	64.4	8,023	7,365
4-person	7.7	7.5	69.6	71.4	7,275	6,723
5-person	8.1	8.1	77.2	75.9	2,924	2,722
6-person +	8.5	9	76	80.4	1,311	1,205
MSA Size (MSA population)						
<250K persons	6.2	5.8	49.4	53.8	8,567	7,786
250K - 500K	5.9	5.9	52	54.3	8,373	7,596
500K - 1Million	5.9	5.9	53.8	53.9	4,792	4,262
1-3 Million	5.7	5.8	51.1	51.8	6,128	5,582
>3 Million	5.1	5.4	45.5	47.3	13,025	11,519
Outside MSAs	5.8	5.9	62.4	62.5	9,866	8,381
Population Density						
<1K/mi ²	6.1	6.2	65.3	66.7	22,778	19,902
1-3K/mi ²	6.2	6.3	52.5	54.1	11,143	10,099
3-5K/mi ²	5.8	5.9	46.5	48.1	6,629	6,003
5-7K/mi ²	5.2	5.3	39.2	40.8	3,493	3,154
7-10K/mi ²	4.7	4.8	39.5	41.1	2,216	1,988
10-15K/mi ²	4.2	4.2	32.4	33.2	1,546	1,379
15-25K/mi ²	3.2	3.2	23.6	24.7	1,262	1,114
25-40K/mi ²	2.6	2.8	16.7	18.2	732	649
Local Accessibility						
<20 jobs/mi ²	6	6.1	66	67.4	17,507	15,108
10-100	6.1	6.2	52.8	54.4	16,547	14,973
100-300	5.4	5.5	42	43.3	9,476	8,562
300-1,000	4.7	4.8	37.8	39.6	5,441	4,897
>1,000	2.9	3	20.7	21.6	1,780	1,586

Model Test and Analysis II

- ✓ Estimated total VT and VMT
 - study model: 31 M. VT, 264 M. VMT
 - SCAG model: 28 M. VT, 222 M. VMT
- ✓ Estimated VT and VMT at TAZ, CSA, or RSA level
 - TAZ level: Adj. R² > 0.9
 - CSA level: Adj. R² > 0.9
 - RSA level: Adj. R² > 0.9

MODEL VS. SCAG REGIONAL MODEL *



* With 2003 socioeconomic data as inputs, VT and VMT were calculated for each TAZ based on SCAG model output, which did not include non home-based VT and VMT

Model Test and Analysis III

✓ Estimated VT and VMT changes between 2035 baseline and plan land use scenario from the study model vs. SCAG model

- 3.3% VT decrease from the study model
- 3.3% VMT decrease from the study model vs. 3.5% decrease from the SCAG model

* Planned land use scenario was developed by SCAG's Compass Blueprint program, reflecting high-density, mixed-use, and transit-oriented development.

2035 BASELINE VS. PLAN*

Year/Scenario	Household	Regression Model		SCAG Model	
		VT	VT	VMT	VMT**
2003	5.55	31.09	na	263.66	380.67
2035 Baseline	7.71	43.53	na	367.11	519.38
2035 Plan	7.71	42.12	na	354.76	501.1
03-35BL	38.90%	40.00%	-	39.20%	36.40%
35BL - 35PL	0.00%	-3.30%	-	-3.40%	-3.50%

Unit = in millions

** Total regional VMT, which explains higher VMT from the SCAG model

Summary and Conclusion

- ✓ Coefficients of explanatory variables have shown significant and reasonable relation to VT and VMT
- ✓ Estimated VT and VMT were consistent with those calculated from SCAG model
- ✓ Study models were sensitive to land use changes

- ✓ Census tract geography
- ✓ SCAG region data
- ✓ Household based

SUMMARY

LIMITATION

THANK YOU