SOCIO-ECONOMIC CAUSES AND CONSEQUENCES OF FUTURE ENVIRONMENTAL CHANGES WORKSHOP

A WORKSHOP SPONSORED BY THE U.S. ENVIRONMENTAL PROTECTION AGENCY'S NATIONAL CENTER FOR ENVIRONMENTAL ECONOMICS (NCEE), NATIONAL CENTER FOR ENVIRONMENTAL RESEARCH (NCER)

November 16, 2005

EPA Region 9 Building

75 Hawthorne Street 1st Floor Conference Room San Francisco, CA

Prepared by Alpha-Gamma Technologies, Inc. 4700 Falls of Neuse Road, Suite 350, Raleigh, NC 27609

ACKNOWLEDGEMENTS

This report has been prepared by Alpha-Gamma Technologies, Inc. with funding from the National Center for Environmental Economics (NCEE). Alpha-Gamma wishes to thank NCEE's Cynthia Morgan and Jennifer Bowen and the Project Officer, Cheryl R. Brown, for their guidance and assistance throughout this project.

DISCLAIMER

U.S. Environmental Protection Agency
Socio-Economic Causes and Consequences of Future Environmental Changes Workshop

November 16, 2005
EPA Region 9
75 Hawthorne Street
1st Floor Conference Room
San Francisco, CA

8:45-9:15	**Registration**	
9:15 -9:30	**Introductory Remarks – Tom Huetteman, Deputy Assistant Regional Administrator, USEPA Pacific Southwest Region 9**	
9:30-11:30	**Session I:**	**Trends in Housing, Land Use, and Land Cover Change** Session Moderator: Jan Baxter, US EPA, Region 9, Senior Science Policy Advisor
	9:30 – 10:00	Determinants of Land Use Conversion on the Southern Cumberland Plateau **Robert Gottfried (presenter)**, Jonathan Evans, David Haskell, and Douglass Williams, University of the South
	10:00– 10:30	Integrating Economic and Physical Data to Forecast Land Use Change and Environmental Consequences for California's Coastal Watersheds Kathleen Lohse, David Newburn, and **Adina Merenlender (presenter)**, University of California at Berkeley
	10:30 – 10:45	**Break**
	10:45 – 11:00	Discussant: Steve Newbold, US EPA, National Center for Environmental Economics
	11:00 – 11:15	Discussant: Heidi Albers, Oregon State University
	11:15 – 11:30	Questions and Discussions
11:30 – 12:30	**Lunch**	
12:30 –2:30	**Session II:**	**The Economic and Demographic Drivers of Aquaculture and Greenhouse Gas Emissions Growth** Session Moderator: Bobbye Smith, U.S. EPA Region 9
	12:30 – 1:00	Future Growth of the U.S. Aquaculture Industry and Associated Environmental Quality Issues **Di Jin (presenter)**, Porter Hoagland, and Hauke Kite Powell, Woods Hole Oceanographic Institution

	1:00 – 1:30	Households, Consumption, and Energy Use: The Role of Demographic Change in Future U.S. Greenhouse Gas Emissions Brian O'Neill, Brown University, **Michael Dalton (presenter)**, California State University – Monterey Bay, John Pitkin, Alexia Prskawetz, Max Planck Institute for Demographic Research
	1:30 – 1:45	Discussant: Tim Eichenberg, The Ocean Conservancy
	1:45 – 2:00	Discussant: Charles Kolstad, University of California at Santa Barbara
	2:00 – 2:30	Questions and Discussion
2:30 – 2:45	**Break**	
2:45 - 4:55	**Session III:**	**New Research: Land Use, Transportation, and Air Quality** Session Moderator: Kathleen Dadey, US EPA, Region 9, Co-chair of the Regional Science Council
	2:45 - 3:10	Transforming Office Parks Into Transit Villages: Pleasanton's Hacienda Business Park **Steve Raney (presenter)**, Cities21
	3:10 – 3:35	Methodology for Assessing the Effects of Technological and Economic Changes on the Location, Timing and Ambient Air Quality Impacts of Power Sector Emissions Joseph Ellis and **Benjamin Hobbs (presenter)**, Johns Hopkins University, Dallas Burtaw and Karen Palmer, Resources for the Future
	3:35 - 4:00	Integrating Land Use, Transportation and Air Quality Modeling **Paul Waddell (presenter)**, University of Washington
	4:00- 4:25	Regional Development, Population Trend, and Technology Change Impacts on Future Air Pollution Emissions in the San Joaquin Valley Michael Kleeman, Deb Niemeier, **Susan Handy (presenter)**, Jay Lund, Song Bai, Sangho Choo, Julie Ogilvie, Shengyi Gao, University of California at Davis
	4:25 – 4:55	Questions and Discussion
4:55 – 5:00	**Wrap-Up and Closing Comments**	

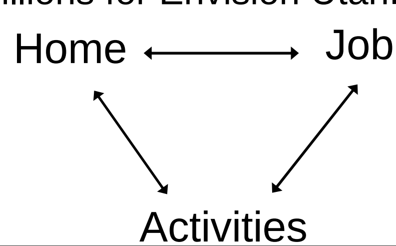
Transforming Office Parks into Transit Villages: Vision

- Less auto-dominated suburbs
- Assumes global warming & peak oil are real
  - Least worst alternative
- Less than 50% of trips by solo driving
- Extreme sustainability, cut energy use
  - From 280 mBTU per HH per year to 97 mBTU
  - Smart Growth on steroids
    - Controversial
- Futuristic, complicated.

steve_raney@cities21.org, slide 1

Disfunctional Human Settlement Patterns (Risse)

- Big required change: demand side. There's no quick transportation or energy supply fix.
  - Frustration: environment ⇔ smart growth links are weak
- For each person, minimize the distances in the triangle below. Miles ➔ feet
  - 50 DU/acre urbanist mixed use ➔ 50% of trips w/o car, mostly ped, not transit (GB Arrington, TCRP 102) – "walk to quart of milk"
- πr^2 :: pipes, wires, streets, distribution. Infrastructure cost savings in the billions for Envision Utah. (25% -TCRP74)



steve_raney@cities21.org, slide 2

The Villain: Suburban Office Parks

- Main cause of sprawl & congestion for 30 years
  - Affordability decreasing, segregation increasing
  - 200 with ~ 30K workers ➔ 6M+ workers
- ULI's *Transforming Suburban Business Districts*
- Calthorpe "We didn't focus on office parks. Huge mistake. Need powerful strategies for these"
- Cervero: So bad they're easy to fix
- Shoup (*High Cost of Free Parking*) - Parking lots ➔ land bank. The new frontier: 5 spaces per car
- Duany: "Upper Rock" business park ➔ TOD
- Rail~Volution session: Tyson's ➔ edgy TOD
- 70% of tech workers want urban vitality.

steve_raney@cities21.org, slide 3

Villain 2: Housing Industry

- Problem: few innovative housing choices
- 1) Zimmerman / Volk. Home industry: "lumbering giants." No genuine innovations. No "meaningful improvement of the product offered to the consumer"
- 2) SG America: "Homes are like pork bellies, all the same, rather than as consumer products which vary greatly according to people's preferences." HPD #12i4
- New choice: vibrant, green suburban lifestyle: short commute apts and condos, mixed use, good schools.

(By John S. Pritchett www.pritchettcartoons.com)

steve_raney@cities21.org, slide 4

Transformational Tools

- Personal Rapid Transit (PRT)
  - Makes carpooling & transit more effective
- GPS cell phones to connect
- Safe Hitchhiking
- Better carpool "matchmaking"
- Small parking charges (automated)
- "Cool to be green" culture
- Parking lots ➔ housing with retail
  - "Walk to work" housing
  - Small parking charges
- Customer-centered design.

steve_raney@cities21.org, slide 5

PRT – Rapid Local Shuttle

- Feeder / Distributor / Circulator
  - Similar to a monorail. Video
- High service level, no waiting, faster than a car.
  - Non-stop, 30 MPH
  - Bypasses intermediate stations
  - Ride alone or with 1-2 people you choose
  - Convenient stops by buildings (not on street)
  - Comfortable, quiet, safe, no exhaust
  - 24x7.

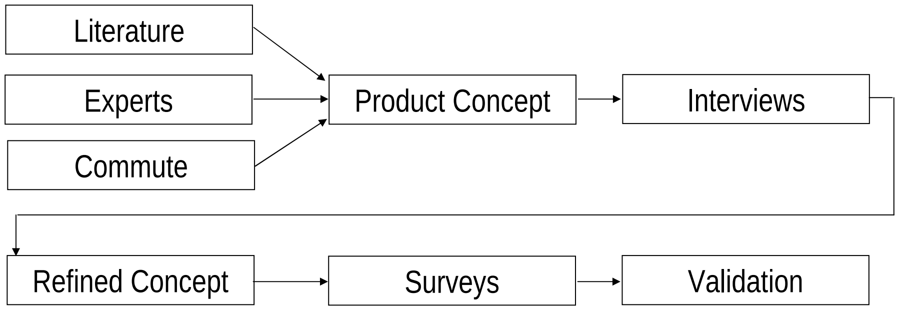
steve_raney@cities21.org, slide 6

5 PRT Development Efforts

- ULTra, Cardiff, Wales (1km track, 2 vehicles)
  - Won Heathrow System RFP
  - $10M investment by British Airport Authority
- Korean Posco for Uppsala, Sweden
  - Close clone of Skyweb design, more funding
- Korea Railroad Research Institute: $30M, 5 yr
- Skyweb Express / Taxi2000, MN
  - (60’ track, 1 vehicle)
- Microrail, TX (60’ track, 1 vehicle)
- Dubai procurement
  - no public review!.

steve_raney@cities21.org, slide 8

Customer-Centered Product Research



- Silicon Valley style
- New technology bias
  - High touch / community building is natural
  - Takes on personality of researching organization
- Start with rough business case in mind and refine.

225 Surveys at Oracle

- Vulcan mind meld
- Teach suburban solo drivers about carpooling and transit (drawbacks)
- Customized for each commute
- + Low income worker interviews.

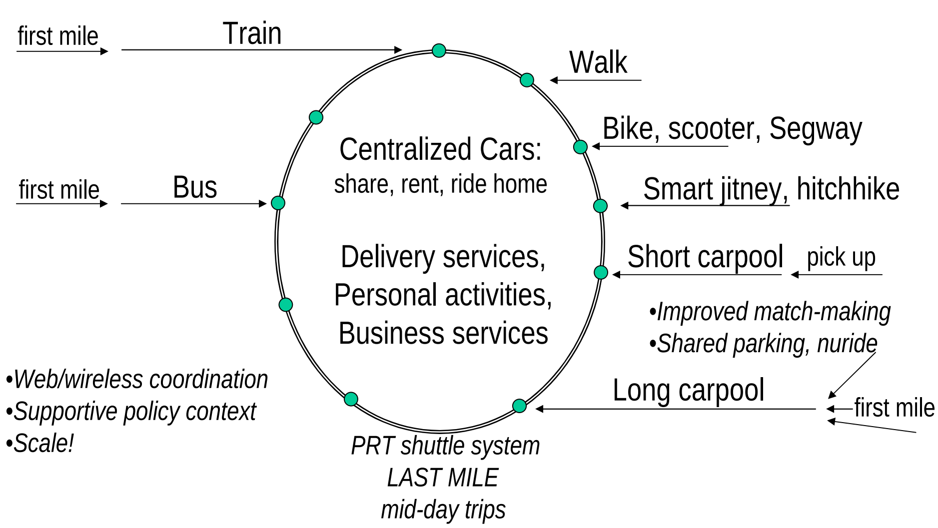
Promising Palo Alto Results

- Promising, but not definitive (62)
- Solo commutes: 89% ➔ 45%
  - Carpool: 9% ➔ 32%, train: 0% ➔ 15.5% train
  - For 20K people, removes 6,600 autos (roughly)
    - @ 350 s.f. per space ➔ 50 acres ➔ $326M hsng profit
- 1.32 PRT trips/day/person => 26K trips/day
  - PRT: profitable (capital, O&M)
- Huge transit village ➔ land value increase
- Apply to 6M workers in major emp. centers
  - 1.98M cars, 12B VMT, 424M gals, 8.4B lbs CO_2 .

steve_raney@cities21.org, slide 11

Comprehensive, Integrated Mobility

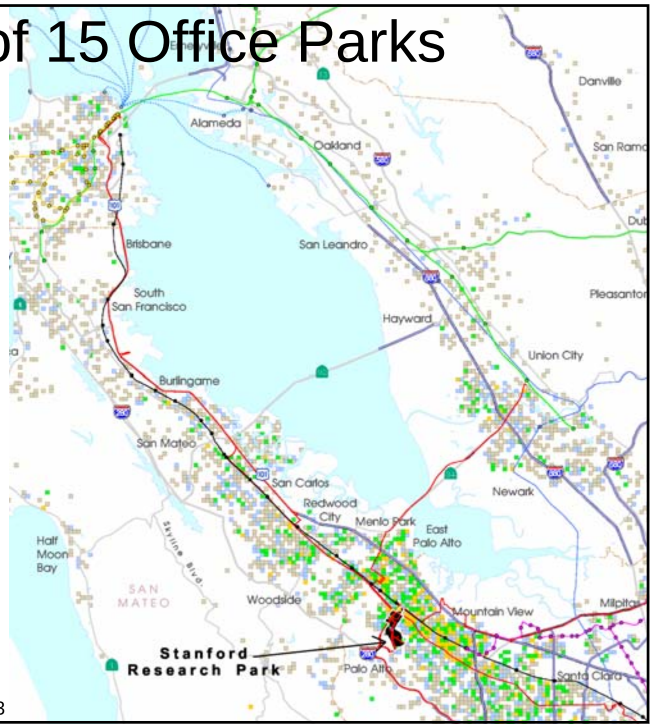
Door to Door



steve_raney@cities21.org, slide 12

GIS study of 15 Office Parks

- Census LEHD
- Commute Shed
- Aerial photography
- Demographics.



steve_raney@cities21.org, slide 13

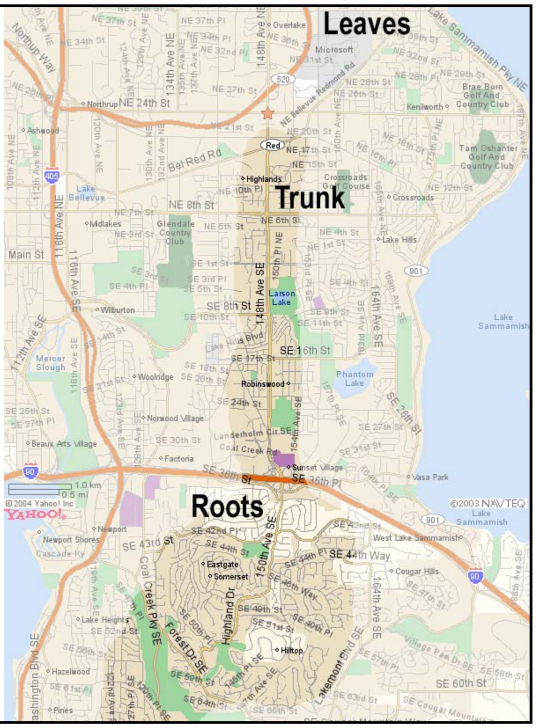
Company Town Housing

- Walk to work apts/condos for tech workers
- The most cost-effective suburban traffic reduction policy (ever). SF ←→ San Jose (swap)
- Priority access to housing for short commuters
- $100 monthly price incentives for good commutes
- Bad location decision creates “negative economic externality” for society. So, “internalize” the cost
- ? Improve tech worker quality of life and leave low income folks farther behind ?
- Low income upward mobility
  - {package deal: job, home, job training, better schools for kids, more family time.} Boost up the ladder.

steve_raney@cities21.org, slide 15

Digital Hitchhiking

- Exploit GIS patterns
- Bus + safe hitchhiking.



steve_raney@cities21.org, slide 16

Toolkit

- "Cool to be green" culture
  - All residents sign a green pledge to get housing
    - Force a tipping point
  - Supporting culture like EBay on-line community
- Grocery shopping without a trunk.

17

THE END

steve_raney@cities21.org, slide 18

Assessing the Effects of Technological & Economic Changes on the Location, Timing, and Ambient Air Quality Impacts of Power Sector Emissions

Investigators

Hugh Ellis (PI), Ben Hobbs

The Johns Hopkins University

Dallas Burtraw, Karen Palmer

Resources for the Future

This research is funded by
U.S. EPA - Science To Achieve Results (STAR) Program
Grant # R831836

PURPOSE

Develop methodology for:

- creating geographically and temporally disaggregated emissions scenarios
- for the electric power sector
- on a multidecadal time-scale

WHY POWER?

- **Source of a large share of SOx, NOx, mercury and CO2 emissions**
  - Future shares are highly uncertain
  - Technology change, fuel mix, electric load growth, regulation
- **Alternative scenarios affect total emissions and their spatial and temporal distribution**
- **Emissions & air quality impacts sensitive to the growth and distribution of electricity demands**
  - Geographically and temporally
  - Linked to temperature and other climate variables that may change significantly

Needed: Theoretically defensible, transparent and practical method for temporal and spatial emissions scenarios

- A sequence of models representing market-driven electricity supply and facility location constrained by land use and policy-based emissions limits
- HAIKU model (RFF) will:
  - Set regional boundary conditions for regional technology, demand, and emissions totals
  - Disaggregate national totals (e.g., IPCC scenarios) to regions
- Finer-scaled regional models then will:
  - Allocates specific generation facilities to a national grid (e.g., 132 columns x 90 rows of 36x36 km cells)
  - Estimate hourly emissions
  - Uses HAIKU totals as boundary conditions

- Must test the robustness of emissions disaggregations to assumptions concerning:
  - demand growth
  - technological change
  - policy (e.g., emissions caps, time of day electricity pricing)
- We will explore the sensitivity of both emissions *and* ambient air quality to these uncertain drivers
  - Tropospheric ozone and particulates for an example set of scenarios will be simulated using MM5/MCIP/SMOKE/CMAQ
- Goal: demonstrate the practicality of integrating the source disaggregation methodology with the SMOKE emissions processing system and subsequently CMAQ

Research Approach Summary

Regional-scale Technology and Emissions (Burtraw and Palmer, RFF)

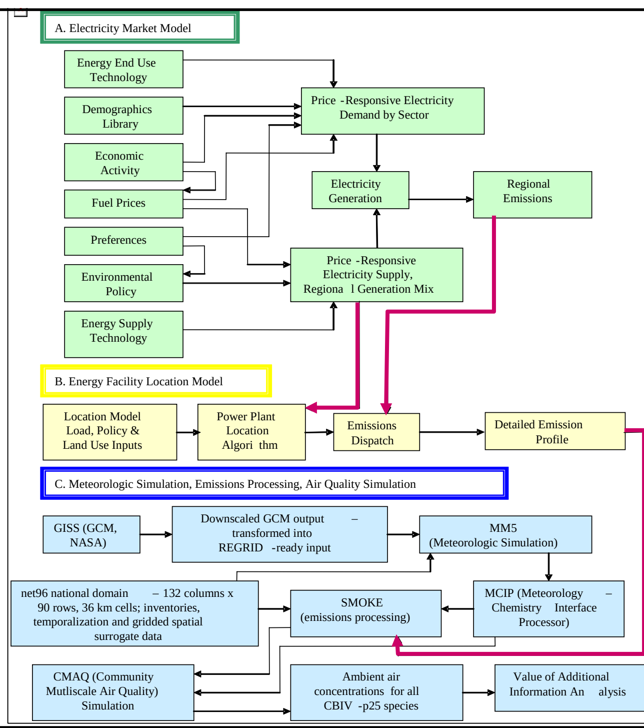
- **Electricity supply**
- **Electricity demand**
- **Value of information in model development**

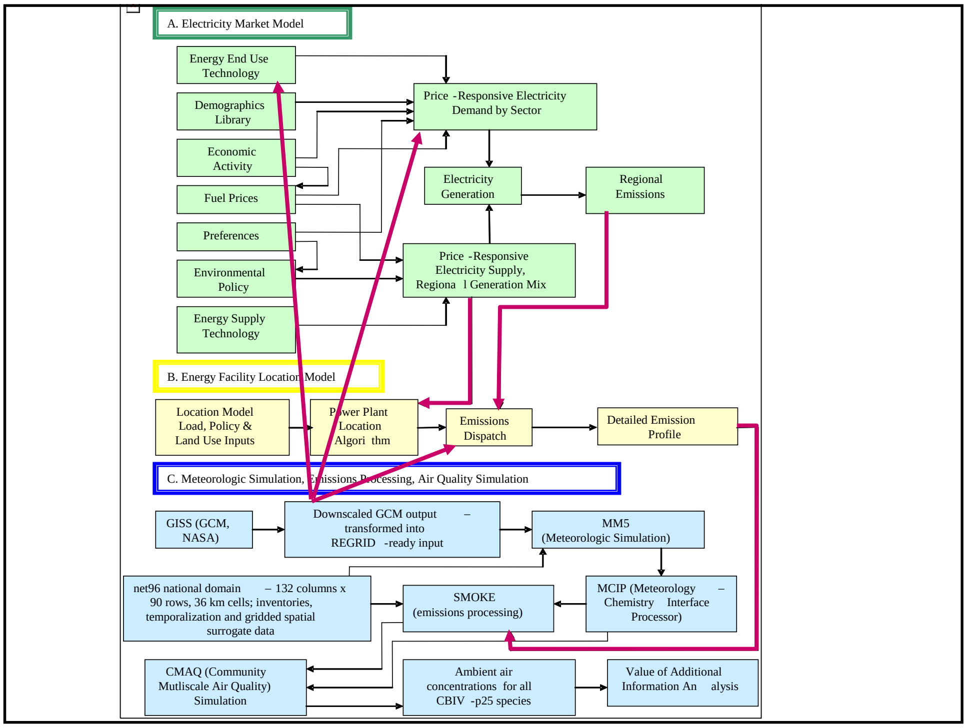
Emissions Downscaling: Load Disaggregation, Facility Siting and Generation Dispatch (Burtraw, Palmer – RFF; Hobbs, Ellis - JHU)

- **Geographically disaggregate power use**
- **Geographically, temporally disaggregate emissions**

Fine-Scale Emissions Processing and Ambient Air Quality Simulation (Ellis, JHU)

- **Meteorologic simulation (MM5), transformation using MCIP, import downscaled emissions into SMOKE V2.2, air quality simulation using CMAQ**
- **In some cases, MM5 will be driven by the GISS GCM**





Emission Processing in SMOKE

- **Many inventory emissions are annual averages (e.g., tons/year)**
- **Hourly emissions created using temporal profiles**
- **Source-specific hourly emissions (e.g., generated through our downscaling) are integrated into the master inventory**
- **Other emissions can be left intact or modified through manually applied growth / reduction factors (by SCC)**

Objective of the RFF Electricity Market Model (HAIKU)

To simulate outcomes of a electricity markets

- **Recognizing institutions for electricity and environmental regulation**
- **Using maximization of economic welfare (profits plus consumer surplus) subject to characterizations of demand, technology and institutions.**

➢ ***Choice variables:***

- **capacity investment**
- **retirement**
- **generation choices.**

Vintage Classico RFF Electricity Market Model

- ***Spatial disaggregation:***
  - **13 NERC subregions with inter-regional trade**
  - **~48 model plants in each region**
  - **Emission compliance (SO_2, NO_X, Hg, CO_2)**
- ***Temporal disaggregation:***
  - **3 seasons x 4 time blocks**
  - **Seasonal capacity and fuel costs**
- ***Price Responsive Demand*:**
  - **3 customer classes**
  - **EIA demand forecast with elasticities**
- ***Technology & fuel characteristics and costs:***
  - **Data from EIA, EPA and industry sources**

Illustration of Demand, Supply Equilibrium and How Pricing Institutions Matter to Resource Use (Example: ERCOT Summer Baseload)

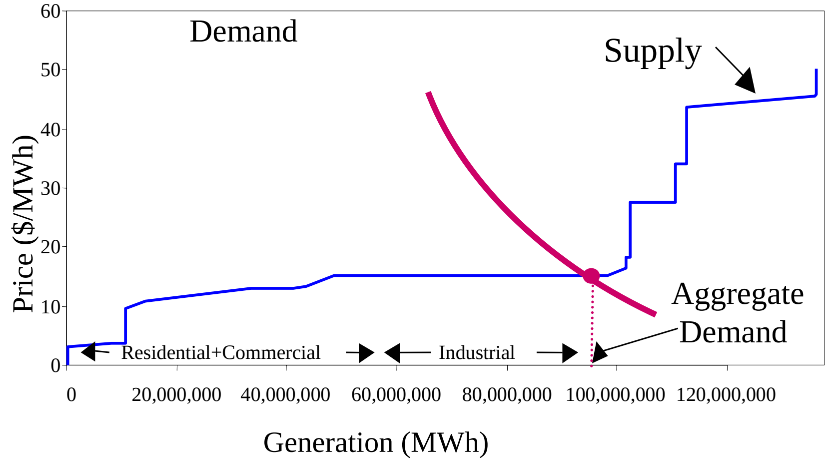


Illustration of Demand, Supply Equilibrium and How Pricing Institutions Matter to Resource Use (Example: ERCOT Summer Baseload)

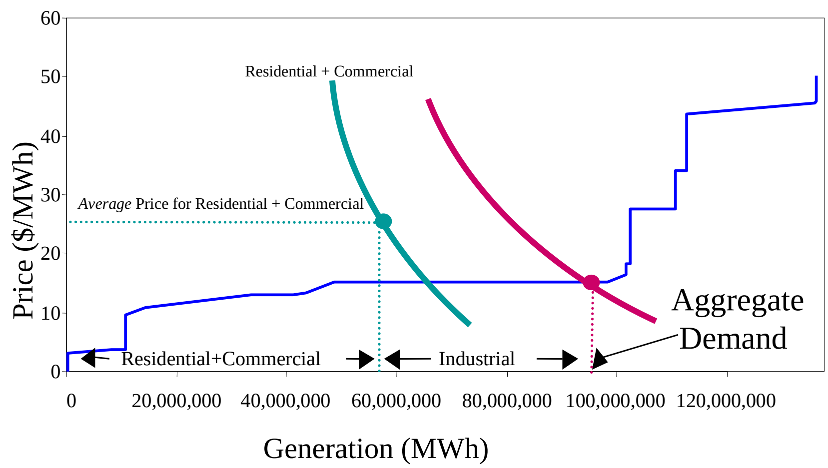


Illustration of Demand, Supply Equilibrium and How Pricing Institutions Matter to Resource Use (Example: ERCOT Summer Baseload)

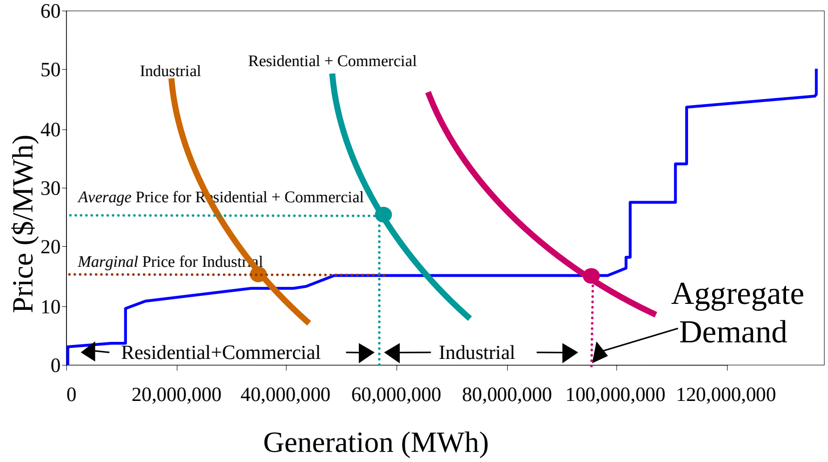
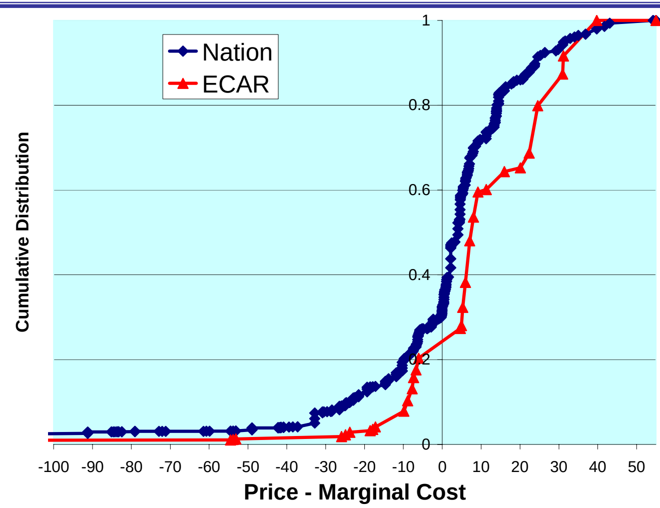


Illustration: How Institutions Set Prices Is Important



- A model based on marginal cost pricing would misestimate electricity demand and generation by specific technologies and times of day

Intermediate Projections:
Using the Model to 2025

- ***Environmental policies, e.g.:***
  - Caps? Allowances allocation?
  - NSR: Announced settlements only?
  - Renewable incentives, state-level multi-pollutant and RPS?
- ***Industry restructuring, e.g.:***
  - 5 regions (NY, NE, MAAC, MAIN, ERCOT) with competitive prices?
  - Time of day pricing for industrial customers only?
  - Rate of transmission growth?

The Challenge: Long Term Projections
Using the Model to 2050

- ***Environmental policy & institutions***
  - Aggregate caps for air pollutants / policy design
  - Regulation and institutions for setting electricity prices
- ***Demand modeling***
  - Demographic, technology forecasts for demand scaling
  - System of demand integrated over time blocks
- ***Technology paths for supply -- scenarios***
  - New nuclear, relicensing
  - Clean coal, carbon capture and storage
  - LNG, FACTS
  - Distributed generation
  - Advanced post combustion controls
  - Renewable penetration / efficiency improvements
  - Exogenous, endogenous technological change

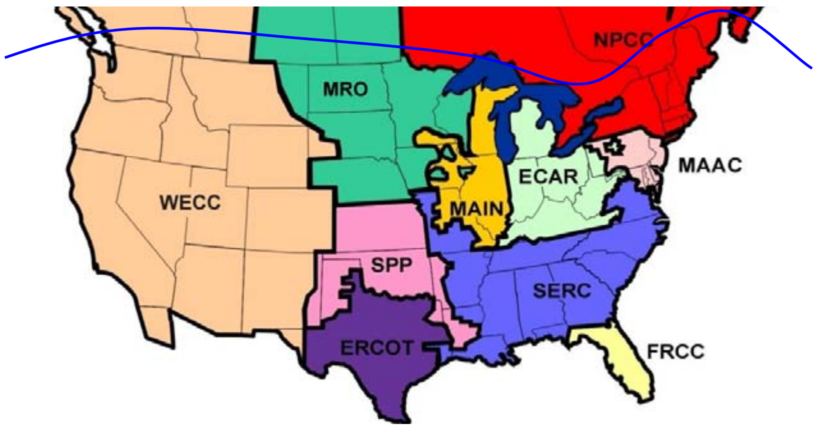
Recent Applications of the HAIKU Model

- “Cost-Effectiveness of Renewable Electricity Policies,” (Palmer and Burtraw) 2006. *Energy Economics,* forthcoming.
- *Reducing Emissions from the Electricity Sector: The Costs and Benefits Nationwide and in the Empire State,* (Palmer, Burtraw and Shih) 2005. New York State Energy Research and Development Authority, Report 05-02.
- “Efficient Emission Fees in the U.S. Electricity Sector,” (Banzhaf, Burtraw and Palmer) 2004. *Resource and Energy Economics* 26(3): 317-341.
- “Uncertainty and the Net Benefits of NOX Emissions Reductions from Electricity Generation,” (Burtraw, Bharvirkar and McGuinness) 2003. *Land Economics*79(3): 382-401.
- “Ancillary Benefits of Reduced Air Pollution in the United States from Moderate Greenhouse Gas Mitigation Policies in the Electricity Sector,” (Burtraw, Krupnick, Palmer, Paul, Toman and Bloyd) 2003. *Journal of Environmental Economics and Management* 45(3): 650-673.
- *Economic Efficiency and Distributional Consequences of Different Approaches to NOx and SO2 Allowance Allocation,* Burtraw and Palmer, Oct. 2003. Report to U.S. EPA.
- “The Effect on Asset Values of the Allocation of Carbon Dioxide Emission Allowances,” (with Karen Palmer, Anthony Paul and Ranjit Bharvirkar) 2002. *The Electricity Journal* 15 (5): 51-62.

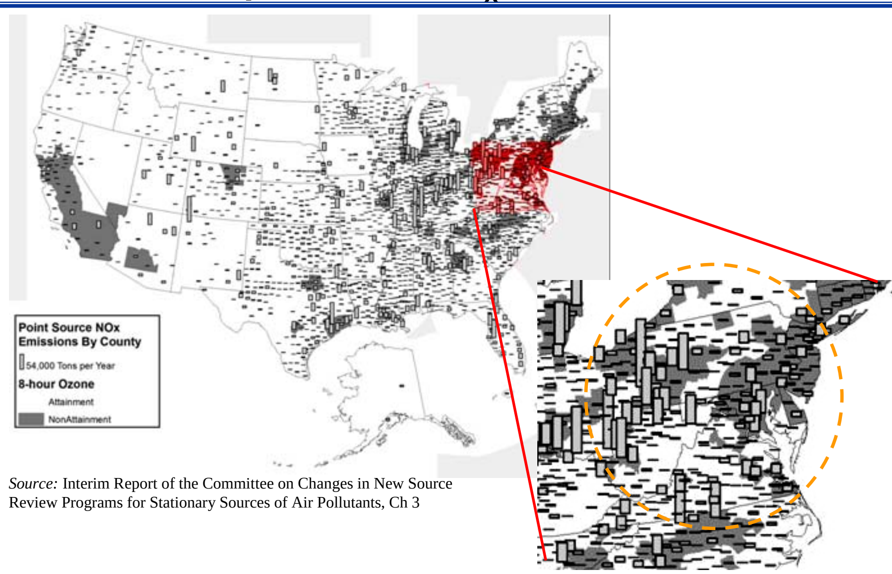
The Downscaling Problem

- **National electric sector models are aggregate in space and time. *RFF model:***
  - **13 NERC subregions**
  - **12 time blocks per year**
  - **Based on average seasonal climate conditions**
- ***The challenges:***
  - **CMAQ requires hourly emissions by point source**
  - **CMAQ results sensitive to interactions of location, meteorology and timing**
  - **There is significant interannual variation in climate and, thus, emissions and their impacts**

Spatial Aggregation
Model Output: By NERC Subregions

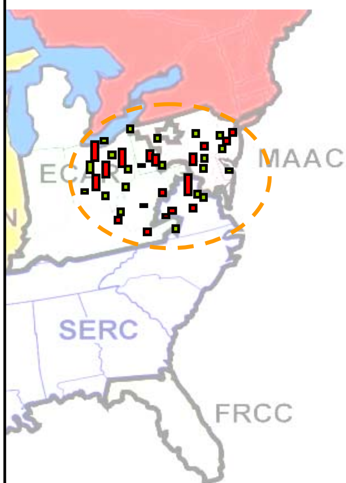


Required Spatial Resolution
CMAQ Input: Point NO_x Emission Sources



Source: Interim Report of the Committee on Changes in New Source Review Programs for Stationary Sources of Air Pollutants, Ch 3

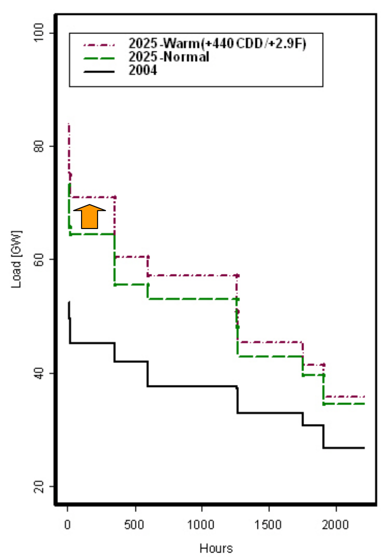
Spatial Disaggregation: Approach



- ***Competitive market simulation model (linear program)***
  - **Choose facility locations (e.g., by county), operation levels (by hour), and emissions**
  - **Subject to boundary conditions from RFF (regional generation mix, emissions by period)**
  - **Consider feasible siting locations, transmission grid**
- ***Similar method used by USDOE for emissions scenarios***
  - **E.g., 1978 National Coal Utilization Assessment**

Temporal Aggregation: Example from National Energy Modeling System

NEMS (National Energy Modeling System) Load



"Load Duration Curve" showing summer distribution of PJM electricity demands for three cases:

- NEMS 2004
- NEMS 2025 (normal climate)
- NEMS 2025 (warmer climate)

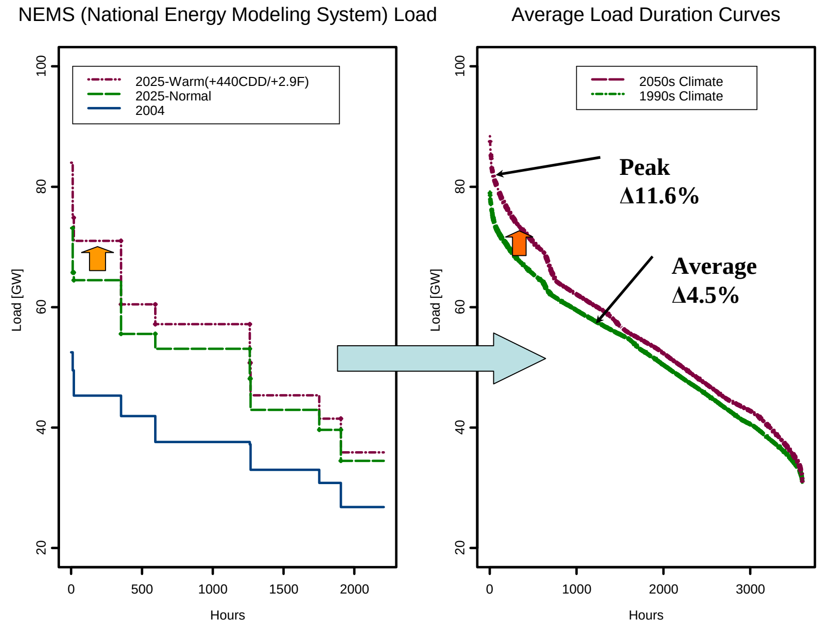
Warmer climate has largest effect during peak hours

- More likely to be coincident with ozone episodes

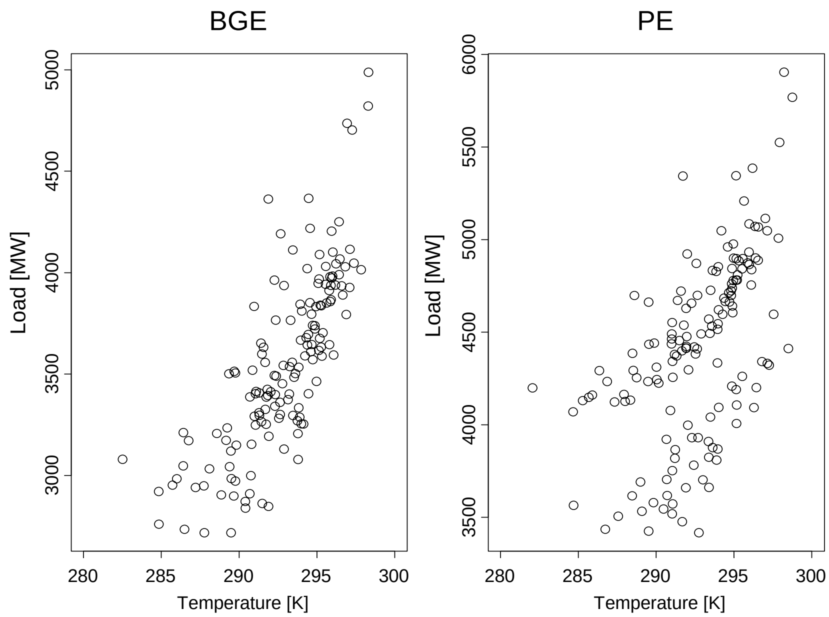
Represents average year

- But there is actually high year-to-year variability in peak demands due to weather
- PJM: σ = 5% of peak
- Ozone formation nonlinear $\Rightarrow$
  ozone during average year $\neq$ average ozone under annual variability

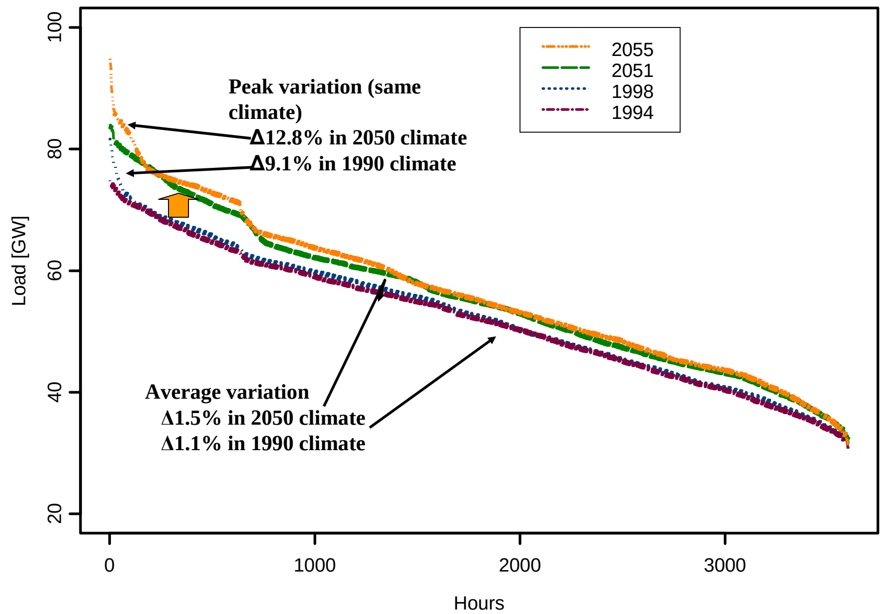
Required Temporal Disaggregation: Blocks to Hourly Demand



Required Temporal Disaggregation: Must Account for Weather-Load Relationships



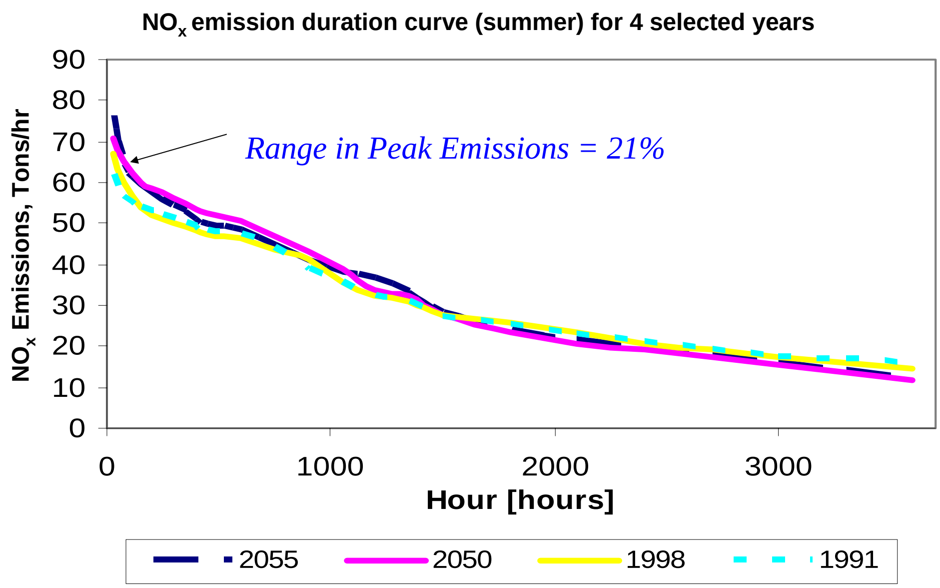
Required Temporal Disaggregation: Interannual Variability



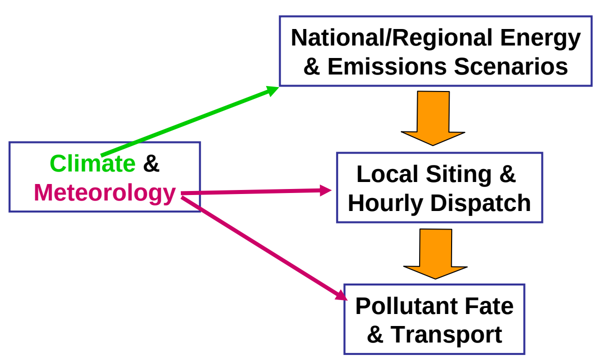
Temporal Disaggregation: Approach

- ***Inputs:***
  - Average loads for 12 time periods under average climate (from RFF model)
  - Multiple years of simulated temperature data (from MM5)
  - Short-run (hourly) model that projects short run (given fixed appliance/housing stock) load response to temperature changes
- ***Procedure:***
  - Project hourly normalized load response to simulated temperature data
  - Transparent rescaling procedure converts normalized loads to hourly loads whose multiyear averages are consistent with RFF time-averaged loads
  - Resulting rescaled loads vary from year-to-year based on temperature

Temporal Disaggregation:
Higher interannual variation in NO_x during peak hours



Summary



Integrating Land Use, Transportation and Air Quality Modeling

Socio-Economic Causes and Consequences of Future Environmental Changes Workshop

November 16, 2005

Paul Waddell
206-221-4161
pwaddell@u.washington.edu

Center for Urban Simulation and Policy Analysis
Evans School of Public Affairs
University of Washington
http://www.urbansim.org

Agenda

- Research Agenda
- EPA STAR Project
- UrbanSim
- A Brief Example

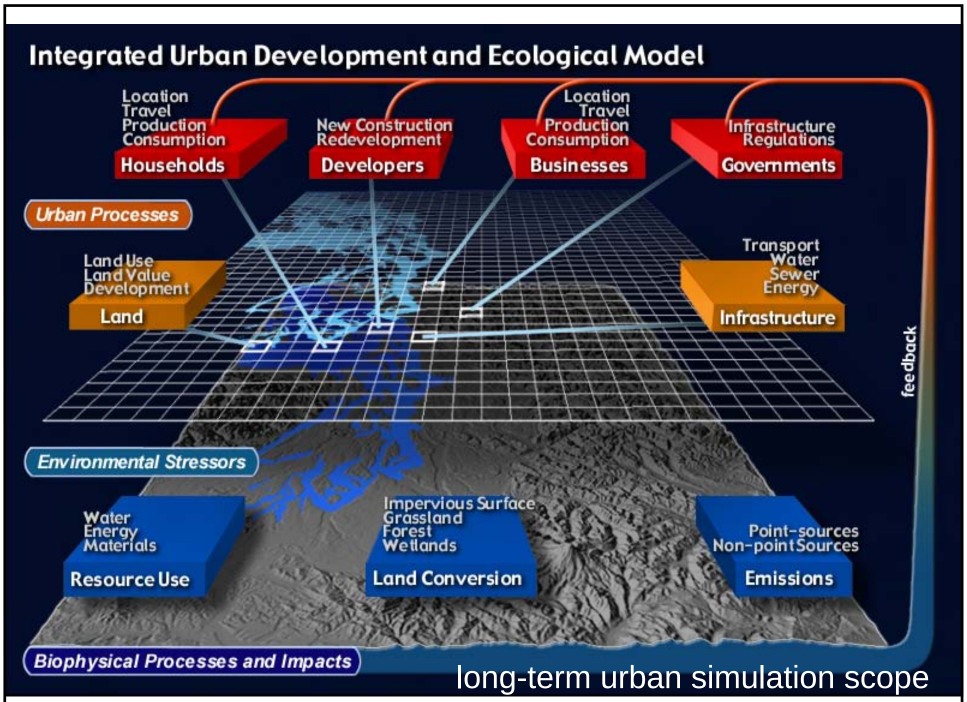
Center for Urban Simulation and Policy Analysis University of Washington

Core Faculty

- Paul Waddell, Director, Public Affairs, Planning
- Alan Borning, Co-Director, Computer Science and Eng.
- Marina Alberti, Urban Design and Planning
- Batya Friedman, Information School
- Mark Handcock, Statistics
- Scott Rutherford, Civil and Environmental Engineering

Current (Active) Research Projects

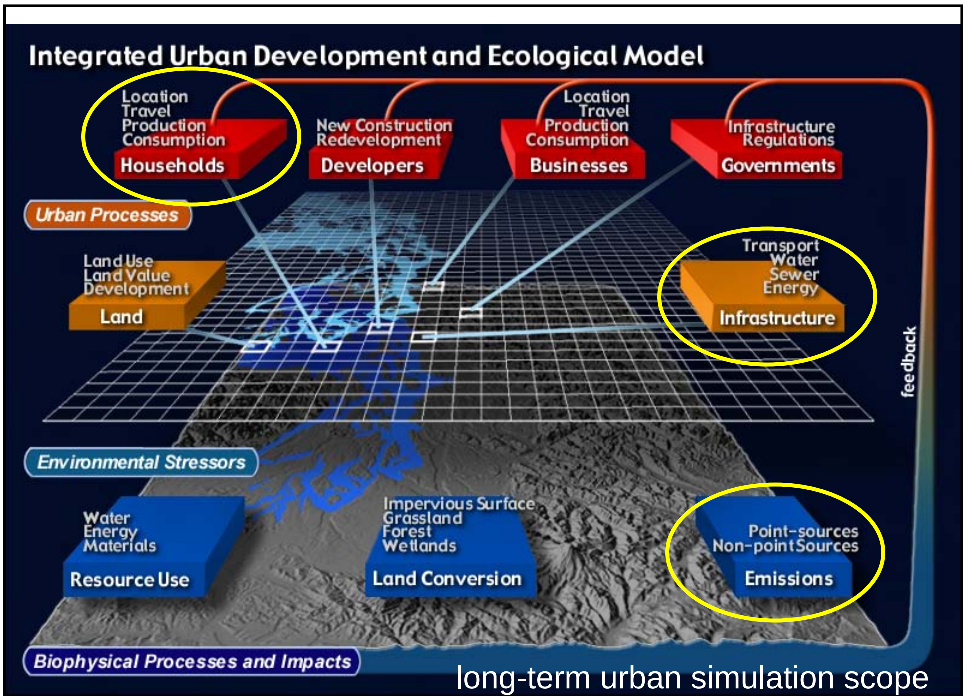
- Integrating Land Use, Activity-Based Travel and Air Quality Models (EPA)
- Integrating Urban Development, Land Cover Change, and Urban Ecology (NSF Biocomplexity)
- Measuring and Representing Uncertainty in Policy Modeling (NSF Digital Government)
- Analyzing Distributional Effects of Policies (FHWA Eisenhower Fellowship)
- Modeling and Measuring Walking and Transit Accessibility (FHWA Eisenhower Fellowship)
- A Stakeholder Interface for Urban Simulation Models (NSF ITR)
- Open Platform for Urban Simulation (NSF ITR)
- Application of UrbanSim to the Puget Sound Region (Puget Sound Regional Council)



EPA STAR Project Objectives

- From the RFA:

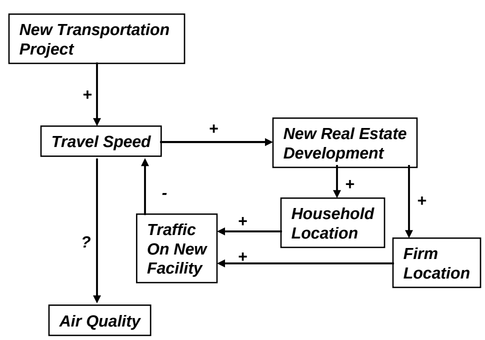
  "**How might models that project changes in land-use and activity locations be improved to better reflect and integrate lifestyle, economic production, and public policy factors that drive vehicle miles traveled?** How might spatial redistribution of activities and changes in land-use influence investments in transportation infrastructure and technology? Conversely, how might investment choices in transportation infrastructure and technology influence changes in spatial distribution of activities and land-use change?"



Long-term Induced Demand

Analysis of Project Effects on Air Quality

Considering Land Use Feedback



Behavioral and Operational Components

- Behavioral
  - Latent lifestyle choices
  - Substitution across long and short-term choices
  - Endogeneity and self-selection issues
  - Econometric estimation methods
- Operational
  - Integration of activity-based models with urban simulation models of land use
  - Integration with traffic assignment models
  - Integration with current and emerging emissions models
  - Testing of integrated platform on alternative scenarios

Key Operational Components

- UrbanSim/OPUS – urban simulation
- PCATS/DEBNetS – activity-based travel
- EPA Moves – emmissions

UrbanSim

- Microsimulation model of household location, job location, real estate development and prices
- Open Source software available on the web
- Individual households and jobs represented
- Simulates annual steps, with path dependence
- Land and real estate represented by small grid cells (150 m x 150 m), or potentially parcels
- Interfaces currently with 4-step travel models
  - Uses a range of zonal-based accessibility measures
  - Loose coupling
- Applied in multiple metropolitan areas in the US and abroad
- Funding: NSF Information Technology Research, Digital Government, Biocomplexity, Urban Research Initiative

Residential Location Variables

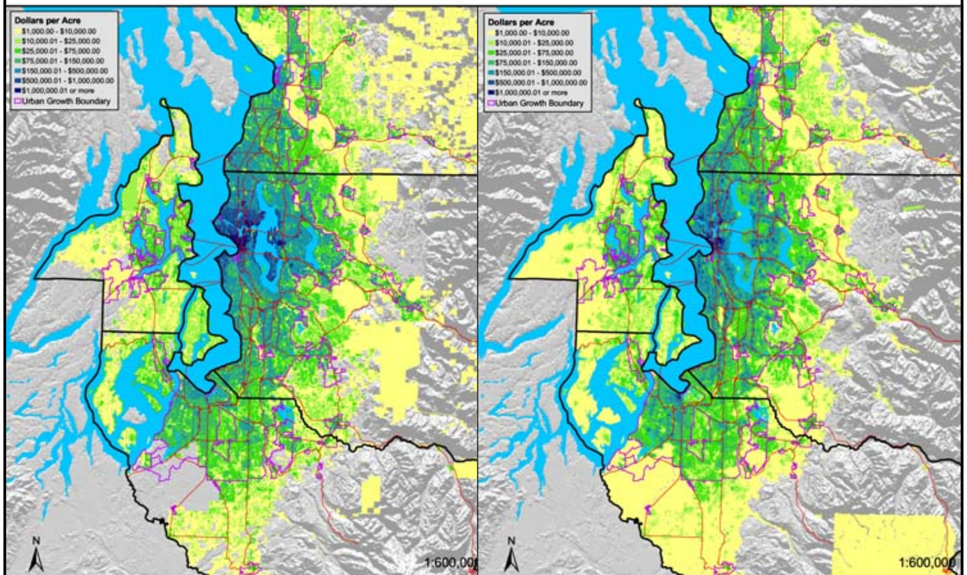
- Housing Characteristics
  - Prices (interacted with income)
  - Development types (density, land use mix)
  - Housing age
- Regional accessibility
  - Job accessibility by auto-ownership group
  - Travel time to CBD and airport
- Urban design-scale (local accessibility)
  - Neighborhood land use mix and density
  - Neighborhood employment
  - Compensates for large traffic zones in Travel Model

Land Price Variables

- Site characteristics
  - Development type
  - Land use plan
  - Environmental constraints
- Regional accessibility
  - Access to population and employment
- Urban design-scale
  - Land use mix and density
  - Proximity to highways and arterials

PSRC Region
2000 Total Land Value per Acre by Gridcell

PSRC Region
Predicted 2000 Total Land Value per Acre by Gridcell



Historical Validation from 1980 – 1994:

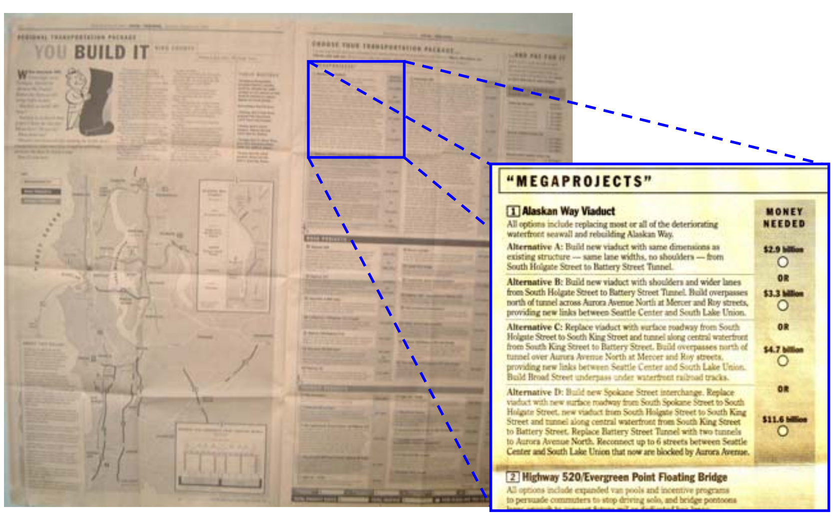
Correlation of Simulated vs Observed 1994
Eugene-Springfield, Oregon

	Cell	Zone	1-Cell Radius
Employment	0.805	0.865	0.917
Population	0.811	0.929	0.919
Nonresidential Sq ft	0.799	0.916	0.927
Housing Units	0.828	0.927	0.918
Land Value	0.830	0.925	0.908

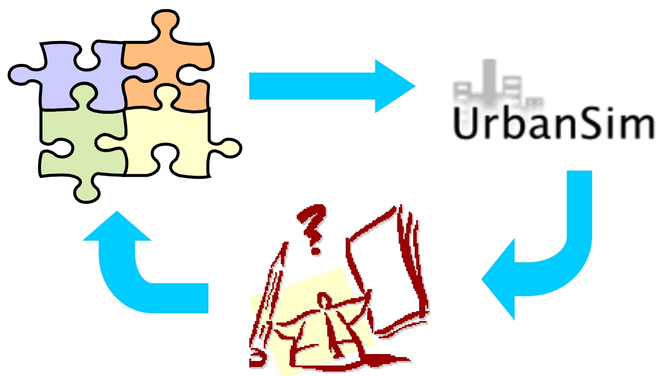
Creating Policy Scenarios

- Macroeconomic Assumptions
  - Household and employment control totals
- Development constraints
  - Can select any combination of
    - Political and planning overlays
    - Environmental overlays
    - Land use plan designation
  - Constraints determine which development types cannot be built
- Transportation infrastructure
- User-specified events

You Build It
(Seattle Times, March 20 2003)

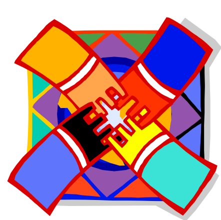


You Build It (UrbanSim)



Goals, Objectives, Indicators

- Help stakeholders to…
  - Evaluate scenarios in a way that relates to their values and concerns
  - Identify areas of consensus, conflict, and potential compromise



A Case Study:
Wasatch Front Region,
Utah

A Case Study: Wasatch Front Region

- Existing Transportation System
  - Dominated by the automobile (~90% of all trips by auto)
  - 2 highly successful light rail lines
- Existing Land-usage
  - Low density
  - Subdivisions, retail centers and office parks
- Population:
  - 1.6 million in 2000
  - ~3.0 million by 2030
- Envision Utah
  - Highly successful visioning process
  - Intensive public outreach/involvement
  - However, the process mixed outcomes and regional goals

Current Modeling Practice at WFRC

- Federally mandated process
- Transportation Analyses:
  - Long-range plans (>20 years)
  - Short-range plans (3-5 years)
  - Corridor studies
- Accepted practice transportation models
- Land-use forecast is independent of planned transportation system

Environmental Concerns

- Inadequate modeling:
  - Treatment of land-use (secondary impacts)
  - Modeling of non-automobile travel
  - Over-exaggerating congestion in “no-build” or transit alternatives
- Inadequate planning:
  - Resource usage
  - Environmental quality
  - Sustainability
- General Skepticism

Lawsuits

- Legacy Highway
  - North of Salt Lake City
  - Wetlands (adjacent to The Salt Lake)
  - Construction halted by court (Clean Water Act violations)
- Long range plan analysis
  - Technical analysis challenged
  - Lawsuit settled: Test UrbanSim for suitability for use, with peer review by 12/31/03

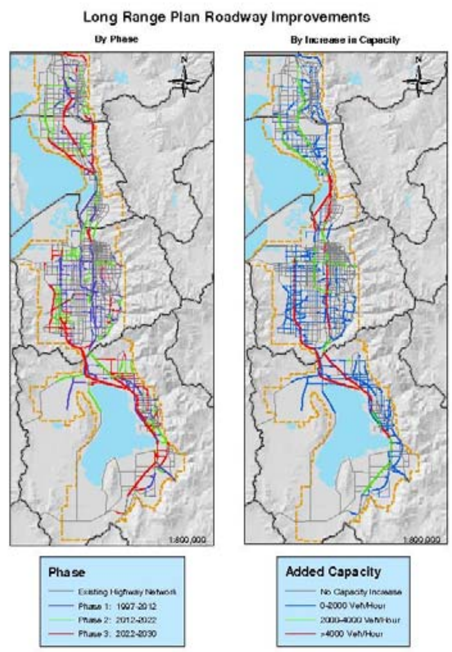
Legacy Highway

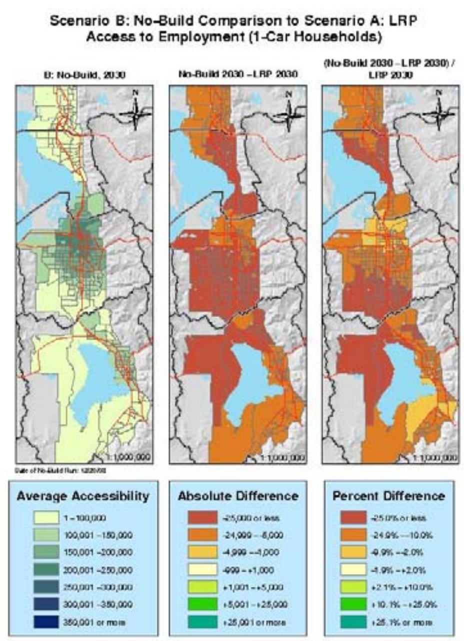
WFRC Goals (short to long-term)

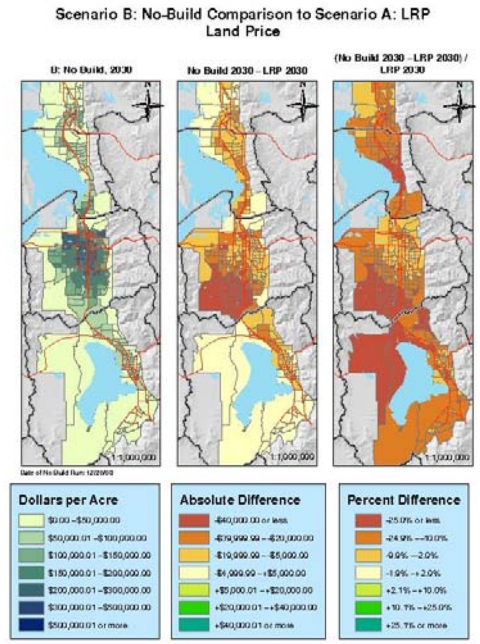
- Successful implementation & evaluation of land use model (UrbanSim)
- Incorporate into MPO modeling work
- Develop advanced-practice transportation models
- Use in a visioning process – evaluate scenarios in terms of regional goals

Sensitivity Testing of Integrated Land Use and Transportation Models

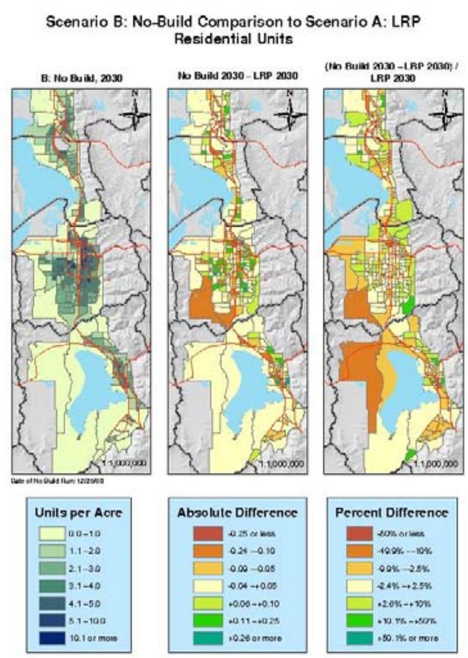
- Tested several scenarios:
  - Long Range Plan (Baseline)
  - No-build
  - Drop a highway project
  - Drop a light rail project
  - Add parking pricing
  - Impose Urban Growth Boundary


Long Range Plan Roadway Improvements
By Phase
By Increase in Capacity
1:800,000
1:800,000
Phase
Existing Highway Network
Phase 1: 1997-2012
Phase 2: 2012-2022
Phase 3: 2022-2030
Added Capacity
No Capacity Increase
0-2000 Veh/Hour
2000-4000 Veh/Hour
>4000 Veh/Hour


Scenario B: No-Build Comparison to Scenario A: LRP
Access to Employment (1-Car Households)
B: No-Build, 2030
No-Build 2030 – LRP 2030
(No-Build 2030 – LRP 2030) / LRP 2030
1:1,000,000
1:1,000,000
1:1,000,000
Average Accessibility
1 – 100,000
100,001 – 150,000
150,001 – 200,000
200,001 – 250,000
250,001 – 300,000
300,001 – 350,000
350,001 or more
Absolute Difference
-25,000 or less
-24,999 – -5,000
-4,999 – -1,000
-999 – +1,000
+1,001 – +5,000
+5,001 – +25,000
+25,001 or more
Percent Difference
-25.0% or less
-24.9% – -10.0%
-9.9% – -2.0%
-1.9% – +2.0%
+2.1% – +10.0%
+10.1% – +25.0%
+25.1% or more



Scenario B: No-Build Comparison to Scenario A: LRP
Land Price
B: No Build, 2030
No Build 2030 – LRP 2030
(No Build 2030 – LRP 2030) / LRP 2030
1:1,000,000
Dollars per Acre
$0.00 – $50,000.00
$50,000.01 – $100,000.00
$100,000.01 – $150,000.00
$150,000.01 – $200,000.00
$200,000.01 – $300,000.00
$300,000.01 – $500,000.00
$500,000.01 or more
Absolute Difference
-$40,000.00 or less
-$19,999.99 – -$5,000.00
-$4,999.99 – +$5,000.00
+$5,000.01 – +$20,000.00
+$20,000.01 – +$40,000.00
+$40,000.01 or more
Percent Difference
-25.0% or less
-24.9% – -10.0%
-9.9% – -2.0%
-1.9% – +2.0%
+2.1% – +10.0%
+10.1% – +25.0%
+25.1% or more



Scenario B: No-Build Comparison to Scenario A: LRP
Residential Units
B: No Build, 2030
No Build 2030 – LRP 2030
(No Build 2030 – LRP 2030) / LRP 2030
1:1,000,000
Units per Acre
0.0 – 1.0
1.1 – 2.0
2.1 – 3.0
3.1 – 4.0
4.1 – 5.0
5.1 – 10.0
10.1 or more
Absolute Difference
-0.25 or less
-0.24 – -0.10
-0.09 – -0.05
-0.04 – +0.05
+0.06 – +0.10
+0.11 – +0.25
+0.26 or more
Percent Difference
-49.9% – -10%
-9.9% – -2.5%
-2.4% – +2.5%
+2.6% – +10%
+10.1% – +50%
+50.1% or more

Regional Development, Population Trend, and Technology Change Impacts on Future Air Pollution Emissions in the San Joaquin Valley

Michael Kleeman
Deb Niemeier
Susan Handy
Jay Lund
With Song Bai, Sangho Choo, Shengyi Gao, and Julie Ogilvie
University of California Davis

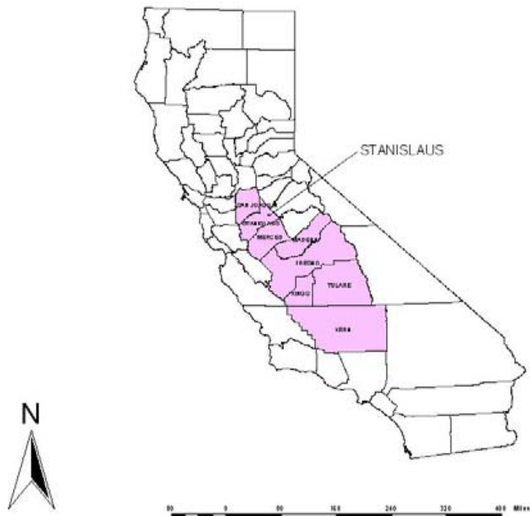
Dana Coe Sullivan
Sonoma Technology, Inc.

This research is funded by
U.S. EPA - Science To Achieve Results (STAR) Program
Grant # RD-83184201

Project Objectives

- Develop a system of models for evaluating the impact of **local and regional** policies and trends on air quality
  - Global variables from sources like IPCC, California Department of Finance
- Apply this system to the San Joaquin Valley to evaluate the sensitivity of air quality to different policy scenarios.

San Joaquin Valley



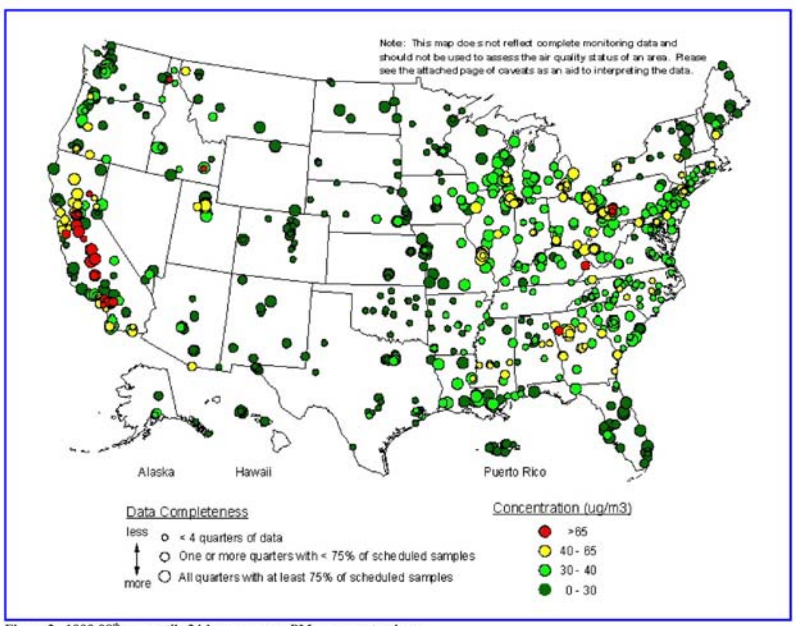
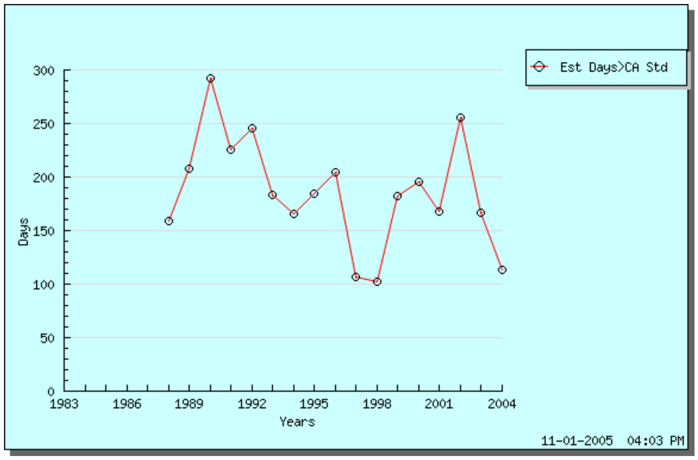


Figure 2. 1999 98th percentile 24-hour average $PM_{2.5}$ concentrations.
Source: U.S. EPA AIRS data base, July 12, 2000.

PM10 Trends Summary: San Joaquin Valley Air Basin



Source: CARB, http://www.arb.ca.gov/adam/php_files/aqdphp/graphtrendpm10bb.php

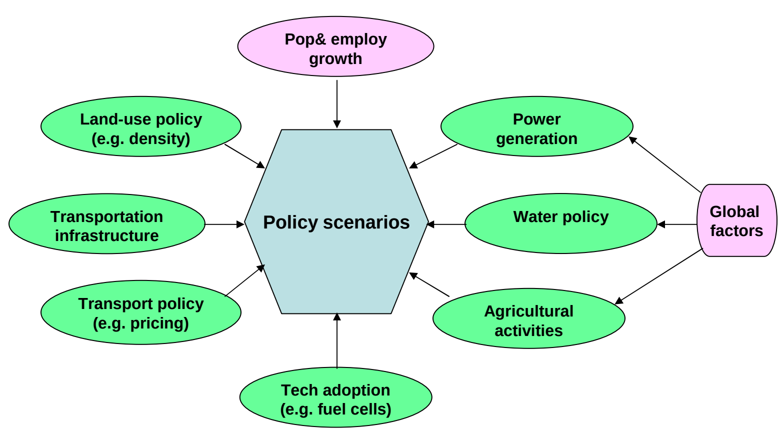
Ozone Trends Summary: San Joaquin Valley Air Basin

Source: CARB, http://www.arb.ca.gov/adam/php_files/aqdphp/graphtrendo3bb.php

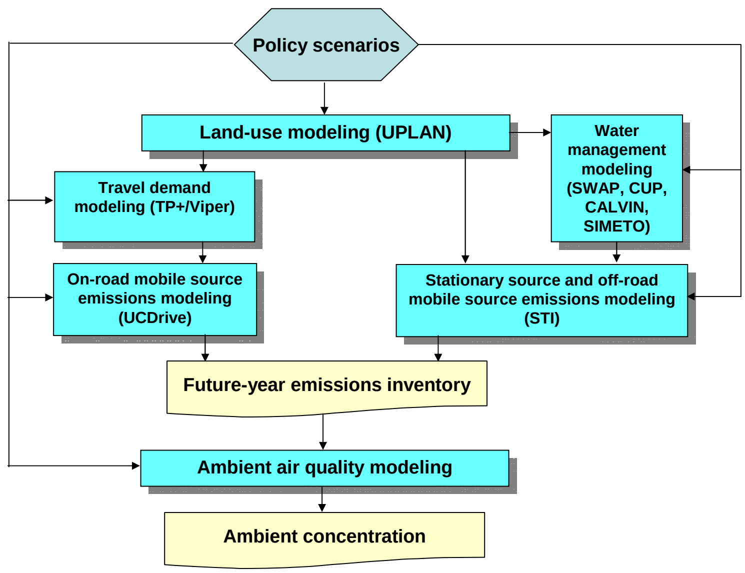
Project Schedule

	Tasks
Year 1	Develop policy scenarios for San Joaquin Valley Run land use models Run travel demand models Begin stationary source estimates
Year 2	Run emissions model Run water management models Complete stationary source estimates
Year 3	Estimate future year emissions inventory Run ambient air quality modeling Estimate future ambient air quality

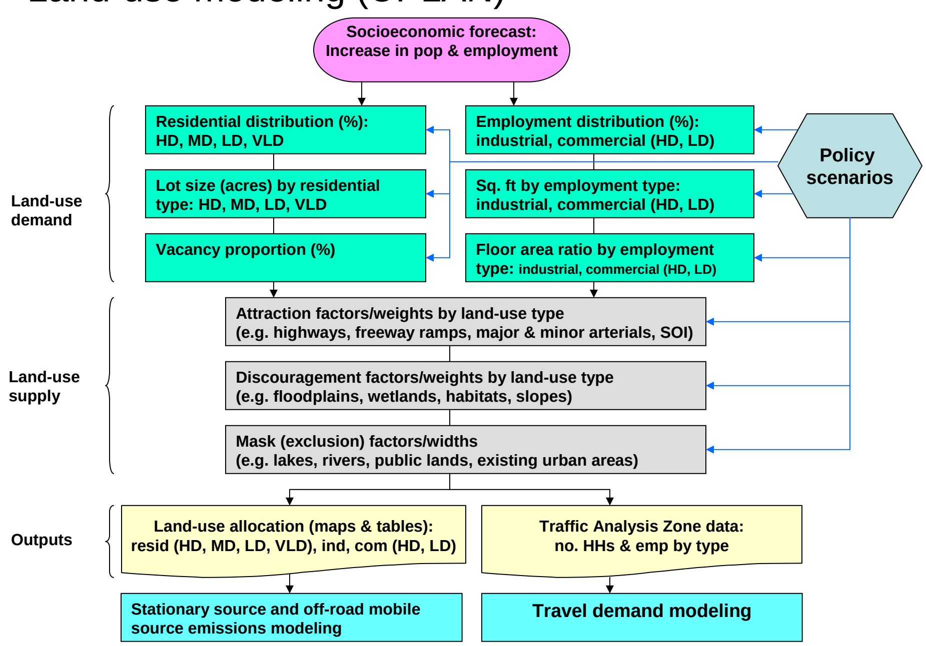
Policy Scenarios

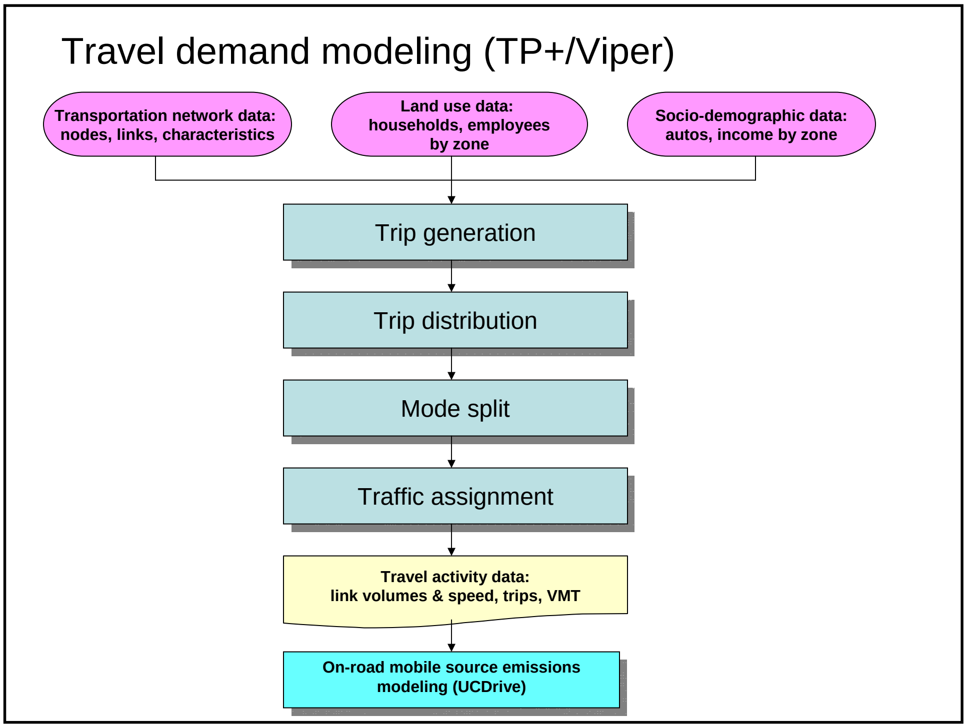


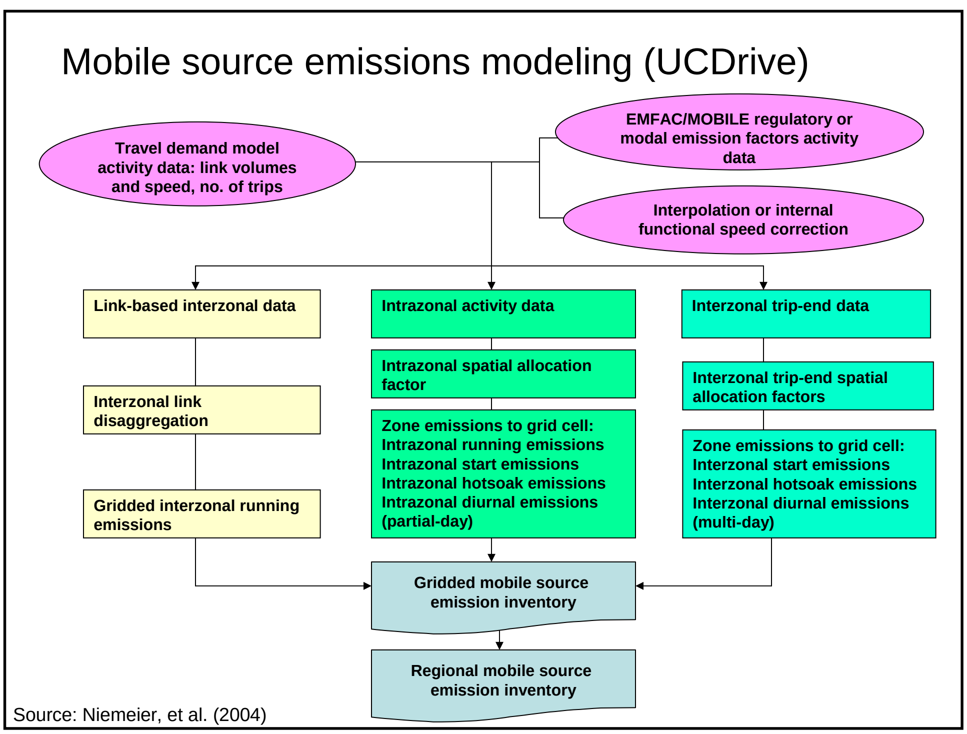
Overall Modeling Procedure



Land-use modeling (UPLAN)




Travel demand modeling (TP+/Viper)
Transportation network data: nodes, links, characteristics
Land use data: households, employees by zone
Socio-demographic data: autos, income by zone
Trip generation
Trip distribution
Mode split
Traffic assignment
Travel activity data: link volumes & speed, trips, VMT
On-road mobile source emissions modeling (UCDrive)


Mobile source emissions modeling (UCDrive)
Travel demand model activity data: link volumes and speed, no. of trips
EMFAC/MOBILE regulatory or modal emission factors activity data
Interpolation or internal functional speed correction
Link-based interzonal data
Intrazonal activity data
Interzonal trip-end data
Interzonal link disaggregation
Intrazonal spatial allocation factor
Interzonal trip-end spatial allocation factors
Gridded interzonal running emissions
Zone emissions to grid cell: Intrazonal running emissions Intrazonal start emissions Intrazonal hotsoak emissions Intrazonal diurnal emissions (partial-day)
Zone emissions to grid cell: Interzonal start emissions Interzonal hotsoak emissions Interzonal diurnal emissions (multi-day)
Gridded mobile source emission inventory
Regional mobile source emission inventory
Source: Niemeier, et al. (2004)

Scenario Development

- Initial list of variables
- Background research and preparation of white papers
- Initial levels and combinations of variables
- Expert panel review – April 2005
  - Caltrans, California High Speed Rail Authority
  - California Air Resources Board
  - Additional experts in economics and agriculture
- Finalization of variables, levels, combinations
- Translation of variables into model inputs

Scenarios

	Scenario 1: Baseline	Scenario 2: Controlled	Scenario 3: Uncontrolled	Scenario 4: As Planned
Transportation	No change	No new roads High Speed Rail	New roads No High Speed Rail	New roads High Speed Rail
Land use	No change	High-density residential Transit-oriented development Infill and redevelopment Increased ag preservation Increased habitat preservation	Low- and very-low density residential	Residential densities as planned Some increased preservation

Scenarios: continued

	Scenario 1: Baseline	Scenario 2: Controlled	Scenario 3: Uncontrolled	Scenario 4: As Planned
Other regional variables	No change	Decentralized power Complete burning ban Ag dust reduction	No change	Some decentralized power Statel rules on burning Some ag dust reduction
Technology variables	No change	Improved vehicle efficiency Fuel cell adoption Mandate alternative energies Complete diesel retrofit Dairy bio-energy	No change	No change

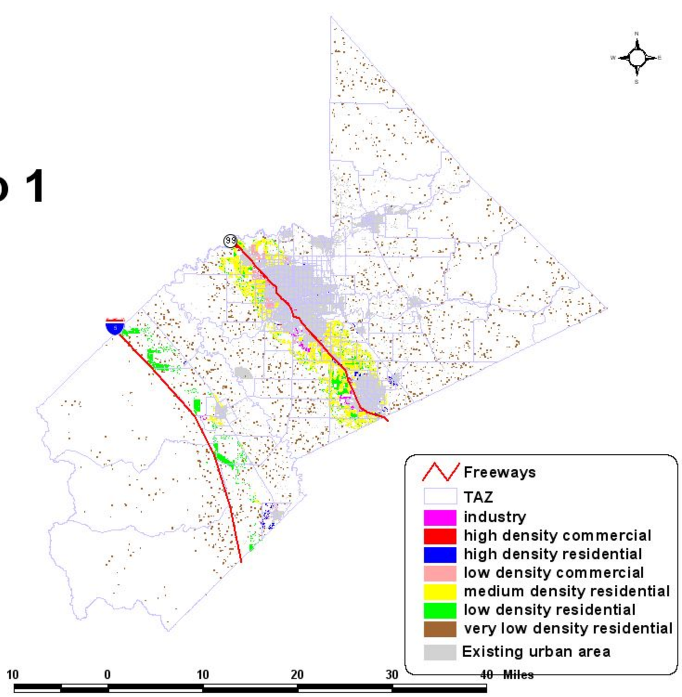
Stanislaus County Results to Date

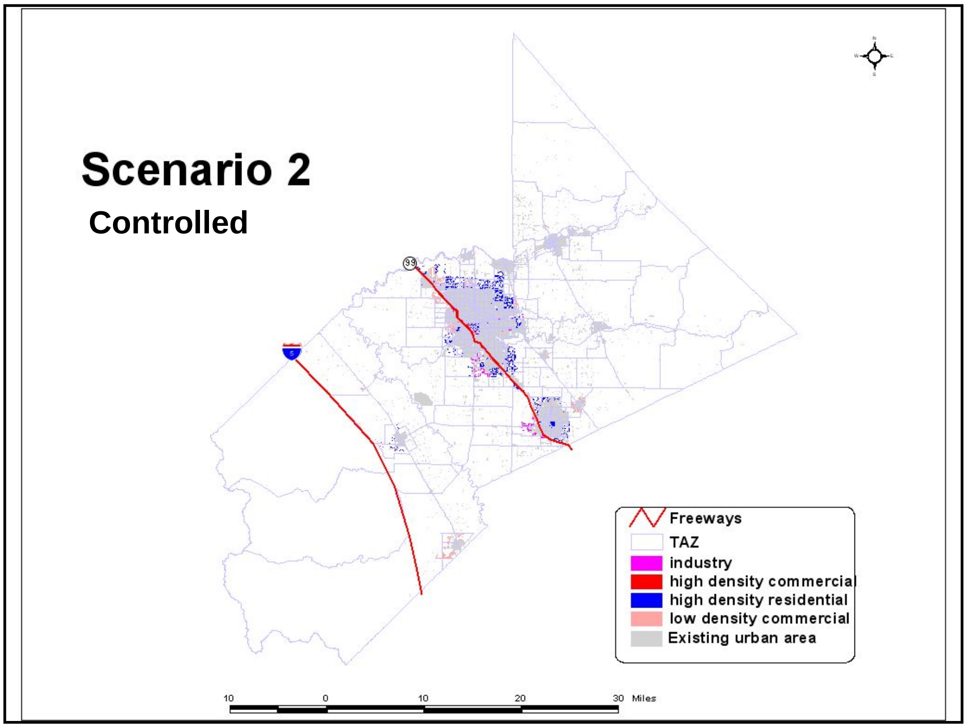
- Land use modeling
- Travel demand modeling

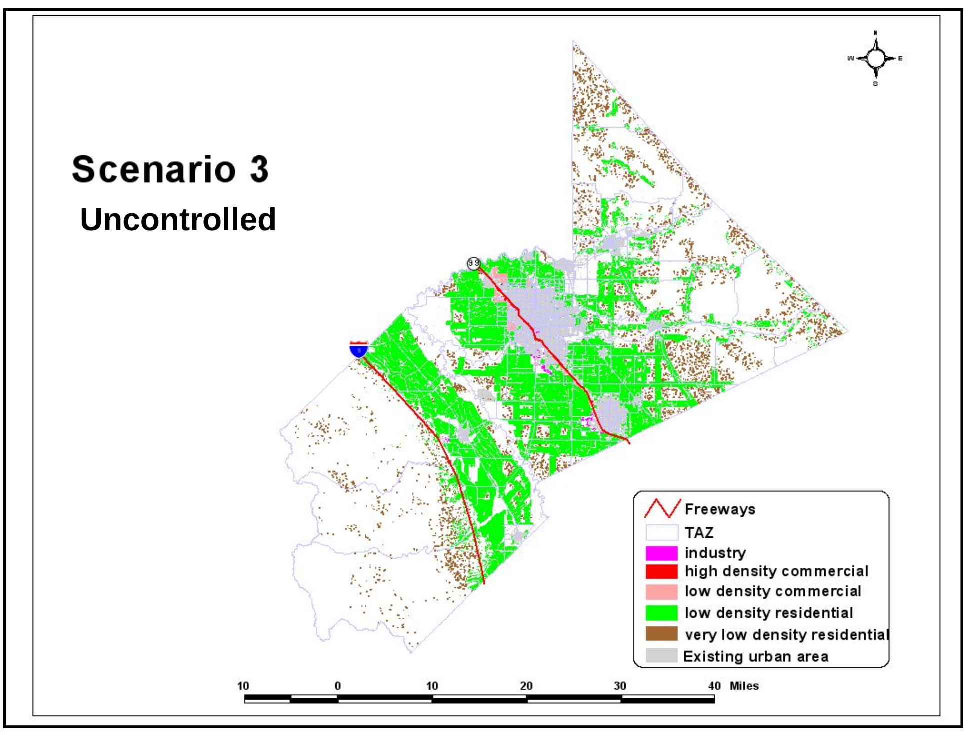
Stanislaus County Growth

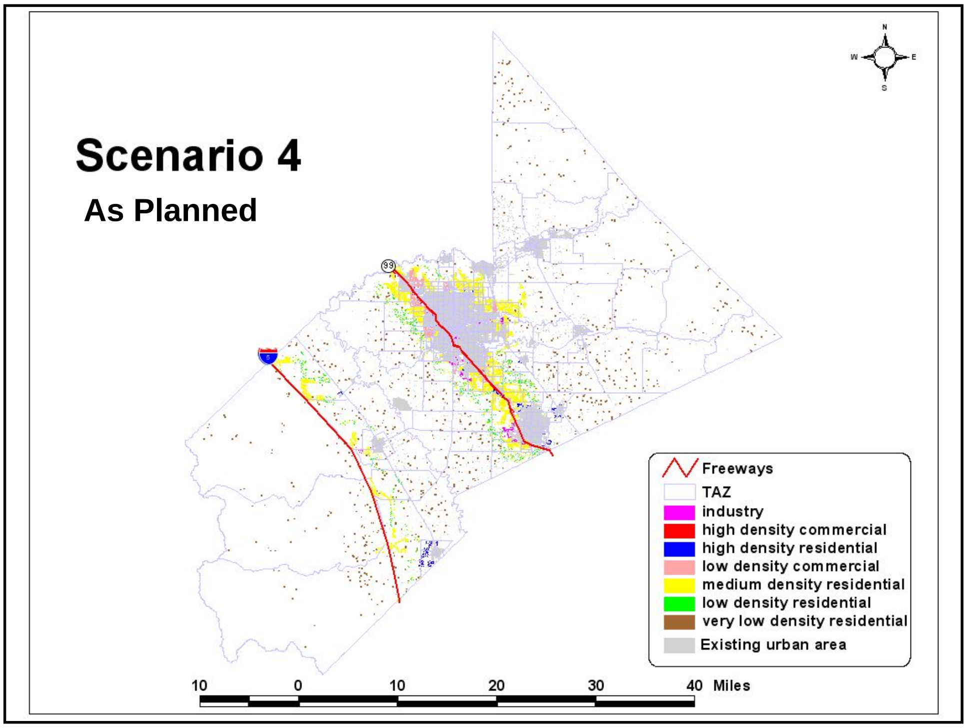
	2000	2030	Change
Population	446,997	744,599	+66.6%
Households	145,154	263,789	+81.7%
Employment	174,066	293,938	+68.9%

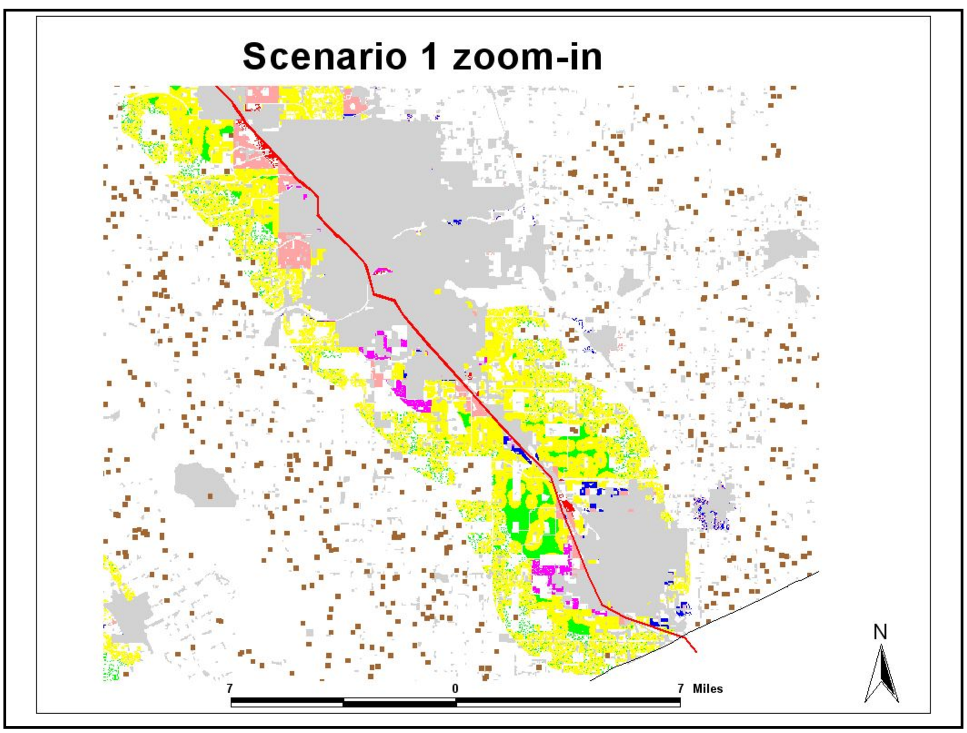
Scenario 1
Baseline

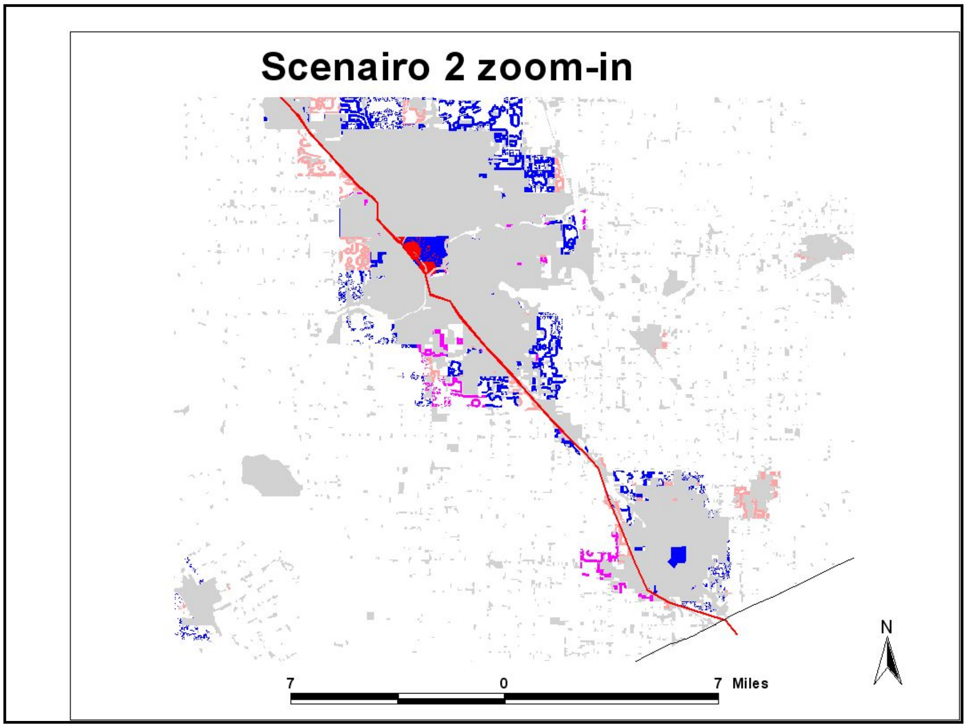


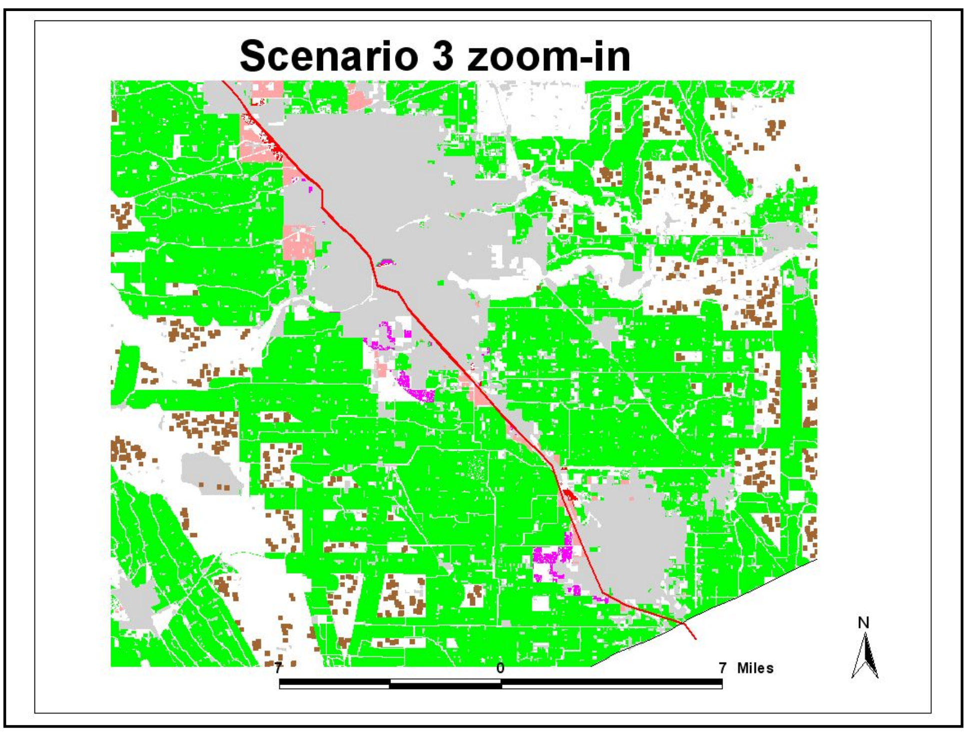

Scenario 2
Controlled
Freeways
TAZ
industry
high density commercial
high density residential
low density commercial
Existing urban area
10
0
10
20
30 Miles


Scenario 3
Uncontrolled
Freeways
TAZ
industry
high density commercial
low density commercial
low density residential
very low density residential
Existing urban area
10
0
10
20
30
40 Miles

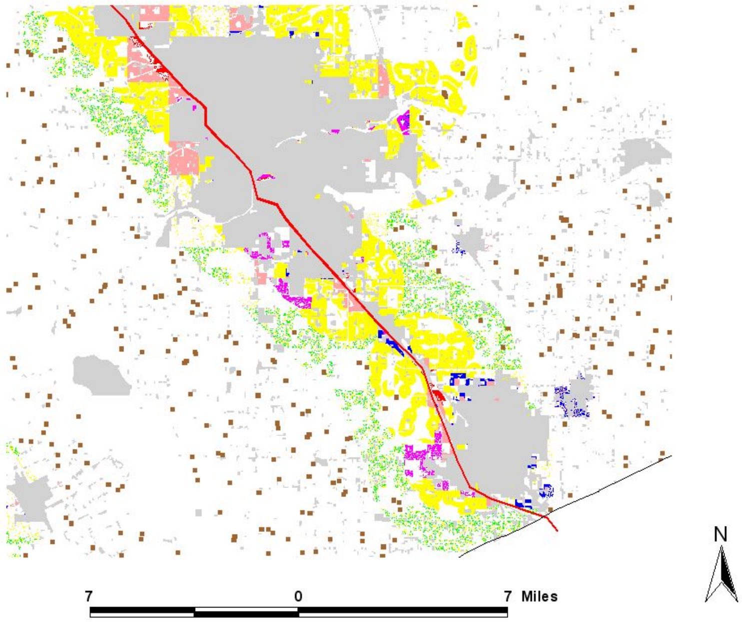

Scenario 4
As Planned
N
W
E
S
99
Freeways
TAZ
industry
high density commercial
high density residential
low density commercial
medium density residential
low density residential
very low density residential
Existing urban area
10
0
10
20
30
40 Miles


Scenario 1 zoom-in
7
0
7 Miles
N


Scenairo 2 zoom-in
N
7
0
7 Miles


Scenario 3 zoom-in
N
7
0
7 Miles

Scenario 4 zoom-in



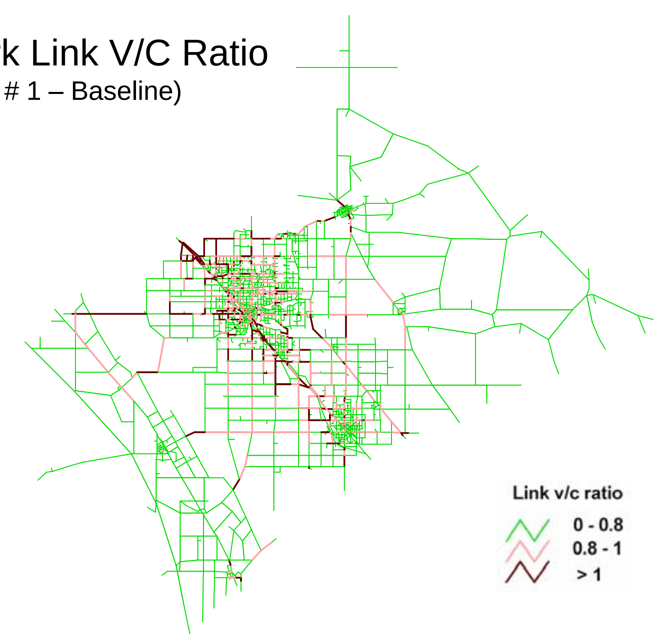
New Households by Residential Density
Stanislaus County

	Scenario 1 Baseline	Scenario 2 Controlled	Scenario 3 Uncontrolled	Scenario 4 As Planned
High density	21,280	118,760	0	23,620
Medium density	93,572	0	0	93,572
Low density residential	1,894	0	114,710	711
Very low density residential	1,894	0	3,983	711

Travel Demand Modeling Results
Stanislaus County

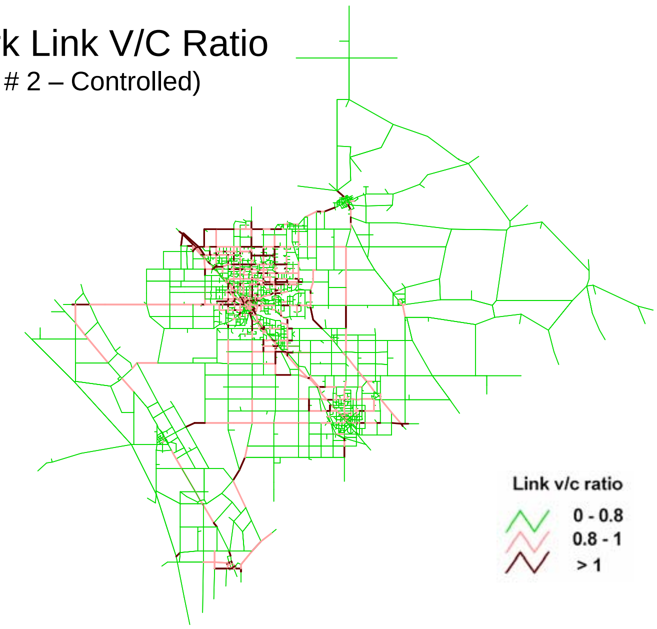
	Unit	Scenario #1 (baseline)	Scenario #2 (controlled)	Scenario #3 (uncontrolled)	Scenario #4 (as planned)
Total VMT	mile	16,411,281	15,427,411 (-6%)	22,089,022 (+35%)	18,860,451 (+15%)
Total VHT	hour	712,671	617,969 (-13%)	1,022,107 (+43%)	744,941 (+5%)
Number of vehicle trips	one-trip	2,233,862	2,122,622 (-5%)	2,308,304 (+3%)	2,274,656 (+2%)
Average trip distance	mile	7.35	7.27	9.57	8.29
Average trip length	minute	19.14	17.47	26.57	19.65
Average trip delay	minute	8.18	6.66	12.72	7.62
Freeway congested speed	miles/hour	37.7	43.9	38.8	42.8
Freeway average vc ratio	v/c	0.898	0.829	0.915	0.865
Arterial congested speed	miles/hour	36.1	36.5	35.3	37.3
Arterial average vc ratio	v/c	0.691	0.654	0.746	0.666

Network Link V/C Ratio
(Scenario # 1 – Baseline)



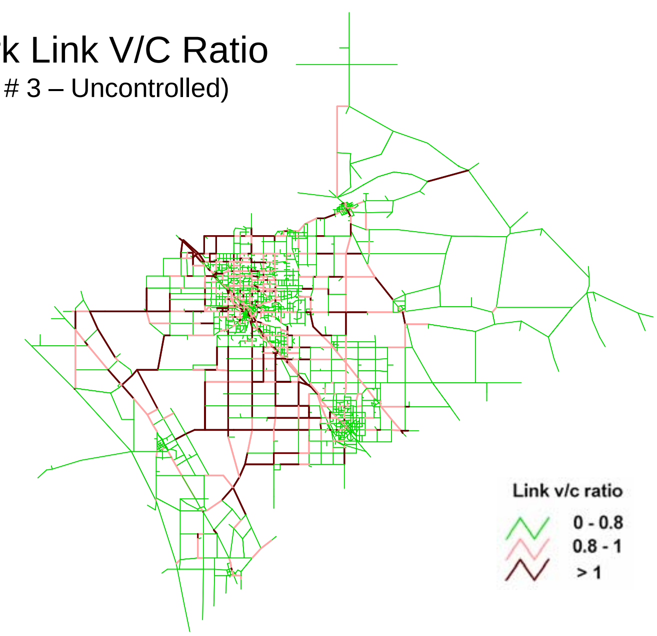
Network Link V/C Ratio

(Scenario # 2 – Controlled)

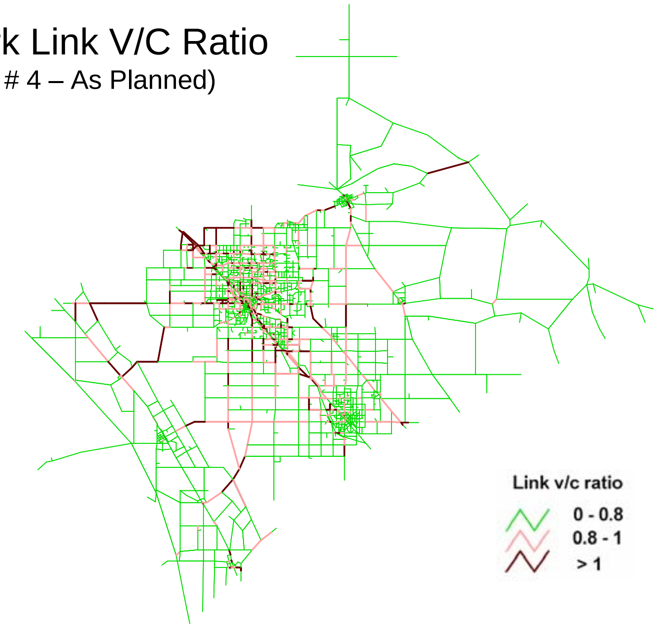


Network Link V/C Ratio

(Scenario # 3 – Uncontrolled)



Network Link V/C Ratio
(Scenario # 4 – As Planned)



Questions

- How will results differ by county?
- How will differences in travel demand translate into differences in vehicle emissions?
- How will differences in land use patterns translate into differences in stationary and off-road source emissions?

Acknowledgements

- United States Environmental Protection Agency Science to Achieve Results (STAR) Grant # RD-83184201

Summary of the Q&A Discussion Following Session III

Maurice Abrams, (a "concerned citizen")
Mr. Abrams asked about the status of the Hacienda Project—whether it has been completed.

Steve Raney, (Cities21)
Mr. Raney replied that the 24-month study was just getting underway. He added, "One of the key things in this study is that the General Manager of the office park, James Paxson, is just a great, progressive guy, and he participates in a lot of forward-thinking transportation studies. He also has a very high social IQ—he's really well liked—and that was really important as he helped in putting together the letters of support that created the winning grant proposal." Dr. Raney went on to say that the researchers are "tied in with MTC and BART and the Congestion Management Agency and lots of other good groups, so it's a pretty exciting team that came together mostly because of James's unique personality."

Steve Raney, (Cities21)
Directing his question to Dr. Paul Waddell, Mr. Raney asked, "What's the order of magnitude of effort to bring the Urban SIM model to the Bay Area or any big place?—Is it four person years of work or what?"

Dr. Paul Waddell, (University of Washington)
Saying, "You *would* end with a hard question," Dr. Waddell stated that as of a year ago the answer would have been "very high" due to the fact that the model is extremely "data hungry, requiring the use of parcel data and business establishment data as well as a lot of data cleaning and data synthesizing." He acknowledged that that's where most of the effort has gone. He added, however, that they've "been working quite hard over the course of this past year to develop capacity to create much simpler models, so that if one wanted to, you could start with a simpler version and then make it more sophisticated or more sensitive or more detailed, as time and data permit."

Dr. Waddell revealed that in about a month [approximately mid-December 2005] they're preparing to release a new version that will have the capacity to generate much more quickly "runnable models with local data, but with lighter data requirements and easier construction." He projected that a "light-weight version of the model could be up and running within 3 to 6 months." He added that a full-detailed model operating with parcel-level data "really depends on the quality of the data in hand and how long it takes to get it into usable shape."

Nancy Levin, (U.S. EPA Region 9)
Saying that she works on the environmental review of transportation projects, Ms. Levin stated that one of the questions they deal with is: To what extent does transportation

affect land use? She asked the panelists what the current thinking is on that and "whether there is an increasing willingness to use land-use models in looking at impacts of transportation projects."

Dr. Paul Waddell, (University of Washington)
Stating that there seemed to be "a couple of questions in there," Dr. Waddell identified one of them as "How much does transportation influence land use?" Another, he said, pertains to connecting land-use models and the interest in using them.

Addressing the first question, Dr. Waddell said, "California has some of the few critics of the argument that transportation influences land use. He specifically named Genevieve Giuliano (USC School of Planning, Policy, and Development), Harry Richardson, and Peter Gordon (both also at USC) as people who have made "pretty strong claims that there are reasons to think that transportation just isn't what it used to be in influencing land use." One of the reasons for this belief, he stated, is that in larger metropolitan areas we now have very mature systems, so adding a particular highway or transit project is a fairly incremental change. He said an additional argument used to bolster this case is that multi-worker households make it much harder to minimize commuting time.

On the other hand, Dr. Waddell feels that "there is still a large body of evidence to the contrary, that even in a large metropolitan area with a mature transport system building a particular project will have at least *localized* effects and [a number of projects] will add cumulative effects across the metropolitan region. He stated that he has found that "even in a place as utterly dominated as Salt Lake City, both regional accessibility and local, walking-scale accessibility measures turn out to be significant in predicting people's location choices in the housing market."

Acknowledging that Susan Handy "has done a lot of work on this topic," Dr. Waddell yielded the floor to her input.

Dr. Susan Handy, (University of California at Davis)
Dr. Handy commented, "I don't think I could answer it any better, Paul."

Dr. Paul Waddell
Dr. Waddell asked whether the second question posed by Ms. Levin was whether there is a greater willingness now to use land-use models.

Nancy Levin
Ms. Levin clarified that in speaking with others from transportation agencies she has found a general reluctance to use land-use models due to great costs, great time involvement, and/or great data needs—basically just the huge investment required. She rephrased her question in this fashion: "Can you only use these models really in a big academic setting for a huge project or is there some move to make them a little bit more accessible to policy makers?"

Dr. Paul Waddell
Saying, "This is perhaps not totally unrelated to the earlier question," Dr. Waddell said that "there were several discussions along this line at the Transportation Research Board conference at the beginning of the year." He added that "there was a sense that academics promoting very complex models—activity-based travel models and integrated land-use and transportation models—may tend to oversell them a little bit, and the practitioners out there who need to implement the models are cautious or skeptical. Essentially, they're being asked to make huge commitments of time and resources to implement models without a whole lot of evidence to date they'll make significant differences in what the benefit/cost ratio really is." Dr. Waddell feels that the skepticism among practitioners is well founded and that academics need to do two things: First, make models easier to implement. Second, "provide more of an incremental development path so that one could start with a simple model, get it running quickly, identify what the weaknesses are in that, and then work on making improvements gradually and with lower levels of investment." He concluded by saying that it's important to be able, at each stage, to document what's been gained and what it cost so that it's easier to make a case for further development of the project. "Otherwise, it will be rather irrelevant if we can't make it [i.e., a model] accessible to practitioners."

Dr. Susan Handy
Dr. Handy added, "The Transportation Research Board is organizing a conference that will be held in May or June in Austin, Texas that will deal with this very issue: How do you bring all these innovations that are coming out of academia into practice?—sort of helping to build that bridge."

Unidentified Questioner
Addressing Dr. Paul Waddell, the questioner said, "Given the effort that is involved in assembling the data for these types of models, is it really the case that what you really need is to assemble the data for the major metropolitan areas and then you can use whatever model is appropriate to use with that? What fraction of the effort involved in setting up a more realistic picture of how transportation interacts with land use is data assembly and data cleaning versus the model itself, and should we perhaps just put that effort into getting the data because we'll need it for whatever we decide to do?"

Dr. Paul Waddell
Dr. Waddell commented that "this is an excellent point," and he said he "would wager that something on the order of 75 percent or so of the effort is in the data" and he added that "there are some important lessons in all that." One lesson is for agencies/institutions to view the data as "infrastructure that has lots of other uses besides the modeling applications—it enables them to answer lots of questions that they couldn't answer otherwise." Consequently, many agencies/institutions are deciding "to go ahead and make commitments and invest in creating databases and maintaining them because they'll have lots of secondary applications."

Continuing, Dr. Waddell added, “Secondly, I’d say we probably need to be a lot smarter about how we deal with the data development process.” He noted that in the past he and his colleagues simply assumed that they could “get good quality data and integrate it and resolve errors in it to the point that it was completely internally consistent—and then use it in modeling.” As an example, he cited the accounting of where jobs are and where commercial space is—“there’s an implied square-footage-per-employee ratio that tells you how many jobs you can fit into the quantity of space that is available.” He went on to explain that errors in the data can create some really unreasonable or impossible square-footage per employee values that really distort the modeling. Dr. Waddell feels that a lesson from this is that “we should make the modeling much more robust to data artifacts, data errors.” He also thinks “we should probably be synthesizing data a little bit more than we are now, using statistical data mining tools to explore data patterns and being less concerned about getting every single data point exactly right, so we can cut the cost down on getting usable data at a high level of detail.”

Michael Gill, (U.S. EPA Region 9)
Mr. Gill commented that “we are fairly blessed in the West with a lot of land and fairly blessed in this country with low gas prices,” particularly in comparison to Europe. He asked, “Are we learning any lessons from Europe or other places in this realm of transportation and land use?”

Steve Raney
Mr. Raney responded that “the grocery bag cart that you showed was the one that I used in the Netherlands to walk from my home to my grocery store.” He added, “It’s a cultural thing there—there it’s *good* to be cheap, which, incidentally, makes you green.”

Dr. Benjamin Hobbs
Dr. Hobbs said he believes that we’re making some progress and beginning to “get in the right mindset,” although these changes are coming slowly. In his view, the environmental challenges we’re facing dictate that the changes “need to accelerate significantly.”

Dr. Susan Handy
Dr. Handy added this comment: “Those of us who care about these things look a lot to Europe and say, “Why can’t we do that here?” She believes that, more and more, we are seeing American versions of European ideas. At the same time, “Europe is also seeing a lot more of what we have happening too,” with Wal-mart and suburbanization. She concluded, “Maybe they need to learn from the mistakes we’ve made, as much as we need to learn from the right things they’ve done.”

Dr. Paul Waddell
Referring to the post-Katrina spike in gas prices, Dr. Waddell said this might provide “one little bit of evidence we have about how people might react to substantially higher gas prices. The sort of spike we’ve seen in transit ridership, for example, provides a little bit of optimism” that sustained higher gasoline prices might bring on meaningful shifts in

people's behavior. He added, "Before this, we didn't really know what threshold of fuel prices would start to trigger that," but this episode has provided "at least some glimmer of evidence that there is some elasticity of demand with respect to fuel prices there."

Dr. Waddell went on to say that he wanted to echo what Susan Handy had said about Europe. He explained that he spent last year on sabbatical in the totally pedestrian environment of central Paris—he had no car and walked everywhere. Shortly afterward he went to a seminar on transportation trends, where he heard about "reports on travel surveys that have been done since 1970 or so in the Isle de France region," and he said he was horrified by what these reports revealed. The trends in central Paris were fairly stable, with very low auto ownership and very high transit ridership being maintained. However, the story in the suburbs is different, with inter-suburban traffic climbing drastically over the years of the studies, and "there's nothing that gives any indication that the pattern of development and the pattern of transport in the suburbs is anything like the old core of the city." Dr. Waddell said he believes this is true not just in Paris but in a lot of European cities. This causes him to wonder whether "they have it all figured out and they're doing things so much better, or whether they have an accident of history on their side—that their cities were built on a more pedestrian transportation economy, and now the outlying areas are developing more on an auto-oriented basis." He ended by classifying this possibility as "quite scary."

END OF SESSION III Q & A