

Geographically Based Infrastructure Analysis

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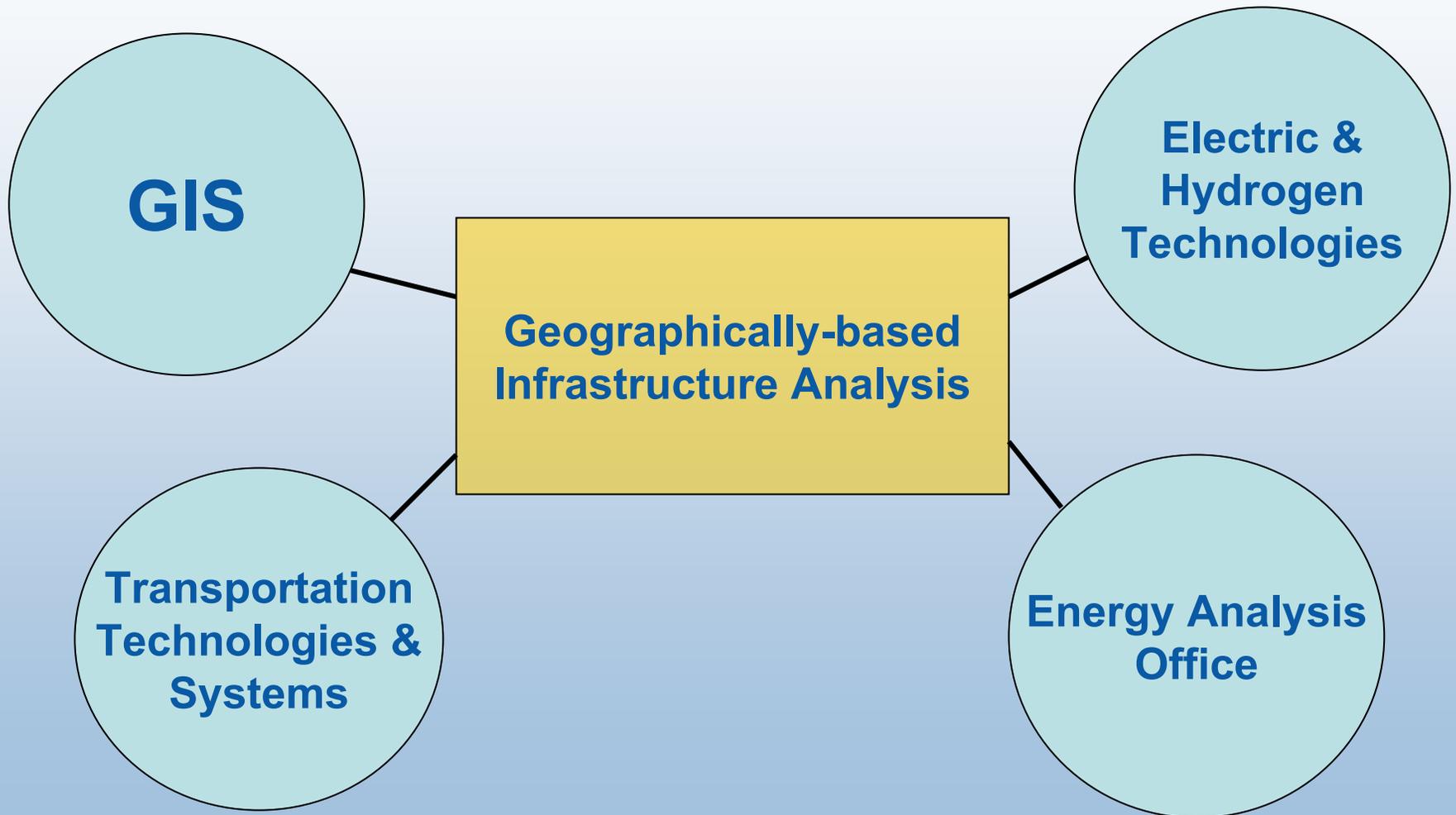
Geographically-Based Infrastructure Analysis (GIA)

Utilizes GIS, geographically segregated data, and transition expertise to add the spatial component to infrastructure analysis

NREL Core Competencies

- Geographic data, tools, and expertise
- Flexibility to address a wide array of transition issues

NREL Capability Diagram



GIA Activities

Previous and Ongoing

- HYDS ME
 - Evaluates best infrastructure options
- Interstate Infrastructure Analysis
 - Minimal infrastructure to facilitate interstate travel during transition

New Analyses

- Quantifying transitional hydrogen demand
- LA basin infrastructure transition modeling

Questions Addressed

- Where will hydrogen demand develop first?
Where should we focus our efforts?
- What methods will be best suited to meeting demand? Central vs. Forecourt? How to distribute?
- How will regional resources be affected?
- What are some options to transition from fleets to consumers?
- How do we minimize stranded assets?

Describing Spatial Infrastructure Demand

Objective: Spatially describe vehicle penetration and hydrogen demand during transition to avoid stranded assets

- Identify key metrics affecting vehicle adoption
- Regionally quantify metrics
- Predict resulting H2 demand and *changing* demand
- Estimate infrastructure needs and usage
- Predict transition infrastructure costs while avoiding stranded assets where possible
- Understand policy options and implications

Methodology – Demand Analysis

- Identify key metrics affecting demand
- Collect data for metrics
- Assign each metric a value
- Spatially combine attributes and values
 - 20 by 20 US grid
 - Metropolitan area blocks

Metrics Affecting Demand

- Population/Growth
- Household Income
- Education
- Commute Distance
- Employment
- Vehicles per Household
- Air Quality
- Tax Incentives
- HOV Incentives
- Clean Cities Coalition
- *AFV Registrations*
- *Hybrid Registrations*
- *Federal Facilities*
- *Other Public Fleets*
- *Private Fleets*

Description of Metrics

Population (High)

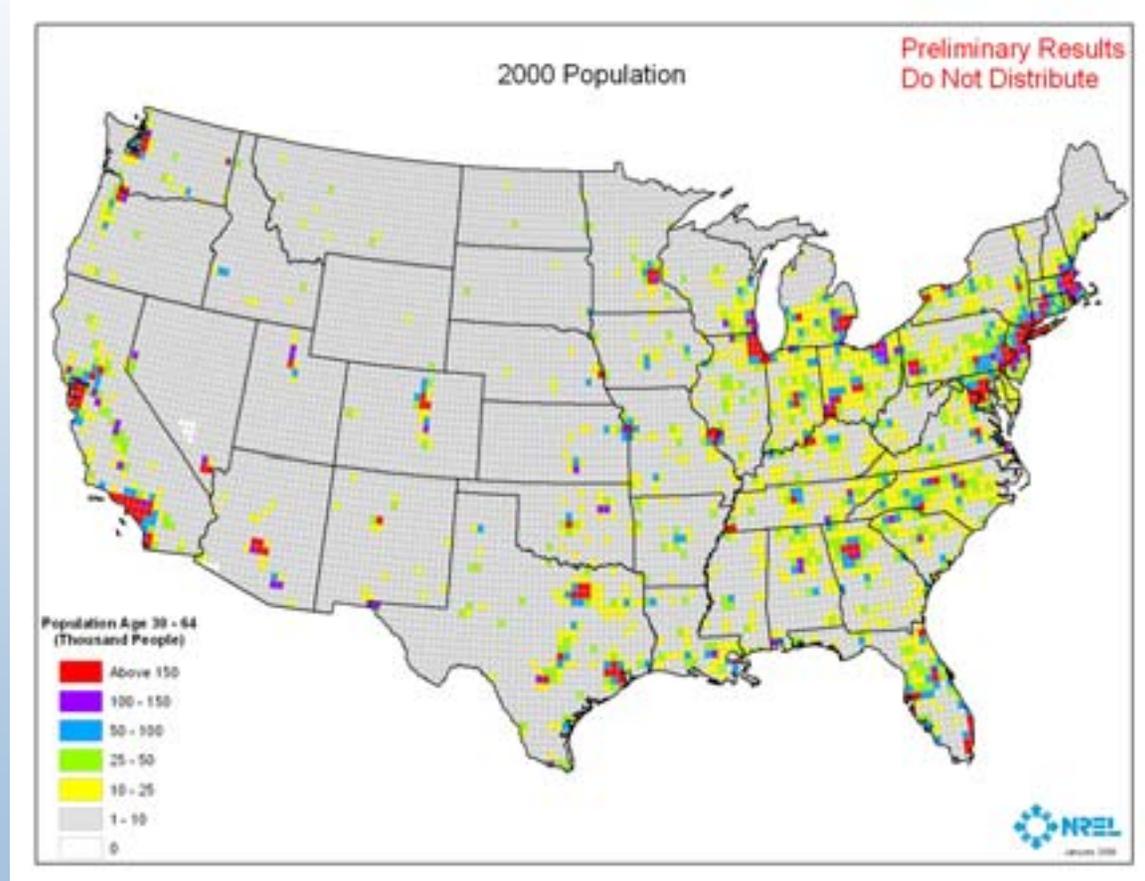
- Vehicles populate similar to population

Pop Change (future)

- Evaluate where growth in H2 vehicles may occur

Ages 30-64

US Census Bureau, 2000



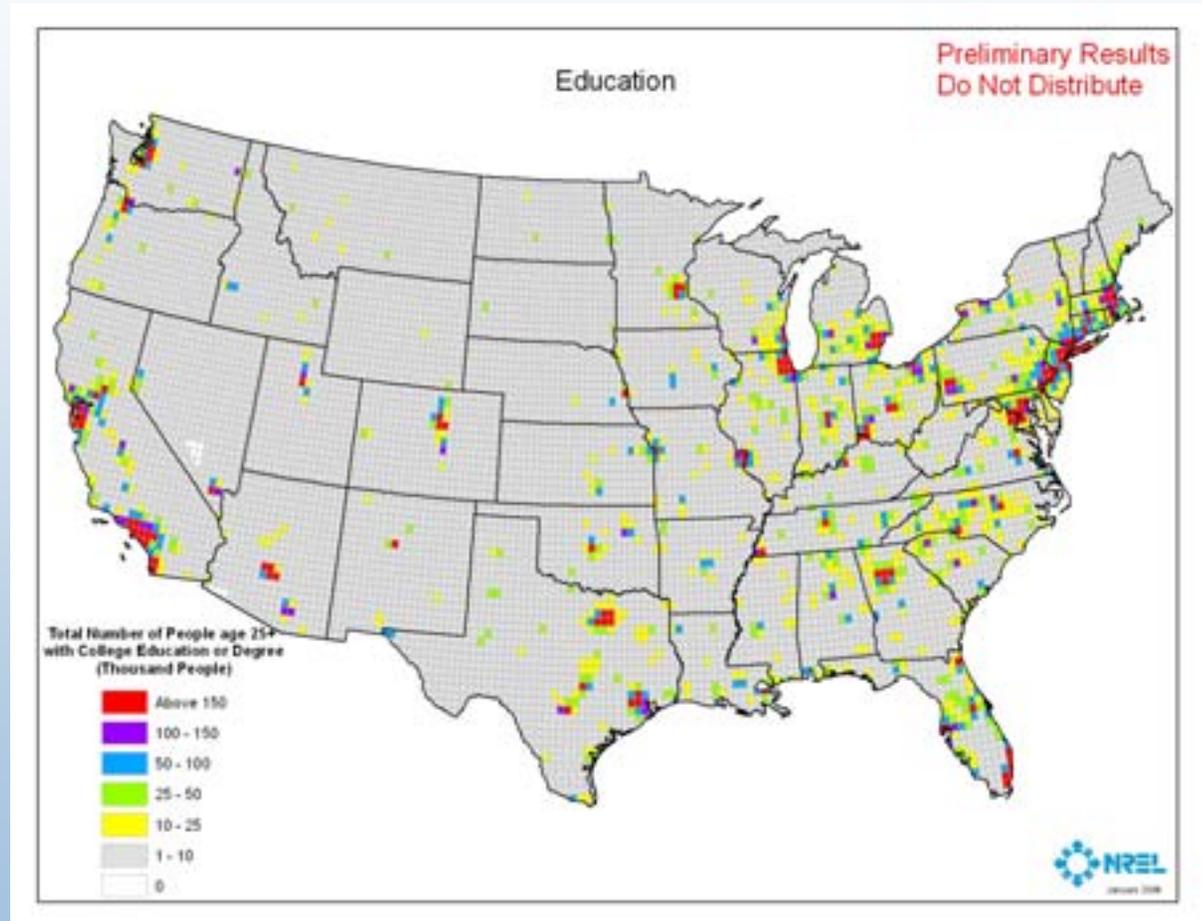
Description of Metrics

Education (Med)

- Higher education leads to earlier adoption

People with college education or degree

U.S.Census Bureau.



Description of Metrics

Employment (Low)

- People employed may be more likely to use H2 vehicle for commuting

U.S. Census Bureau

Household Income (High)

- Higher incomes lead to earlier adoption
1999 median household income

U.S. Census Bureau, 2000



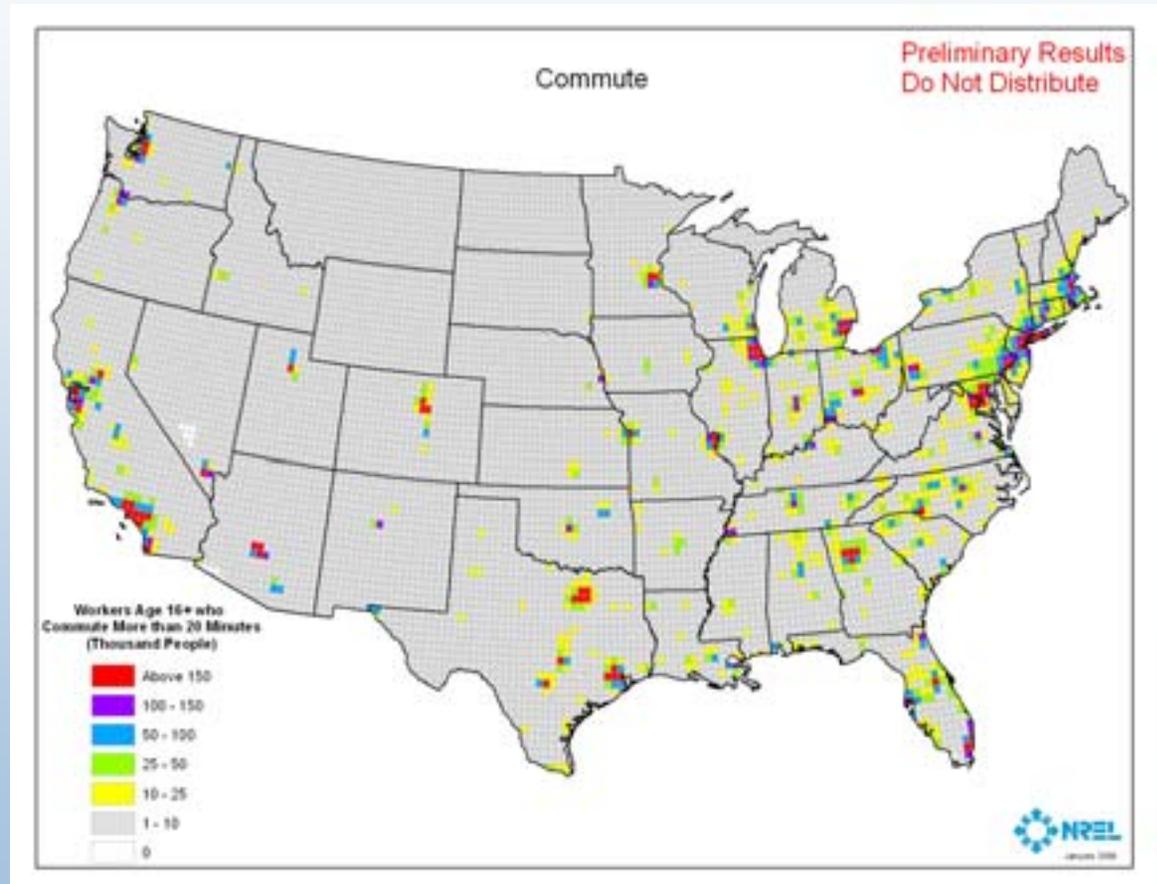
Description of Metrics

Commute Distance (Med)

- Impacts infrastructure needs and tolerance to refueling inconvenience

Commute more than 20 minutes

U.S. Census Bureau



Description of Metrics

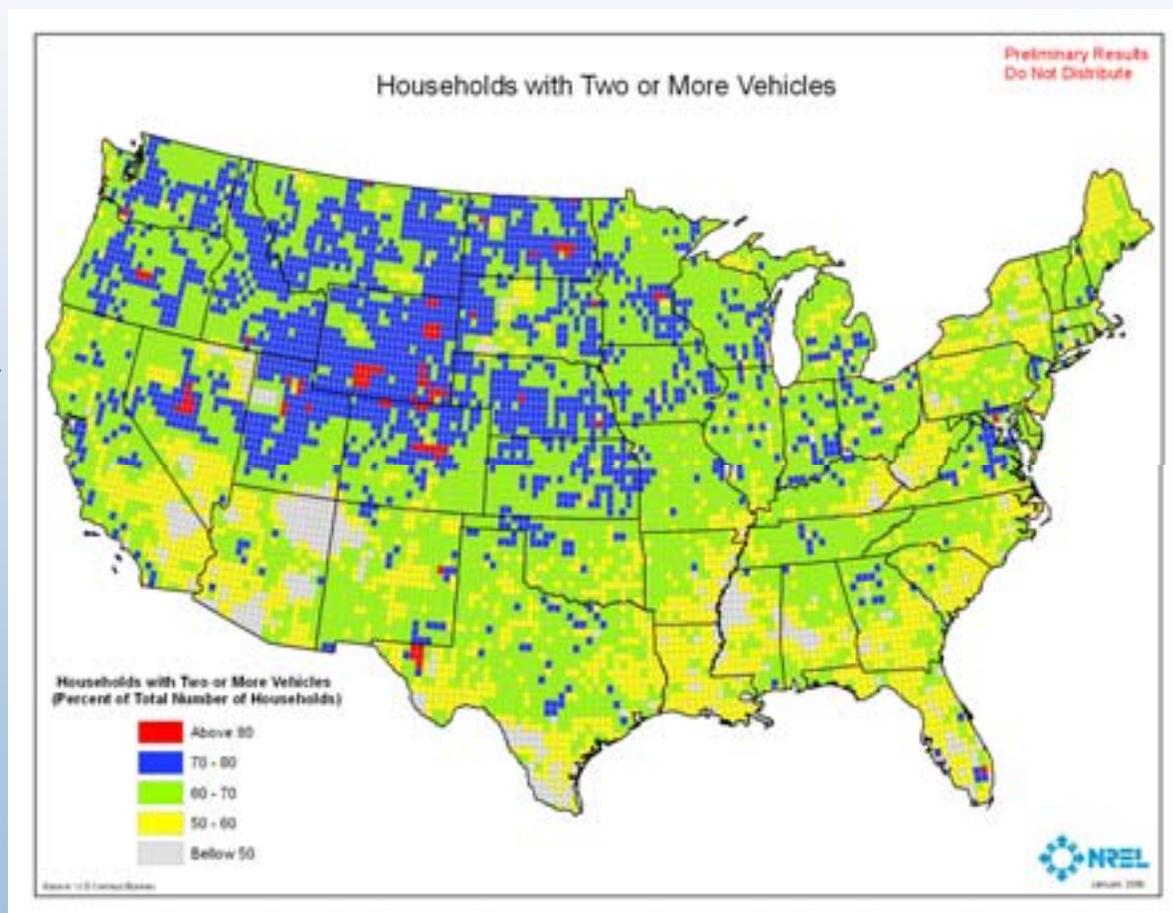
Driving and Transportation Attributes

Vehicles per Household (High)

More likely to adopt H2 vehicles with multiple vehicles per household

Households with 2+ vehicles

U.S. Census Bureau



Description of Metrics

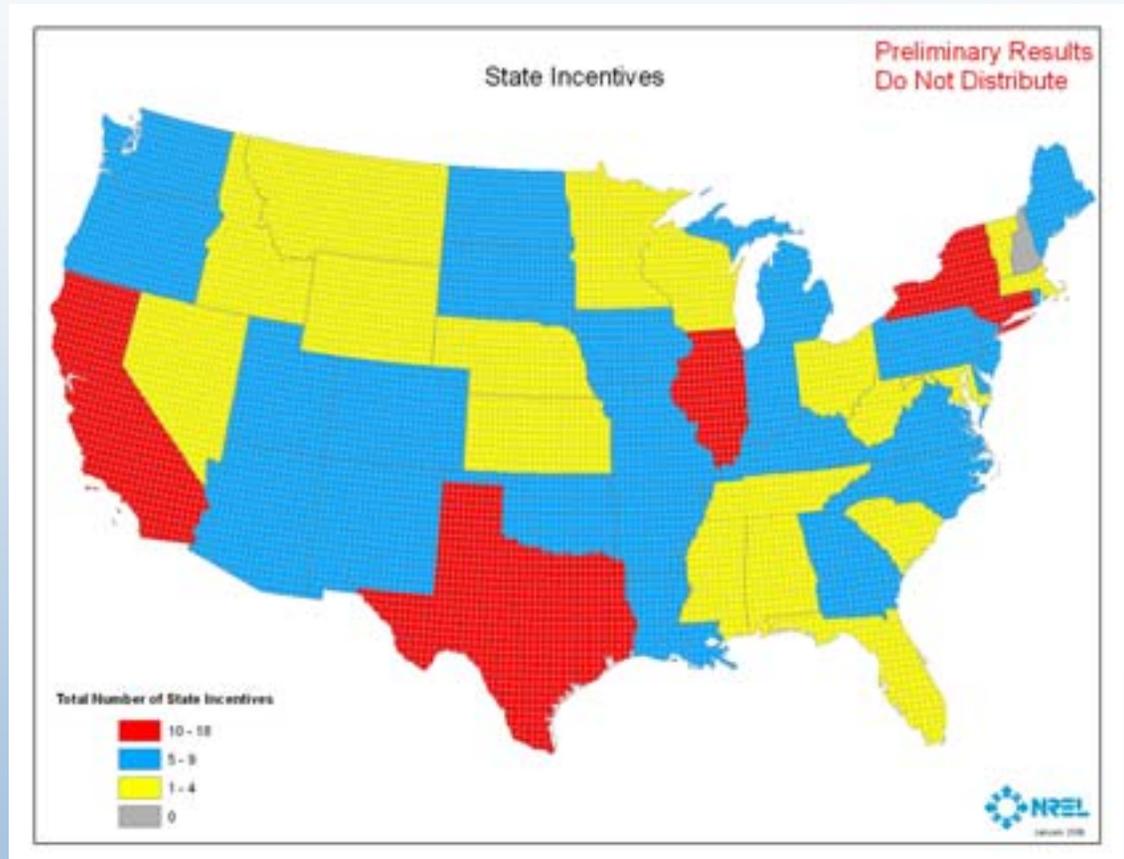
Tax Incentives (High)

- AFV incentives could indicate future or existing H2 incentives

HOV Incentives (High)

- HOV access is incentive to purchase

*Alternative Fuels Data
Center, EERE*



Description of Metrics

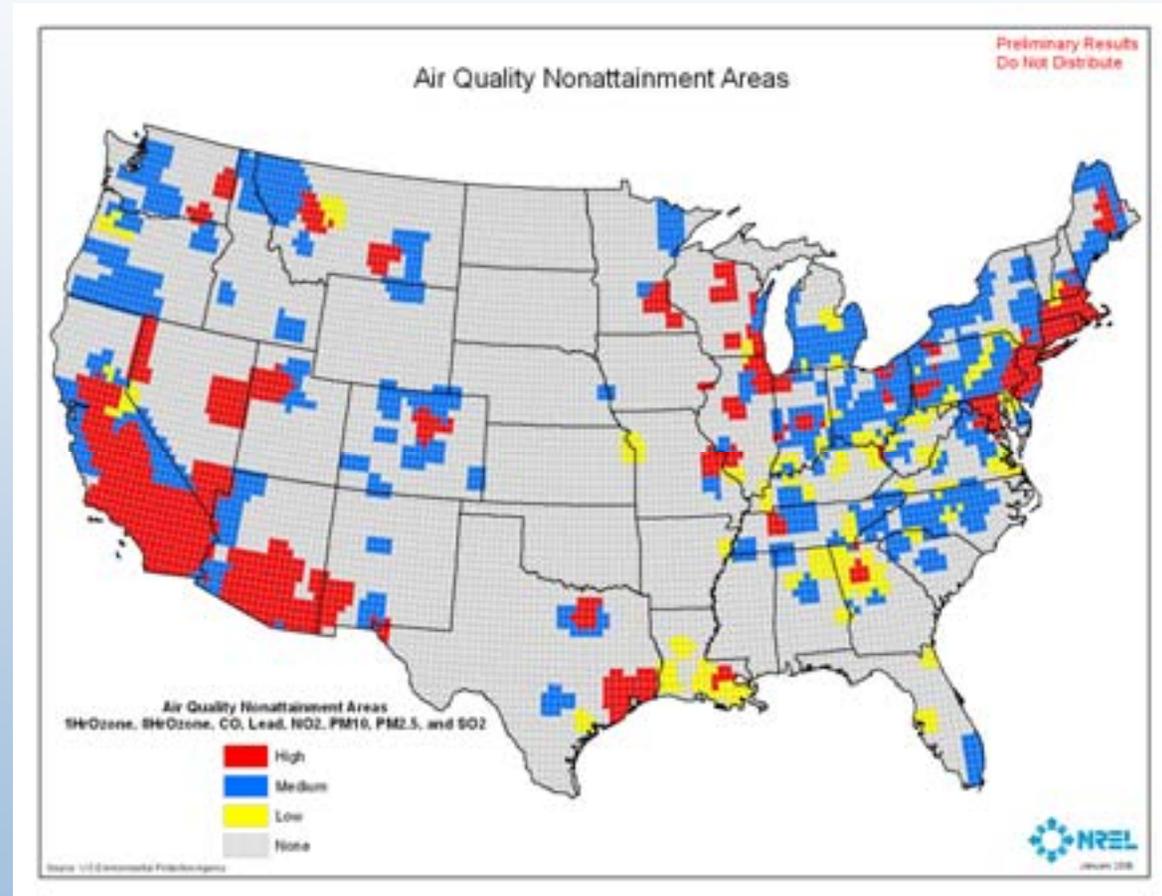
Vehicle and Transportation Policies

Air Quality (Med)

- Worse air quality leads to consumer awareness and incentives

Non-attainment areas

US EPA, September 2005



Description of Metrics

Outreach and Implementation Attributes

Clean Cities Coalition

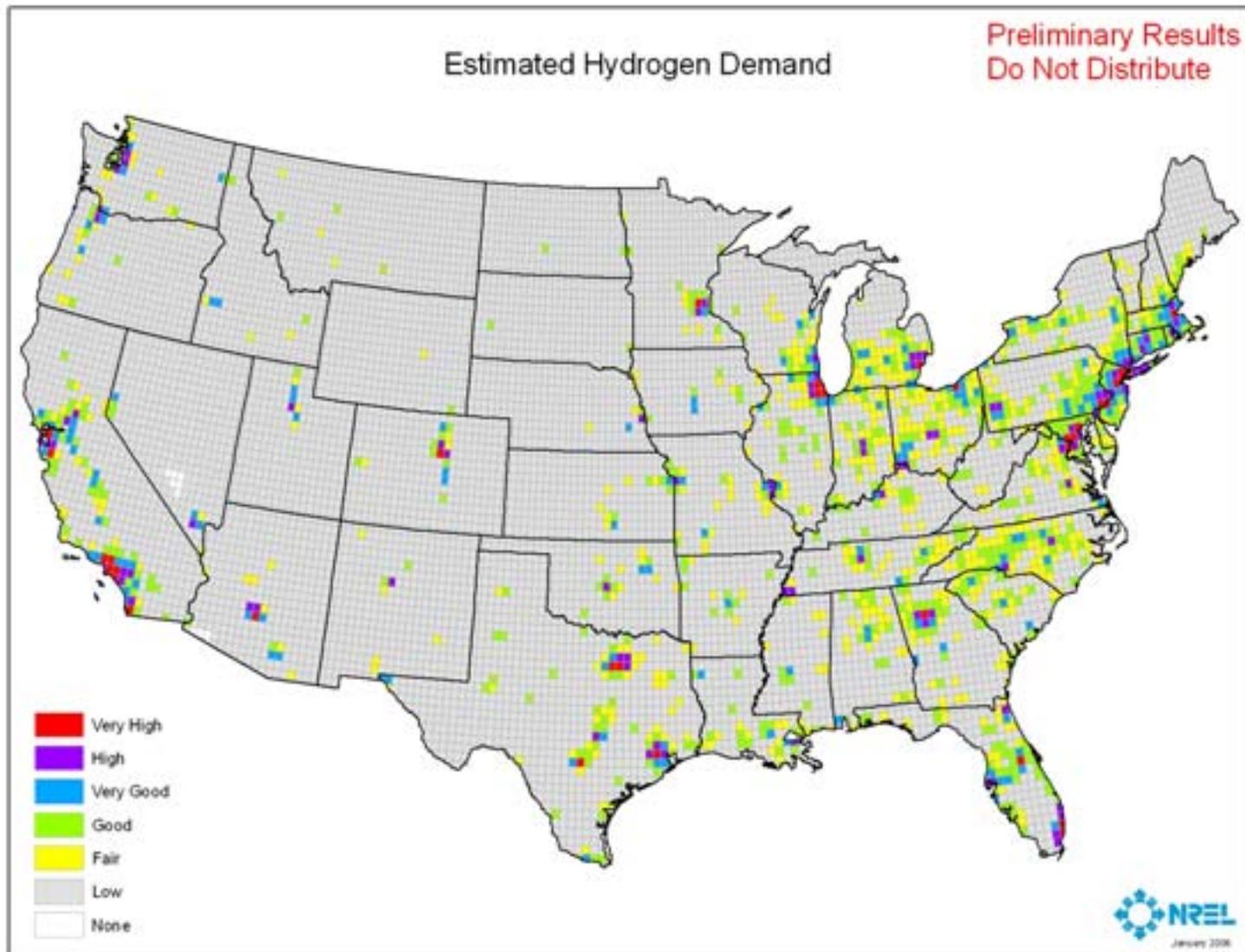
(High)

- Facilitation to pull funding opportunities together and awareness is important

*Clean Cities Coalitions
Alternative Fuels Data Center,
EERE*



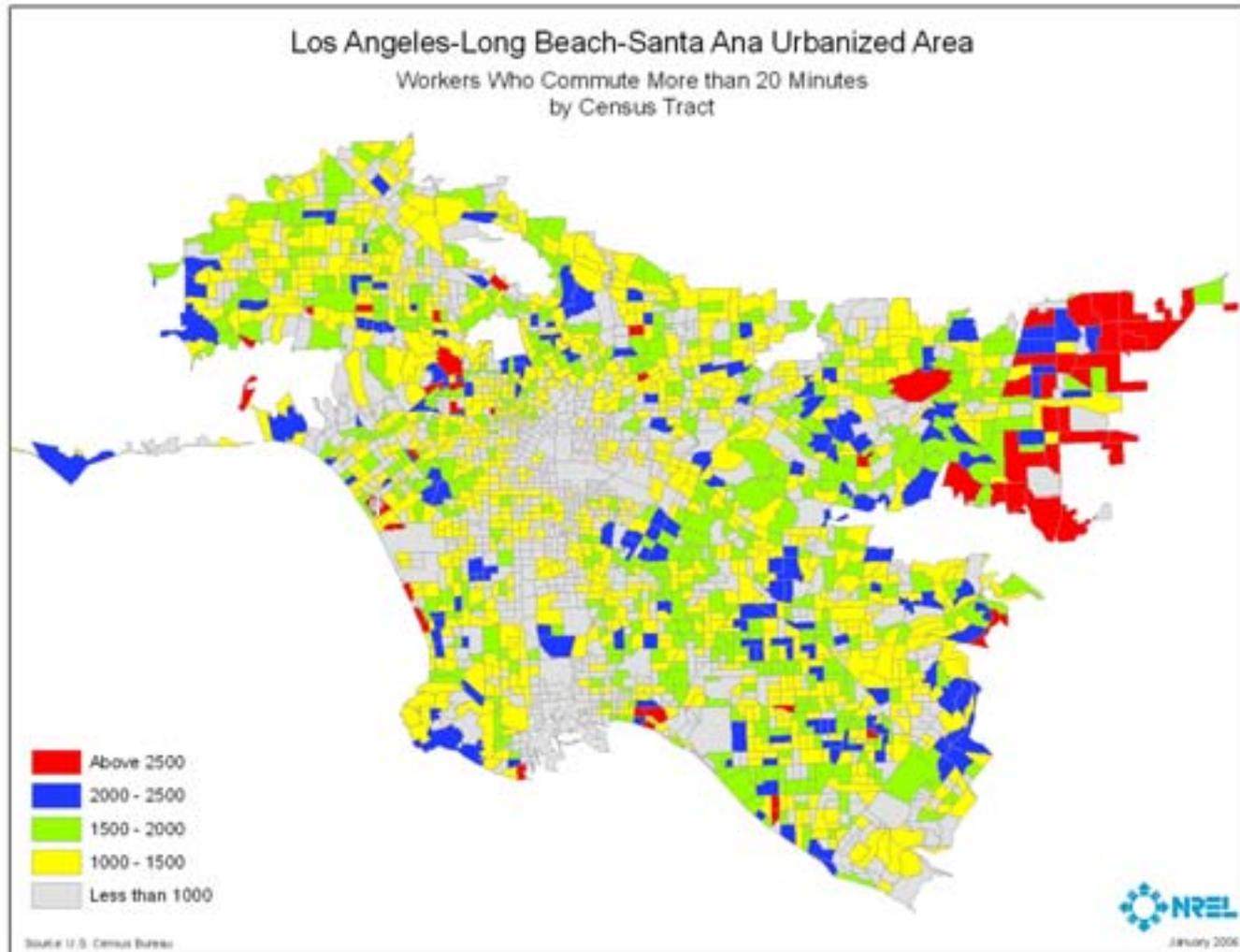
Preliminary Findings



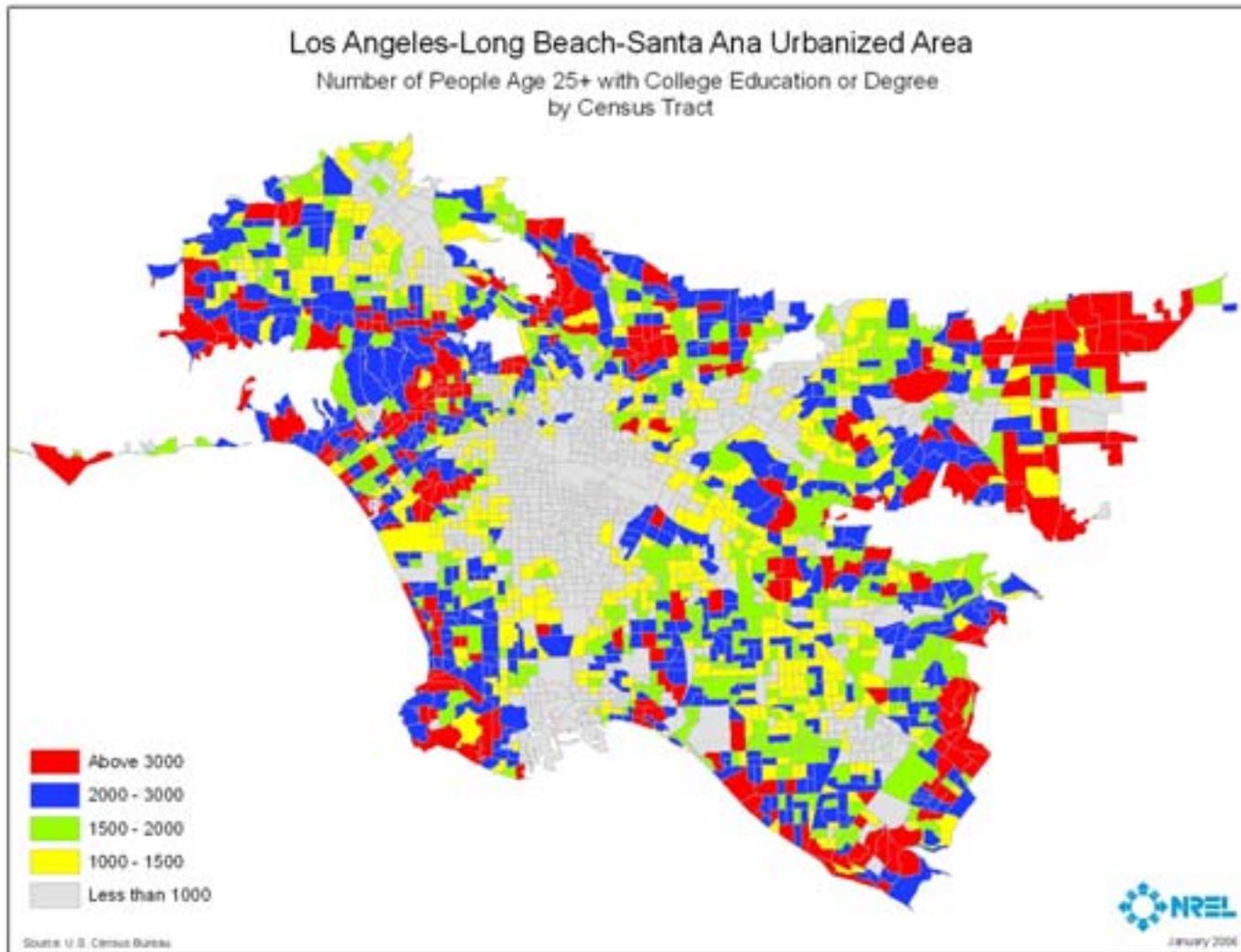
Preliminary Findings

- Population centers tend to be important, but with income results may change
- Some pockets of rural areas are important
- May be highly sensitive to certain metrics

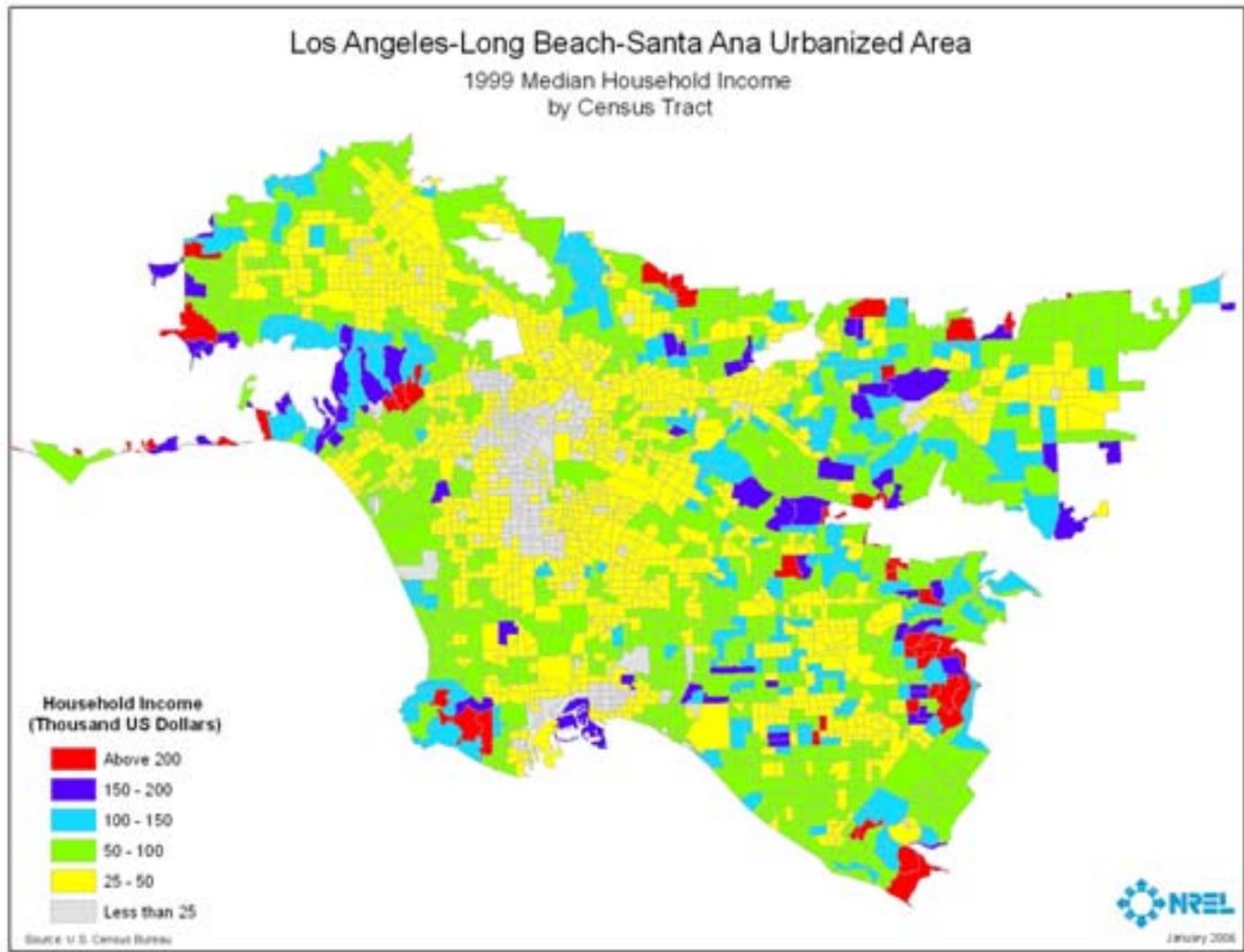
Preliminary Findings



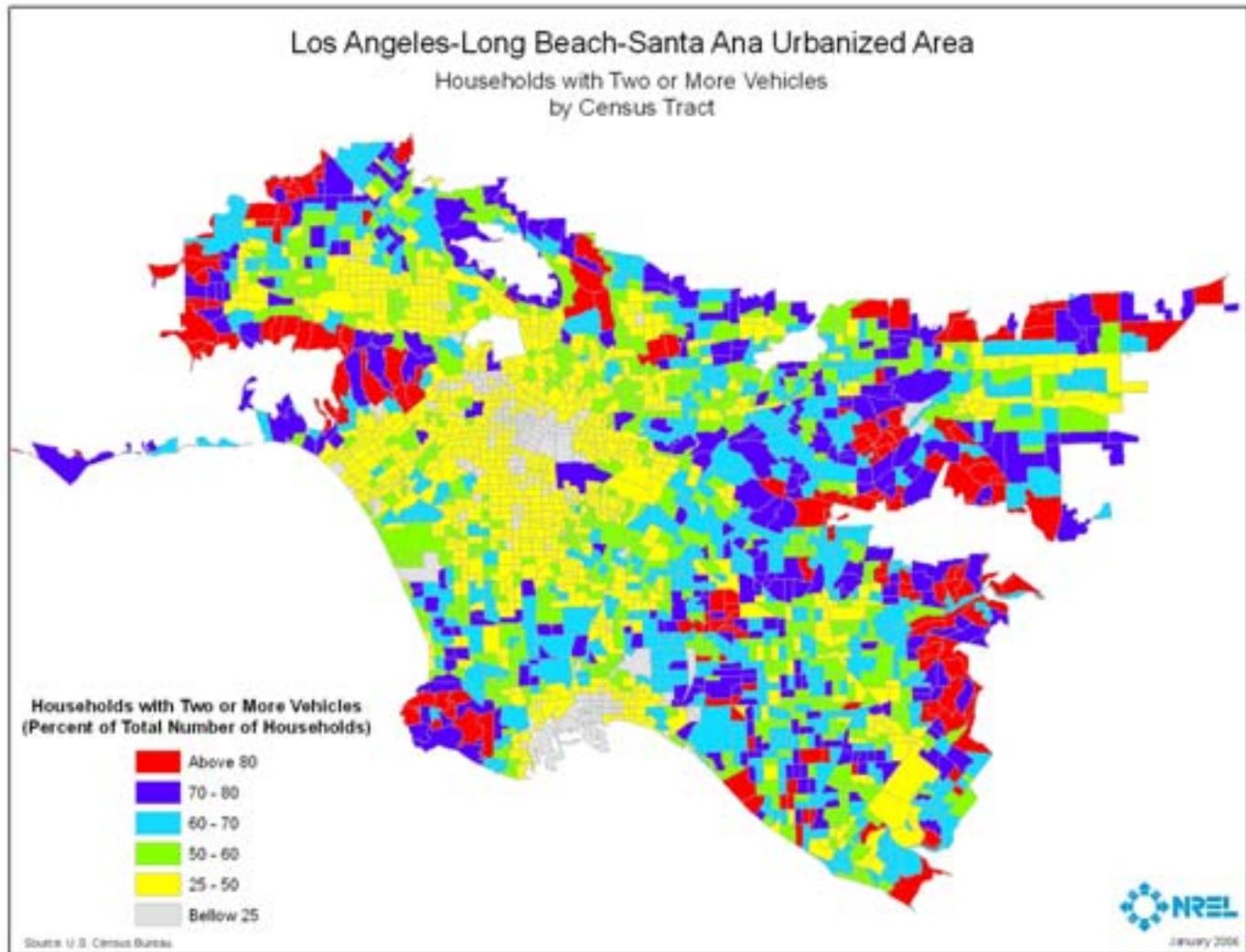
Preliminary Findings



Preliminary Findings



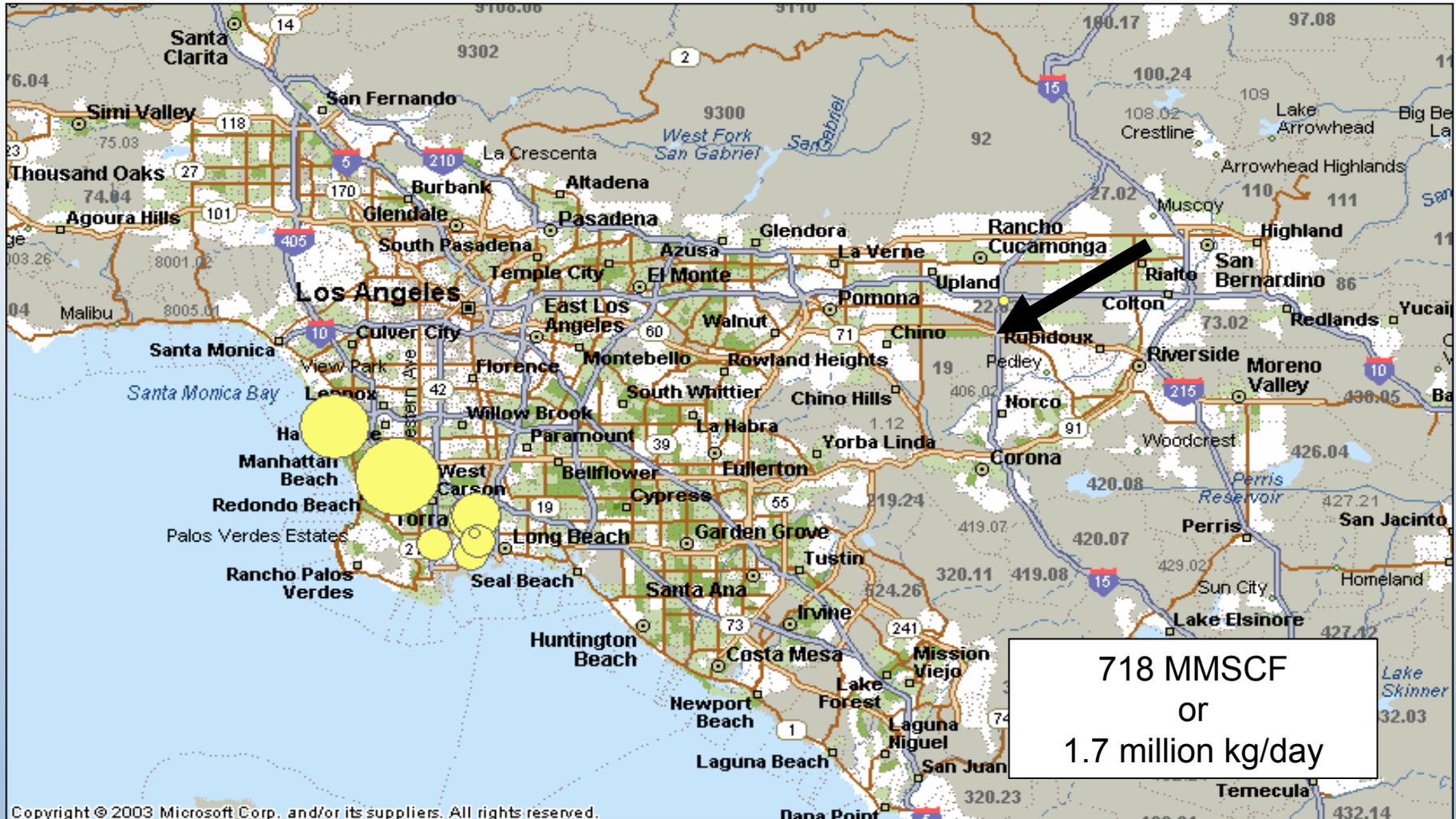
Preliminary Findings



LA Basin Analysis

- Case Study of Existing Facilities
 - Hydrogen Production
 - Fueling Stations
- Vehicles
 - Vehicles to Production
 - SRC Scenarios
- Other Analysis...

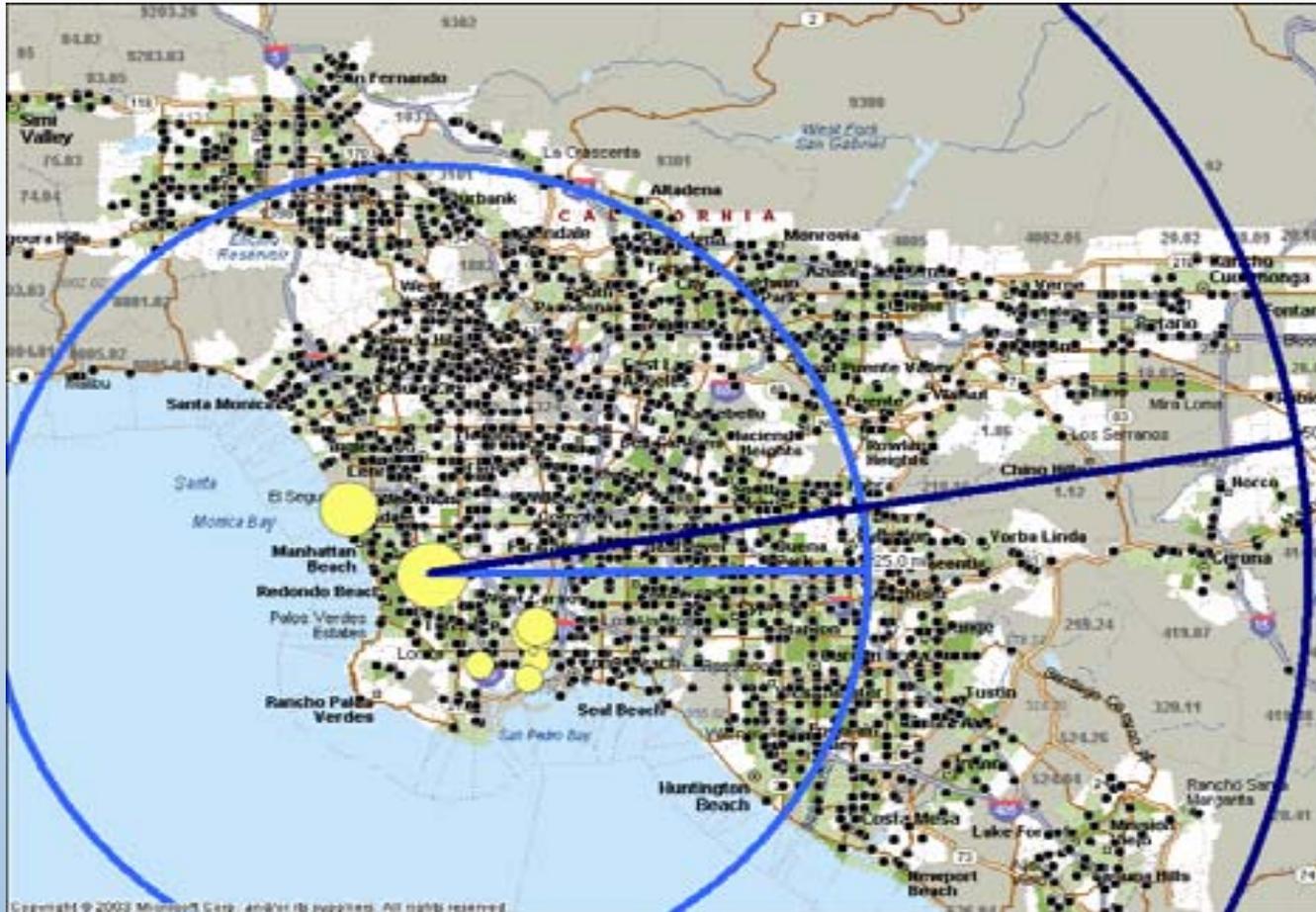
Existing Hydrogen Production



LA Basin – Proximity Rings



Fueling Stations (50-mile radius)



Statistics:

60% of stations within **25-mile** radius

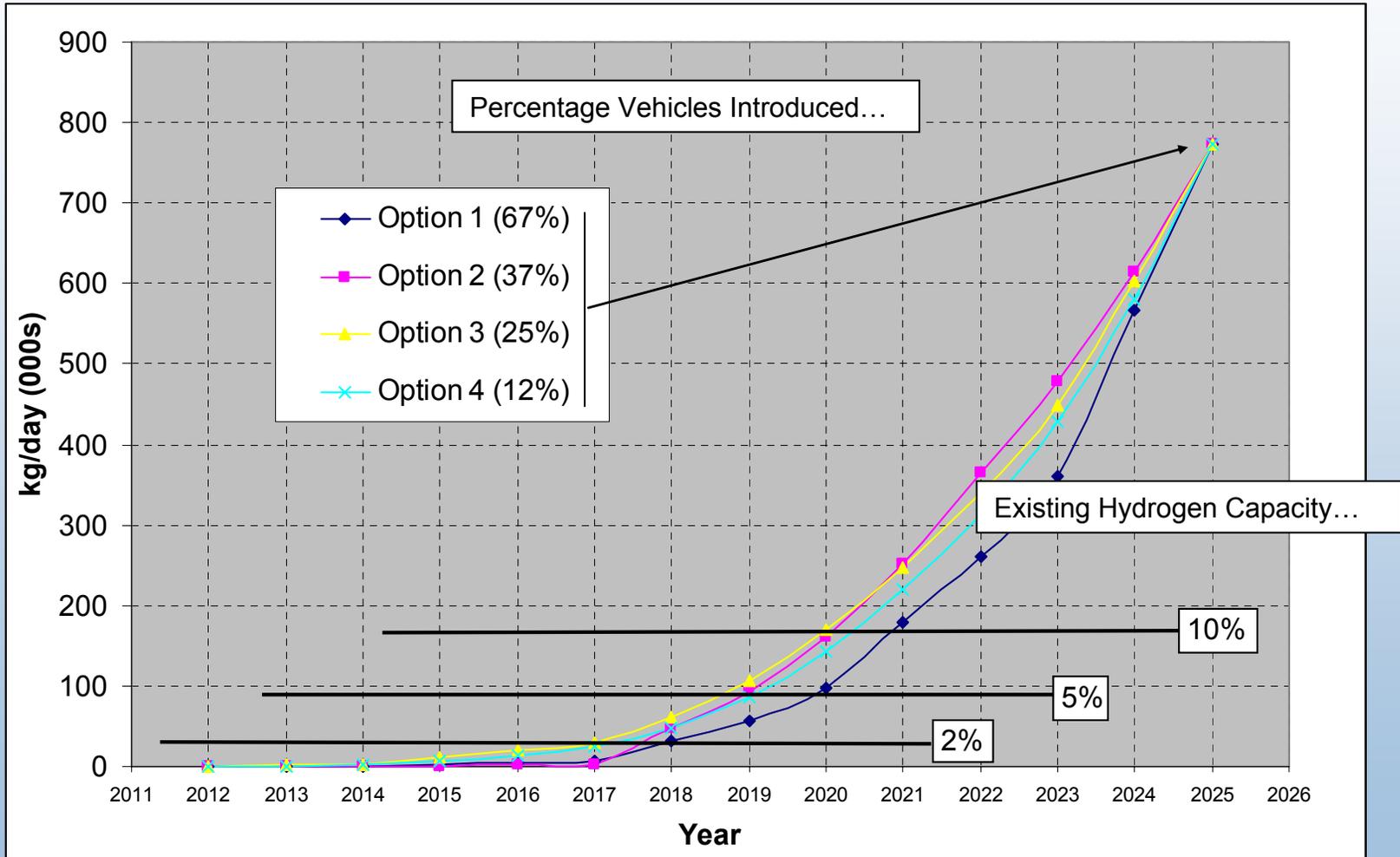
77% of stations within **30-mile** radius

Weighted average distance to all fueling stations **24.95 miles**

Snapshot of Vehicles and Existing Production

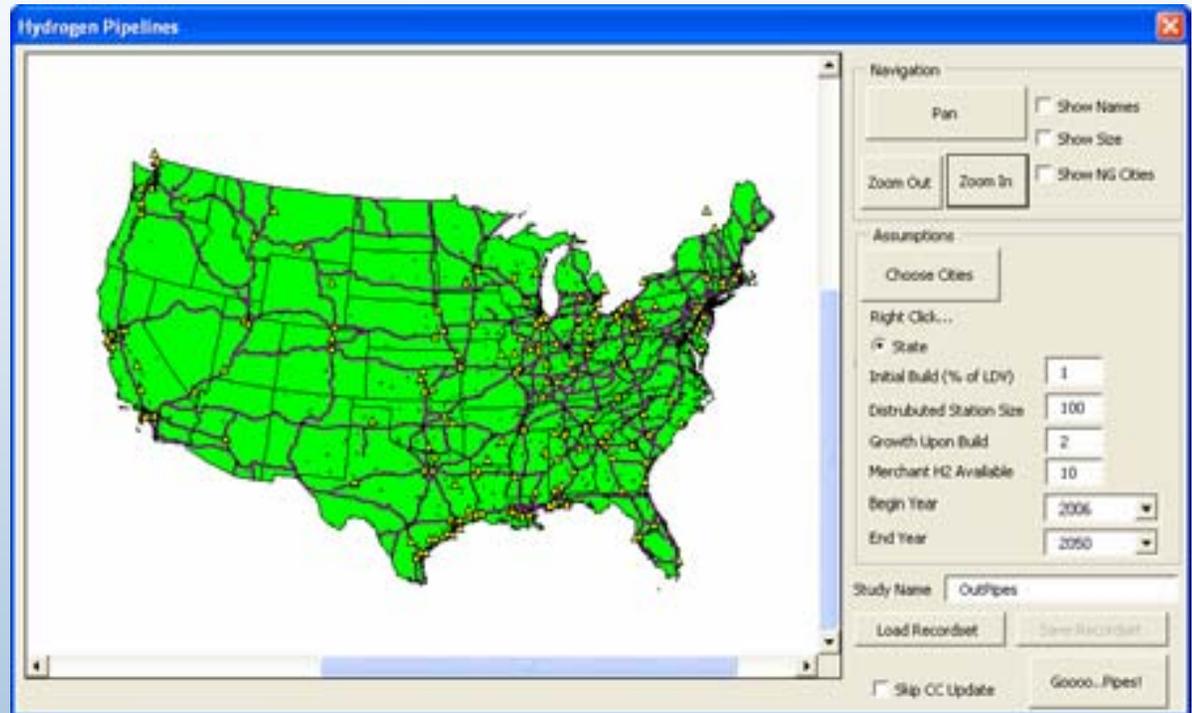
- **125,000 Vehicles**
 - 2% Vehicles (LA & Orange County 2002 Census)
 - 5% Existing Production (PNNL Hydrogen Data Book/NREL GIS Data/CEC Website)
- **250,000 Vehicles**
 - 4% Vehicles
 - 10% Existing Production (~)
- **1,000,000 Vehicles**
 - 15% Vehicles
 - 36% Existing Production (!)

Production Capacity for LA Basin (SRC Scenarios)



GIS Based Infrastructure Modeling

- Combination of NREL GIS-Based Models
 - HyDS
 - Go Pipes
- Inputs
 - H2A Production
 - H2A Delivery
 - Demographic Demand Model
- Collaboration with HYTRANS
- Focus
 - Transparency
 - Electricity Sector Impacts



Significance of Work

- Identify key geographic areas to focus detailed analysis, demonstrations, or policies
- Understand spatial aspects of early transition and beyond
- Evaluate regional resources as demand grows

Significance of Work

- Provide a spatial component to other transition analyses (HyTrans, HYDS, MSM)
- Provide a spatial component to non-transition analyses (HOPE, H2A)
- Evaluate strategies for a transition that includes fleets leading to consumers
 - Placement of infrastructure
 - Demand at infrastructure
 - What will work for both? What won't?

Next Steps

- Refine values and mix of demand metrics
 - Sensitivity analysis
 - Stakeholder feedback
 - Literature review
- Regional analysis
 - Incorporation of more specific local data
 - Distribution component with HYDS
 - Incorporate demand into LA analyses

Next Steps

- Understand H2 demand growth and address stranded assets
- Quantify related infrastructure costs
- Examine fleet and consumer scenarios
 - Can one investment in infrastructure serve both?