Geographic Disaggregation of Energy Demand

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Outline

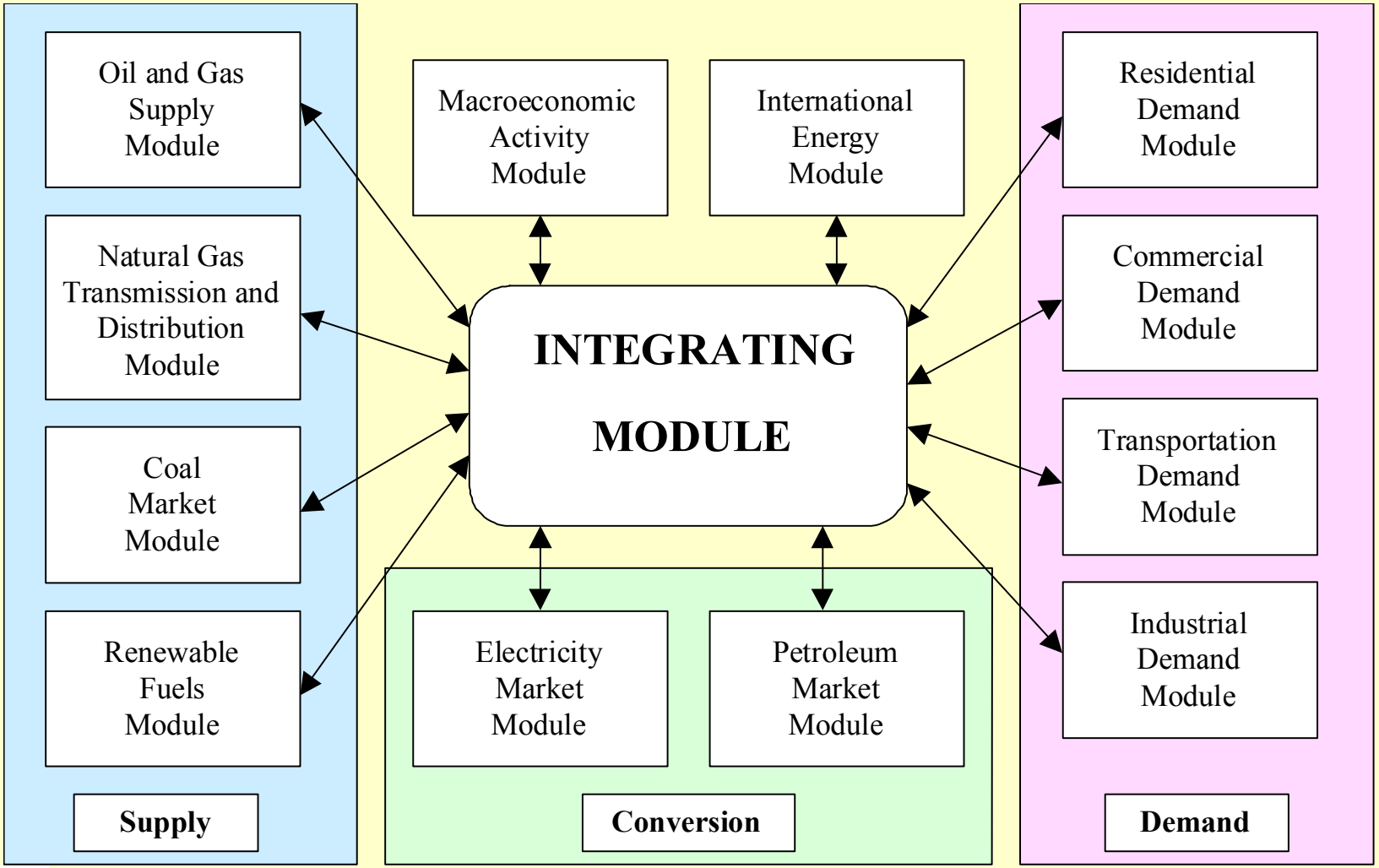
I. Context: NEMS Exogenous Analysis

II. Recent Berkeley Lab GIS Activities:

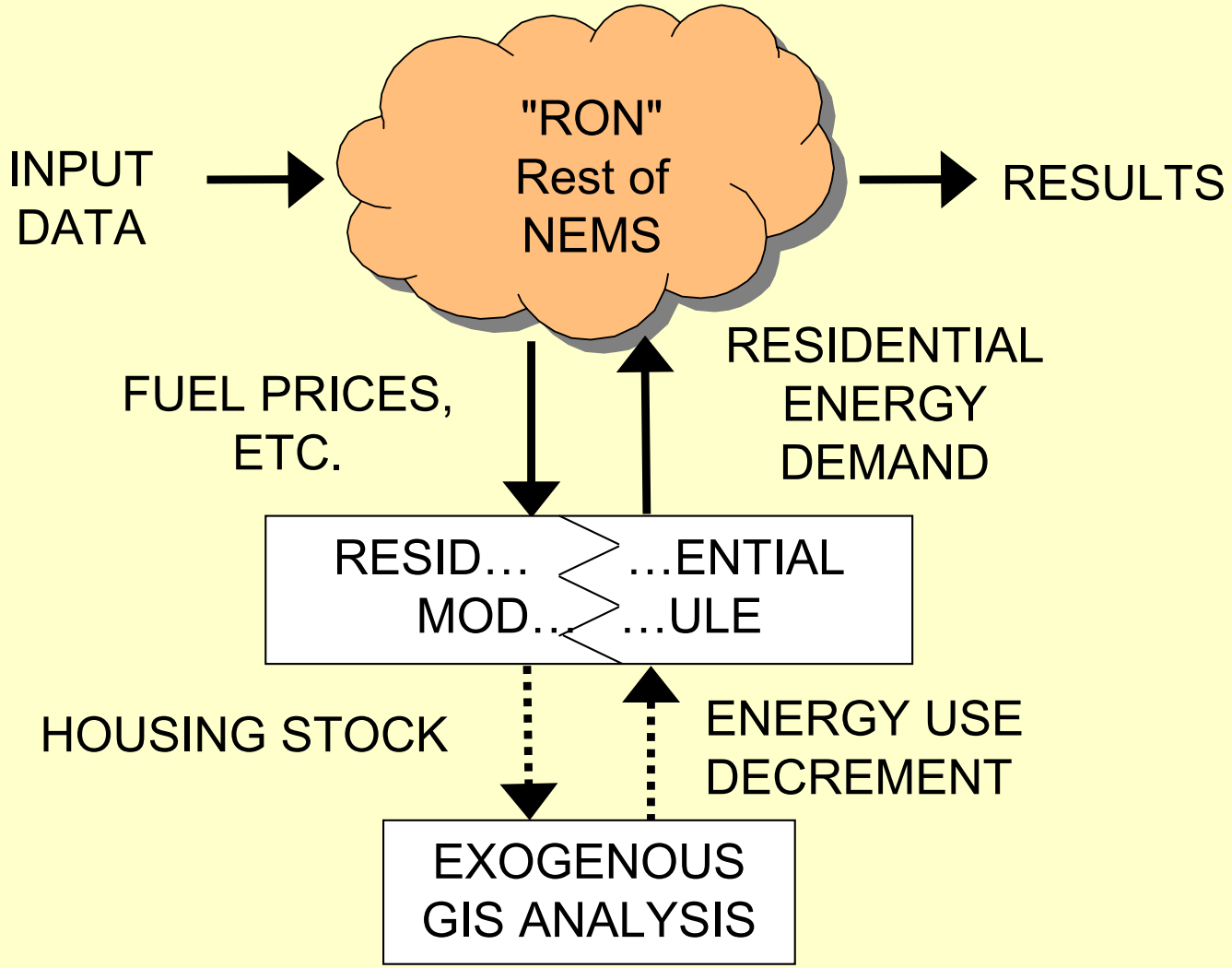
- The regional difference in the value of PV systems in New York;
- The variation of absorption cooling technology potential in California;
- Disaggregation of NEMS demand-side data.

I. NEMS Exogenous Analysis

The Modular Structure of NEMS



Communicating With RON



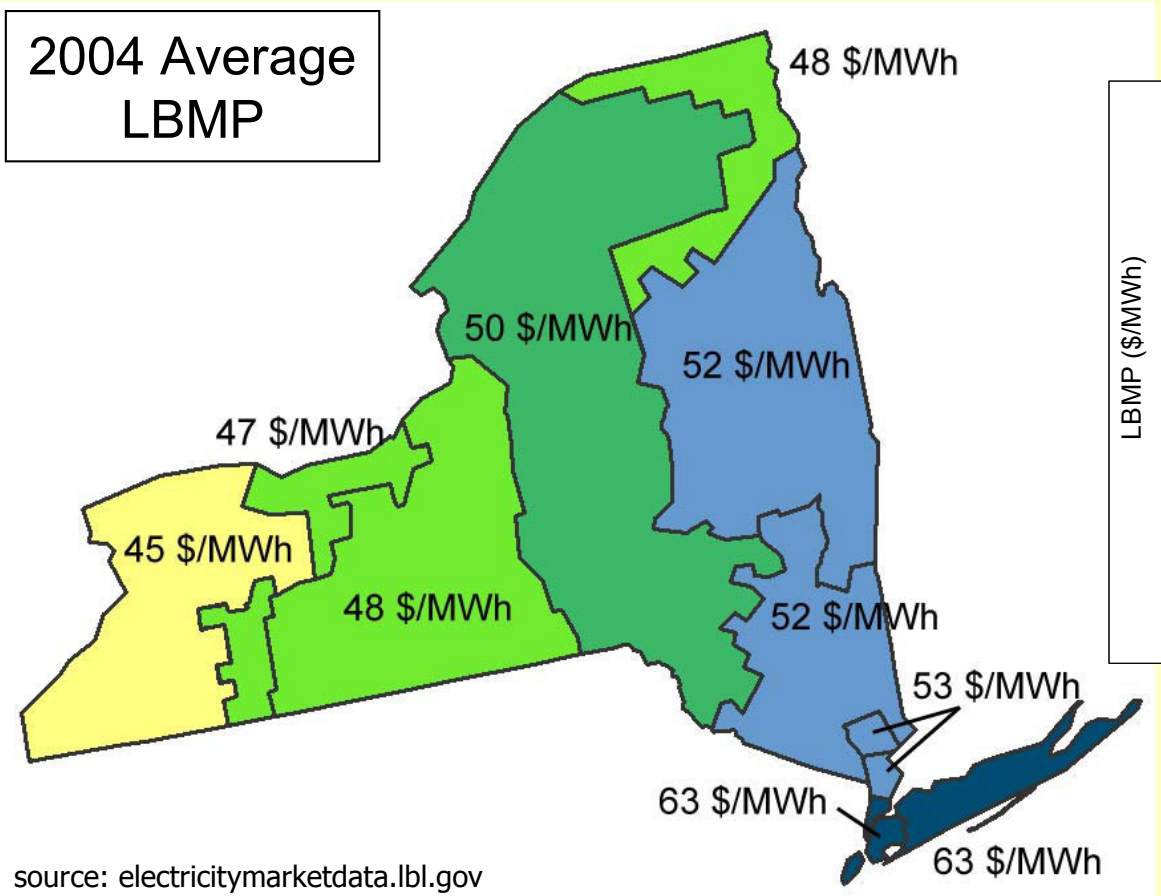
II. Recent Berkeley Lab GIS Activities

1. The Regional Value of Rooftop PV Systems in New York State

- Focus on three different factors:
  - How does the value of electricity vary throughout the state?
  - Where does the sun shine?
  - Where are the rooftops?

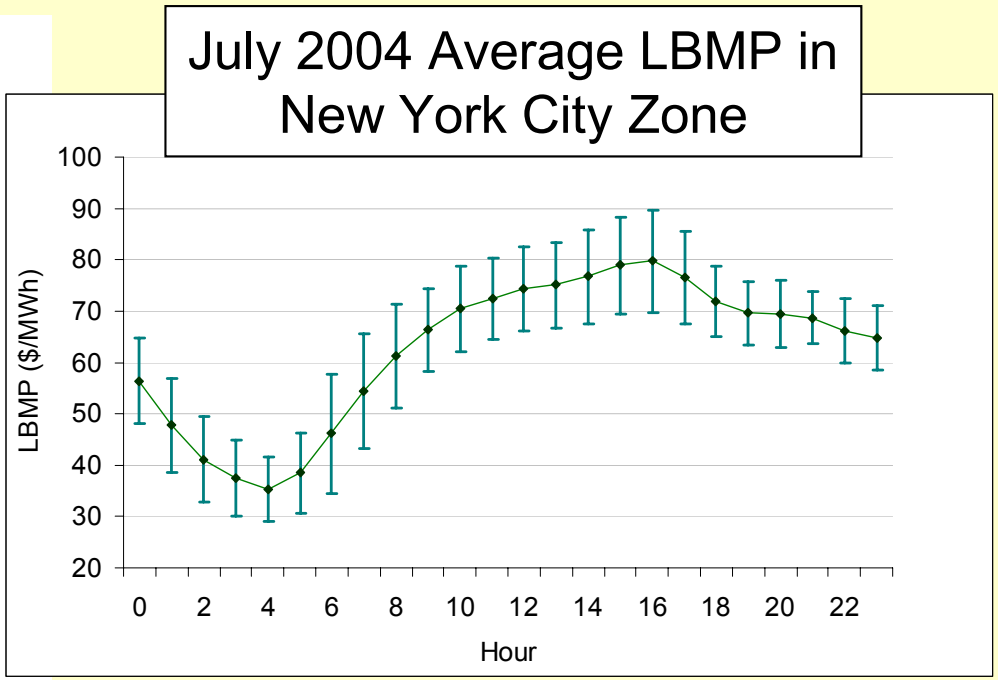
Price Variation in NYISO Load Zones: Location-Based Marginal Price

Geographic Variation



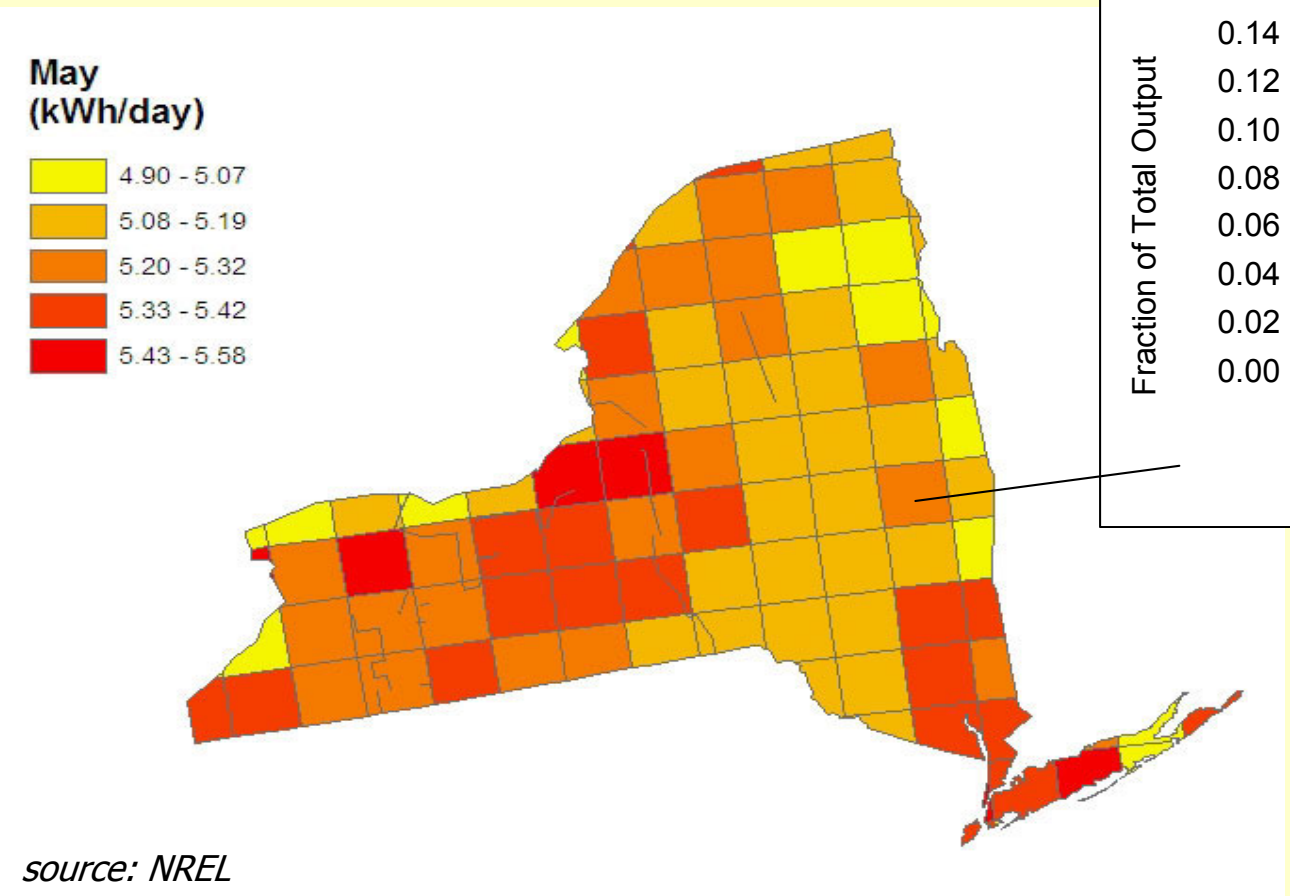
source: electricitymarketdata.lbl.gov

Temporal Variation



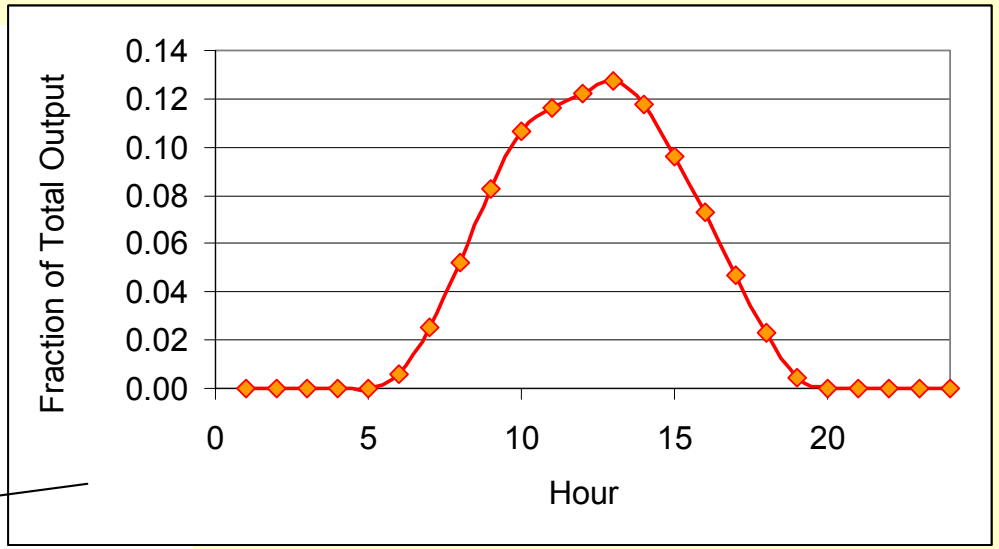
PV System Output: Where Does the Sun Shine?

Geographic Variation

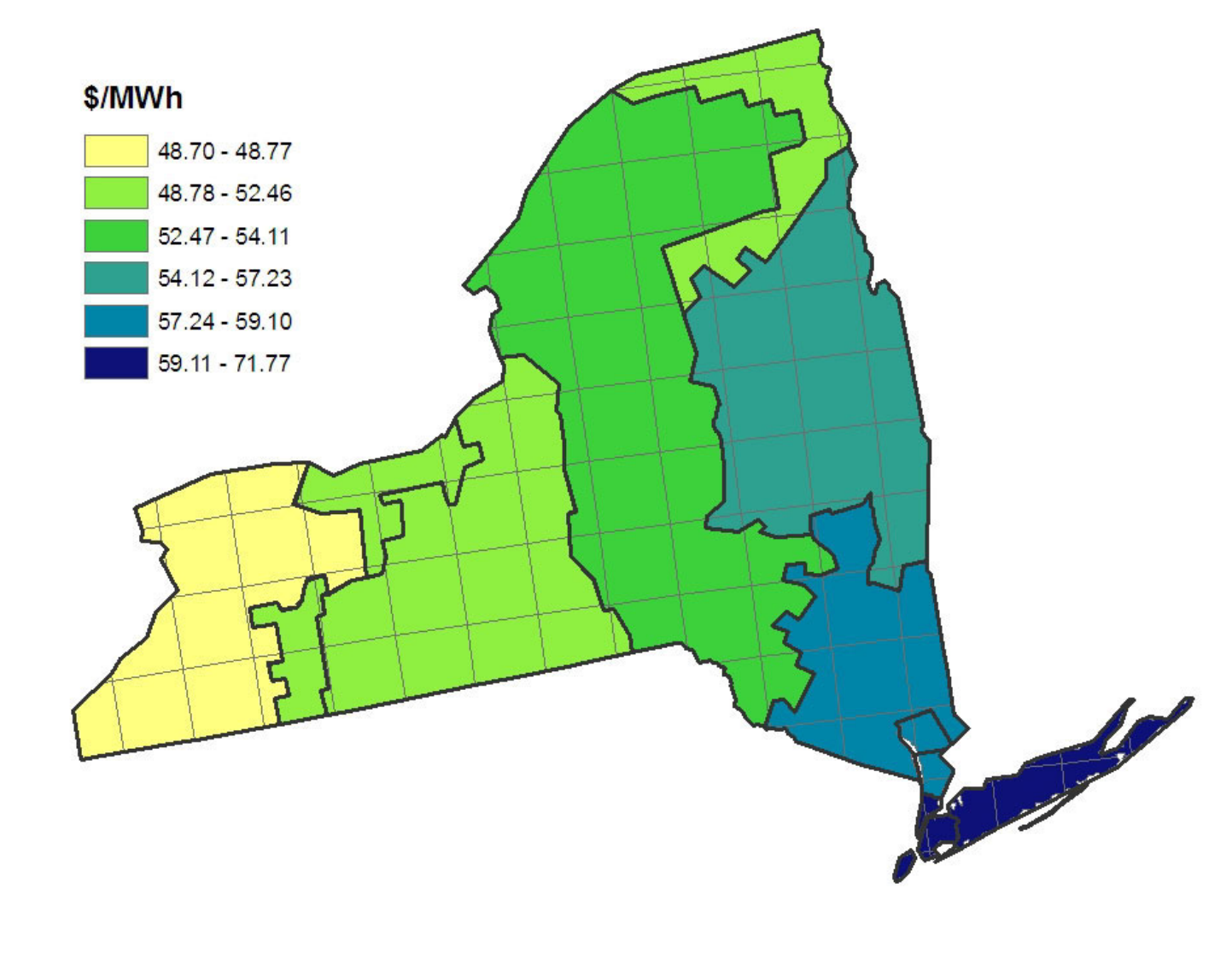


source: NREL

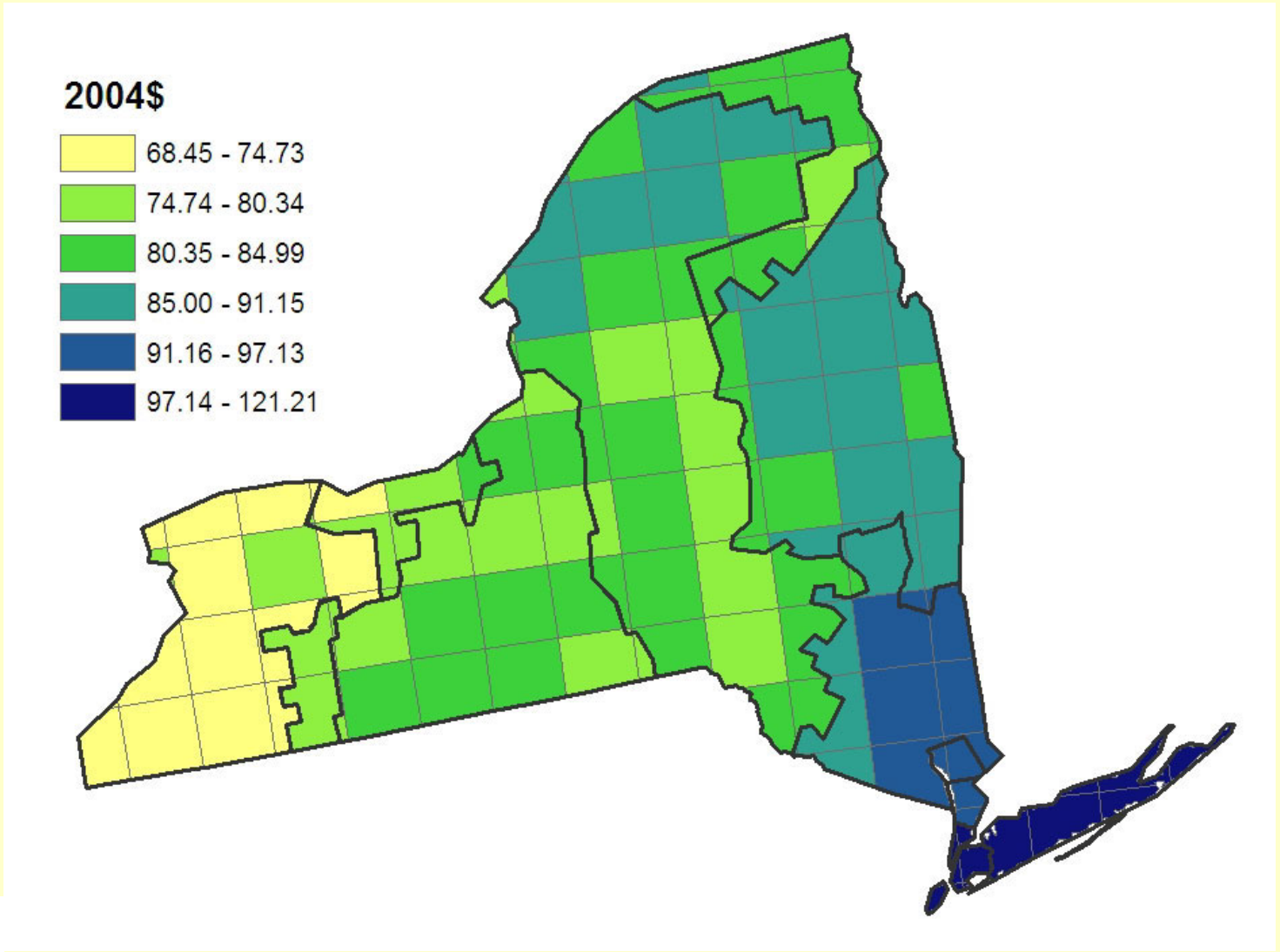
Temporal Variation



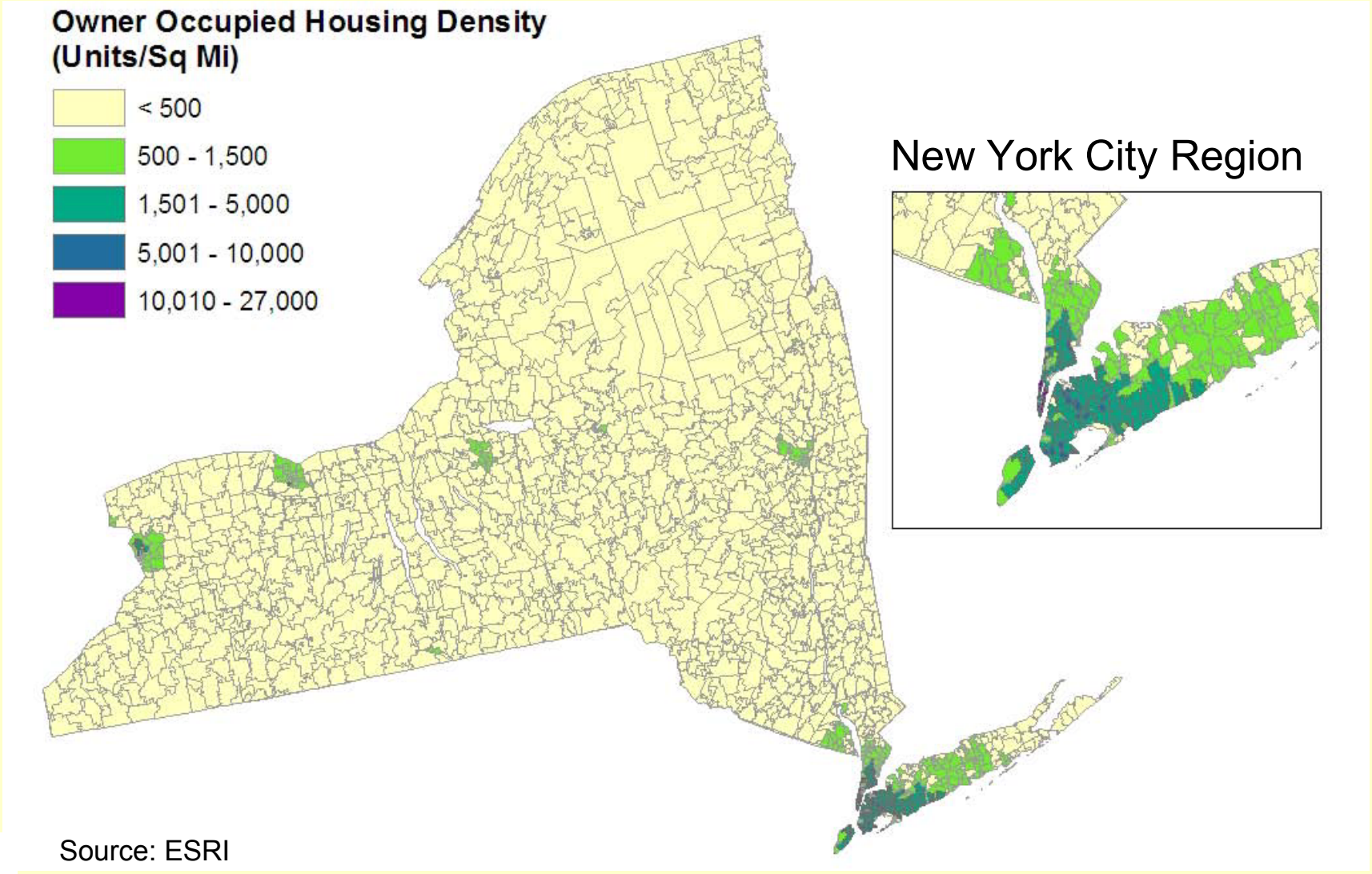
Results : 2004 Average Electricity Value During PV Output Hours



Results (Cont.): Total Annual Value for a 1 kW PV System



Next Analysis Step: Where are the Rooftops?



Source: ESRI

Major Findings

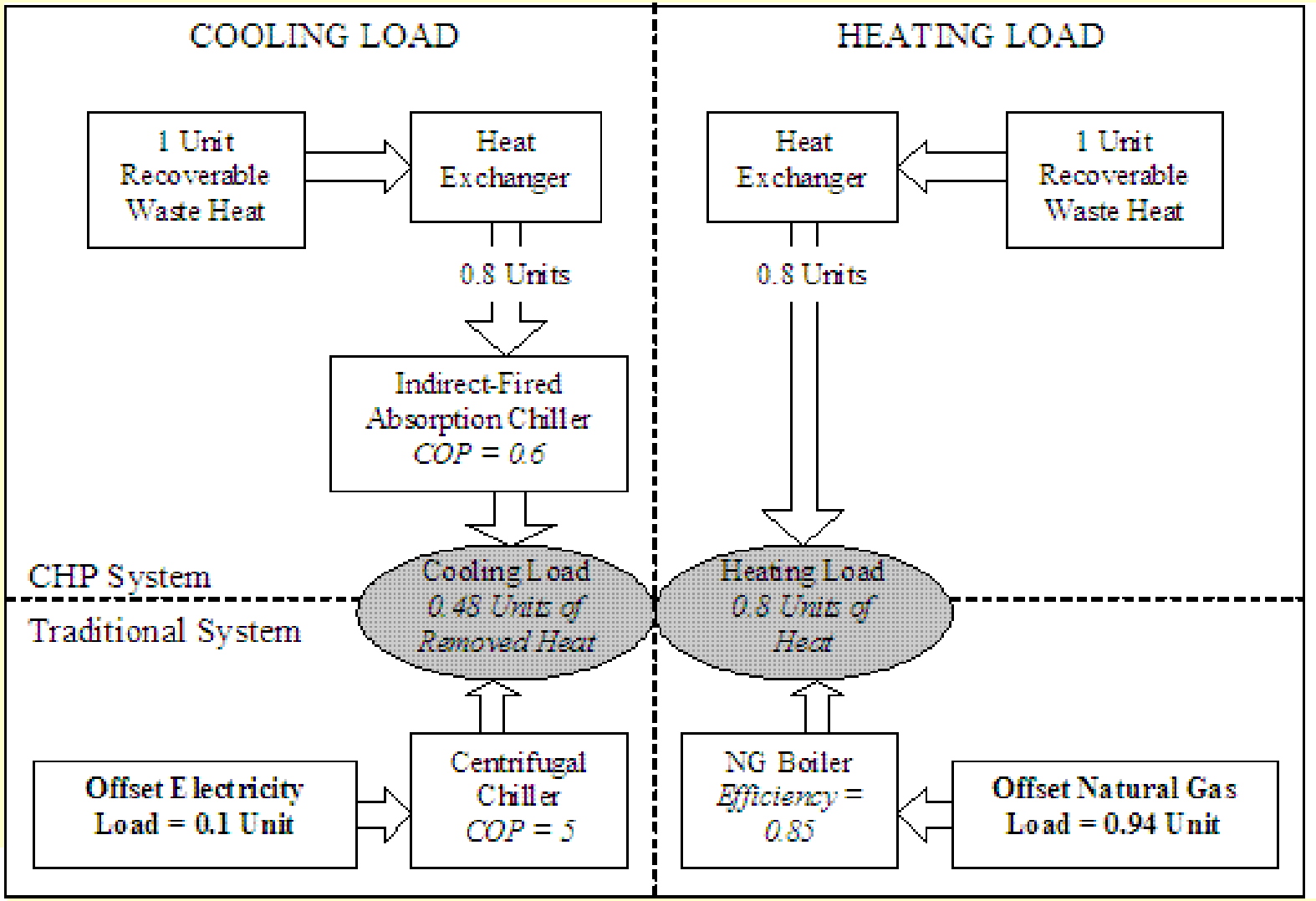
- Congestion in the New York transmission grid leads to significant geographic variation in electricity costs.
- Rooftop PV is producing power during the times when the LBMP is highest, which leads to a high societal benefit
- PV systems have the highest value in the regions where all the people live.

2. Varying Potential of Absorption Cooling Systems in California

- This is a customer-side analysis.
- Where is CHP for cooling more cost effective than CHP for heating?
  - What are the relative cooling and heating loads in different parts of the state?
  - How do the average and marginal electricity prices vary throughout the state?

Heating Versus Cooling Loads:

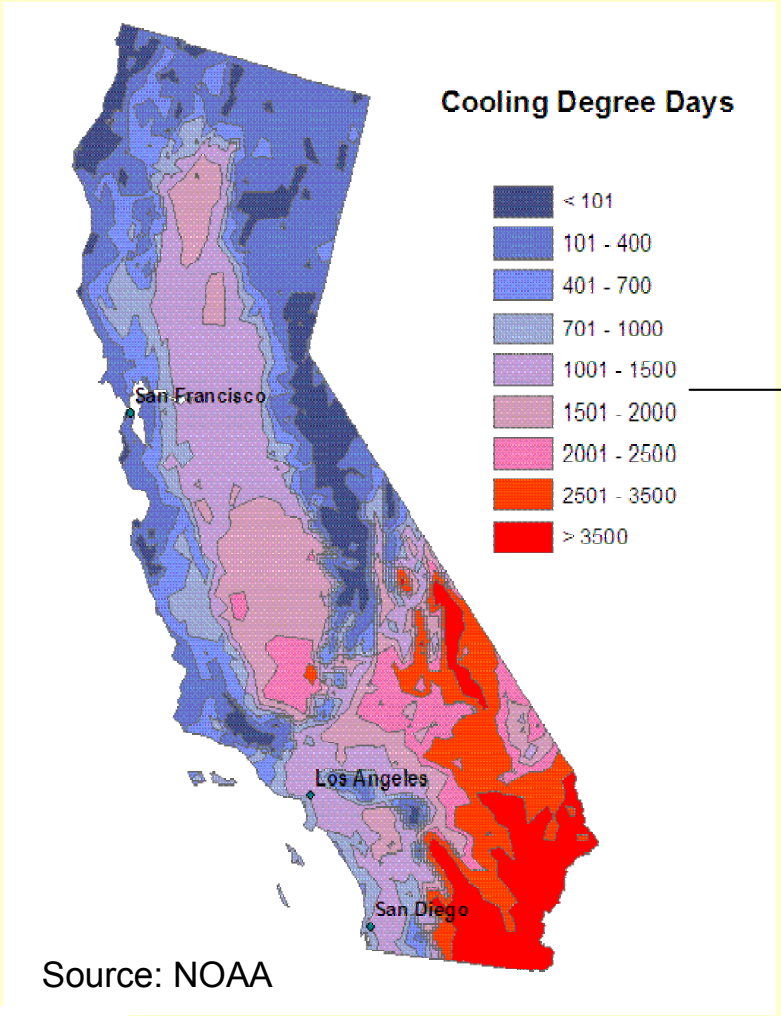
Which is Better Served With Waste Heat?



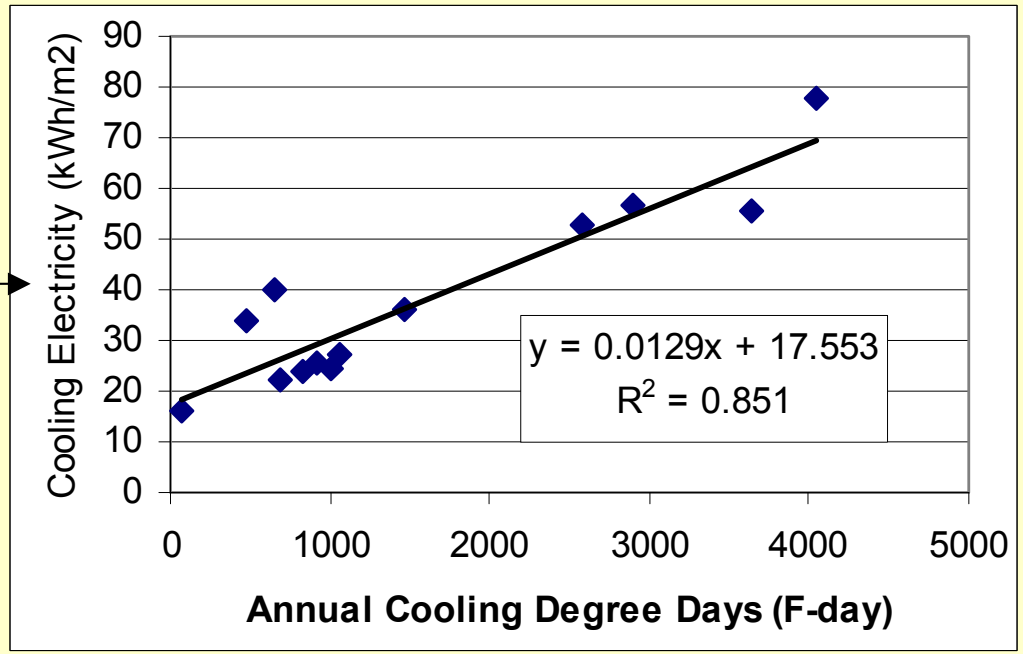
Compare Two Options for California Office Buildings

- Option 1: Use the waste heat to meet heating loads only
- Option 2: Use the waste heat to meet the building cooling load, then use remainder to meet the heating load

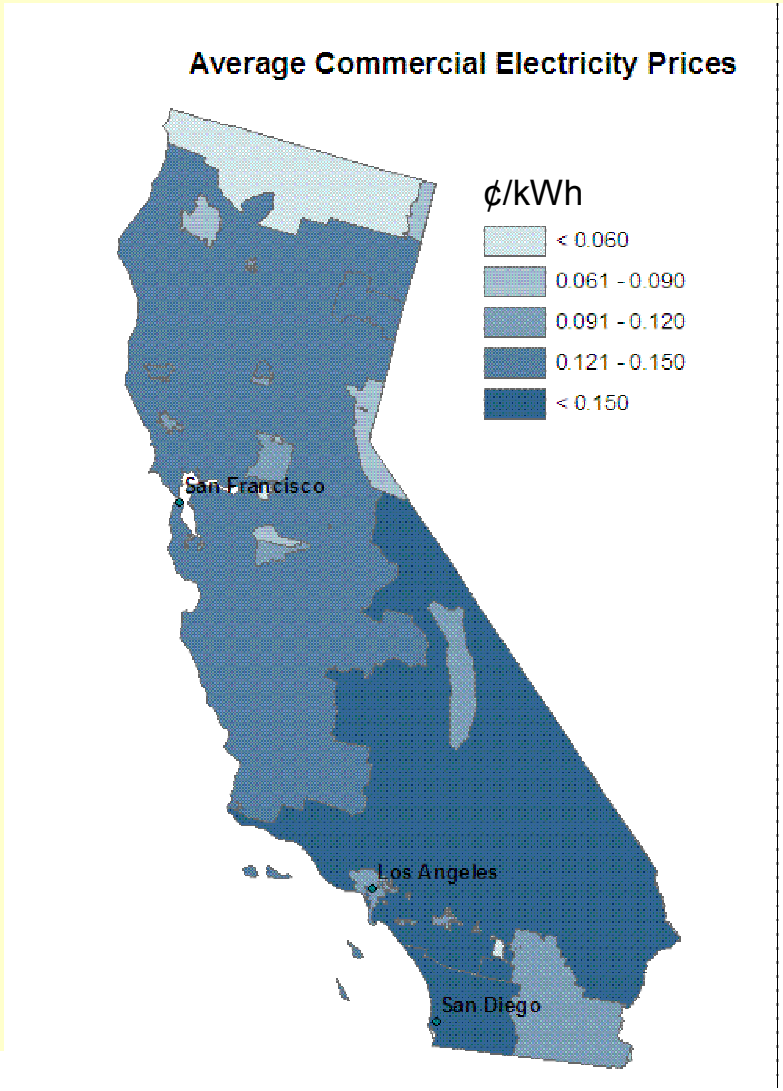
Cooling Demand in California Office Buildings

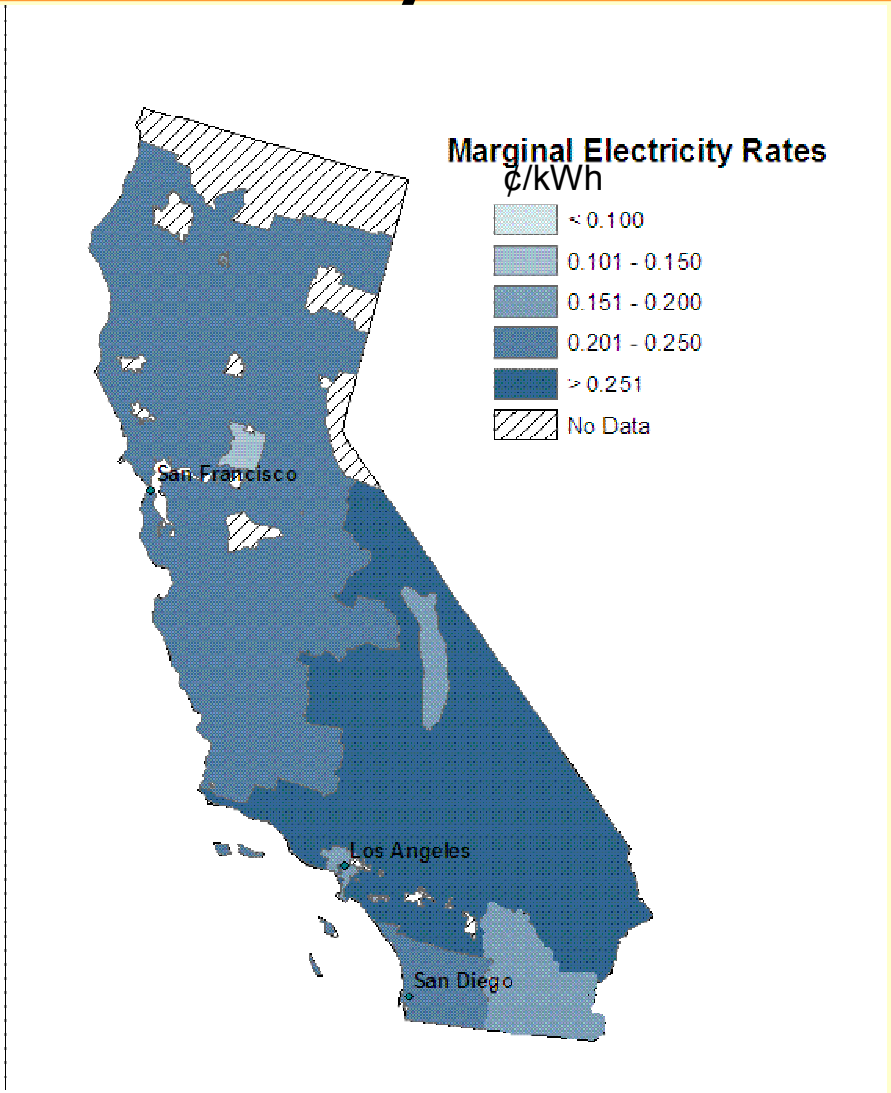


Source: NOAA

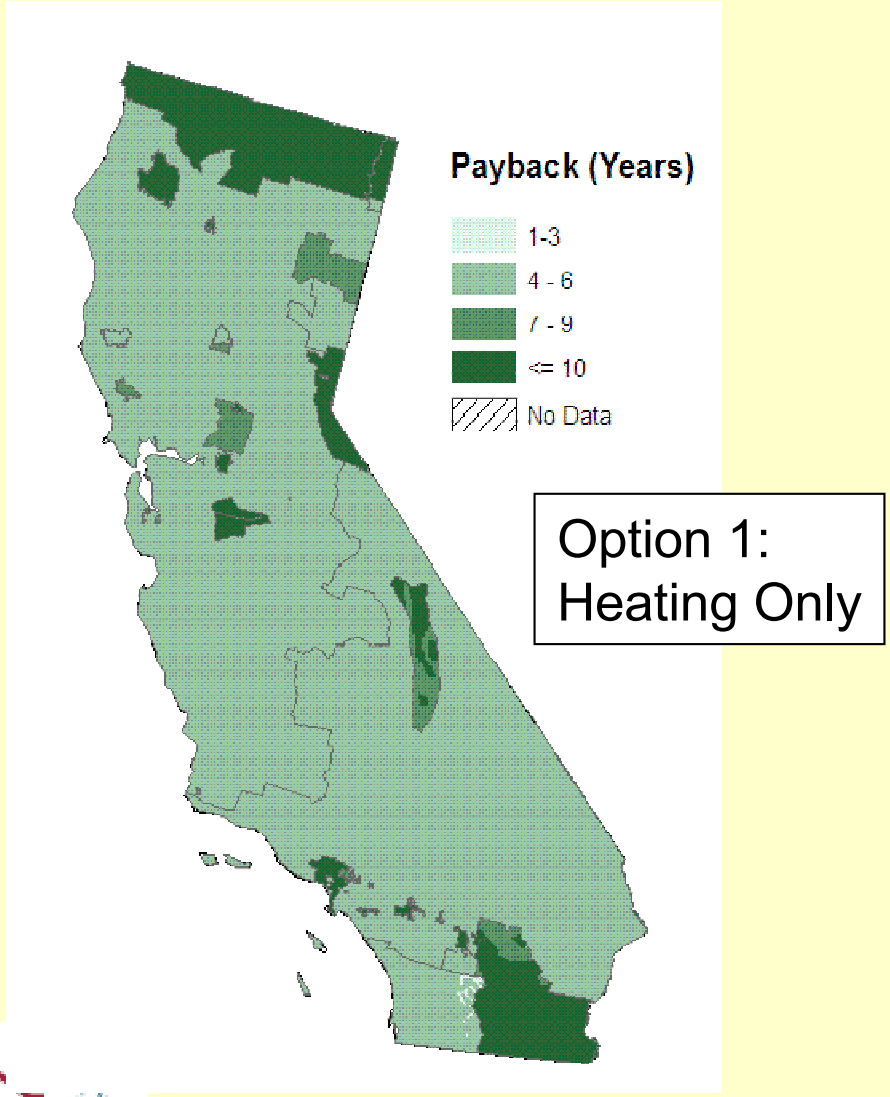


Average and Marginal Commercial Electricity Rates

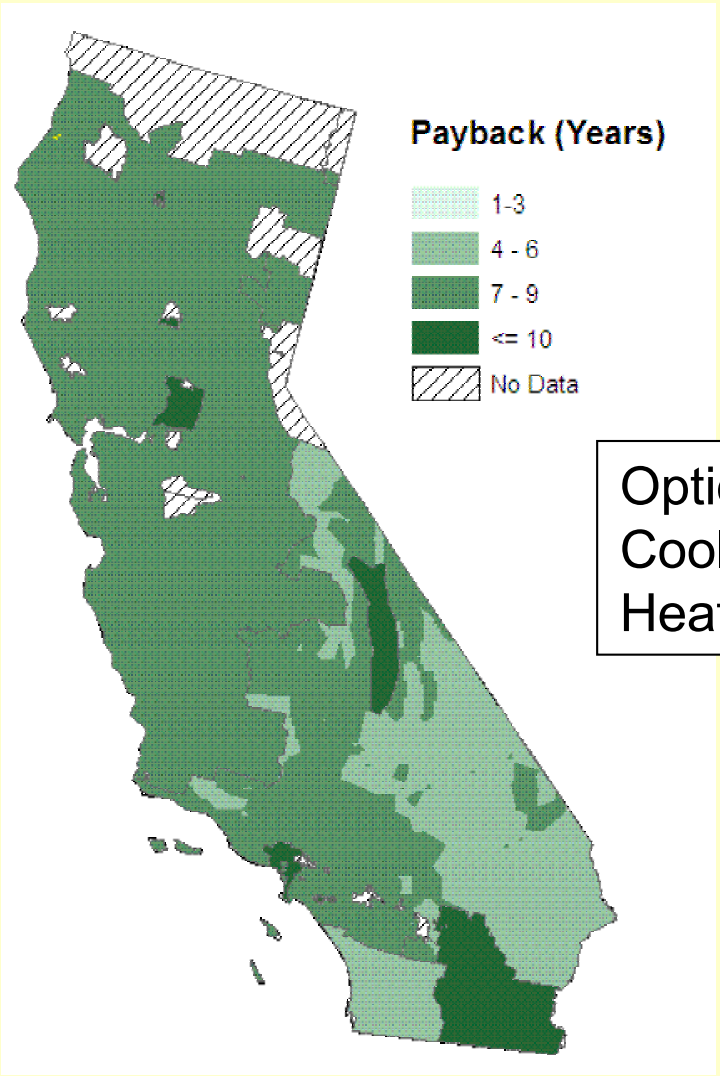




Results: Meeting the Heating Load is More Cost-Effective in Most Areas



Option 1: Heating Only



Option 2: Cooling, then Heating

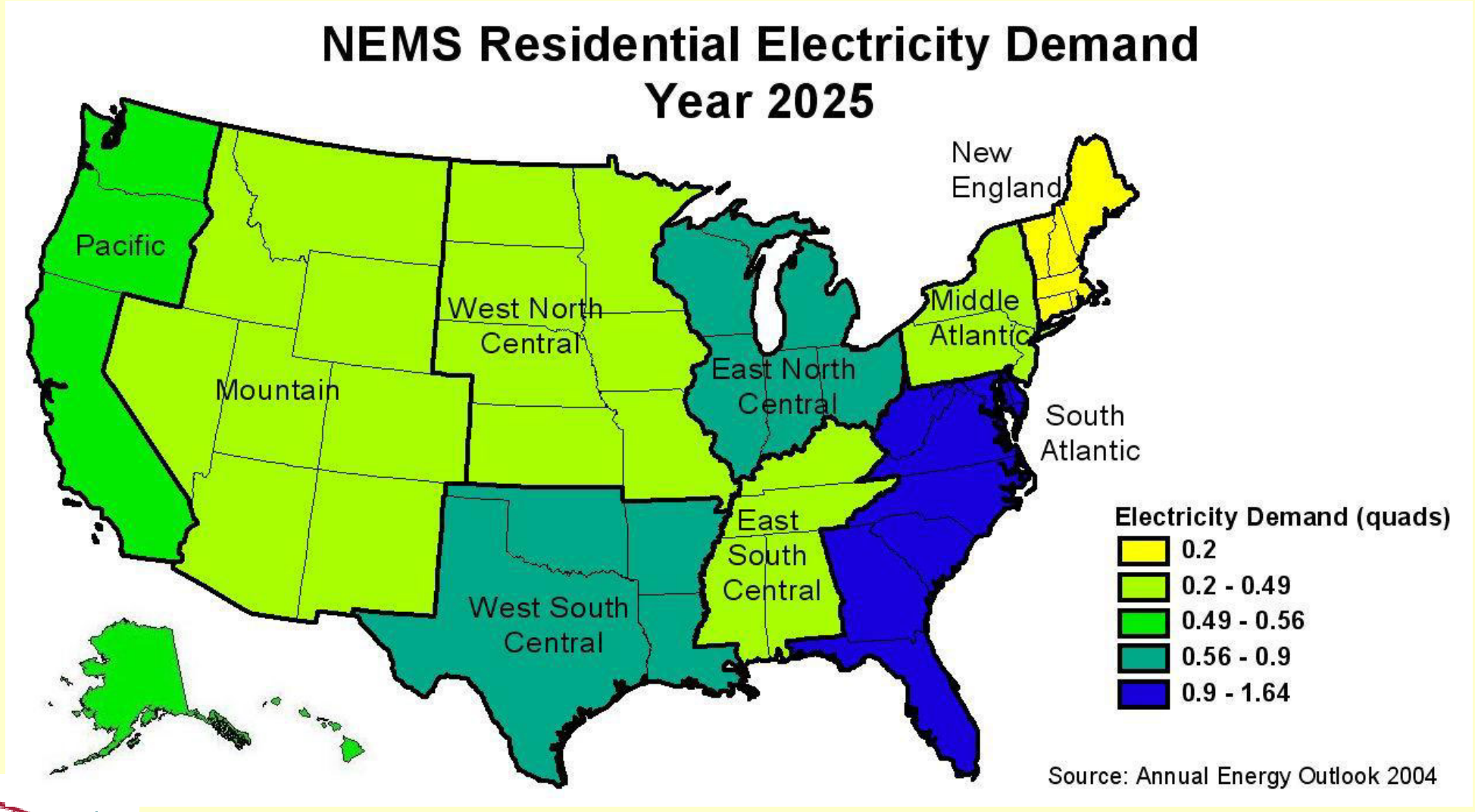
Major Findings

- CHP for heating is more cost-effective than CHP for cooling in most regions of California
- Absorption cooling provides a shorter payback period when it lowers the capacity of the prime mover.
- Geographic variation is primarily along utility service territory boundaries

3. Disaggregation of NEMS Demand Forecasts

- Goal of project is to take NEMS national forecasts of energy demand and disaggregate them to the county level

The Geographic Scale of NEMS- Demand Side



Disaggregated by Population and Climate

NEMS Energy Forecasts (census division, year, sector, fuel)

↓

Distribute by Population (county, year)

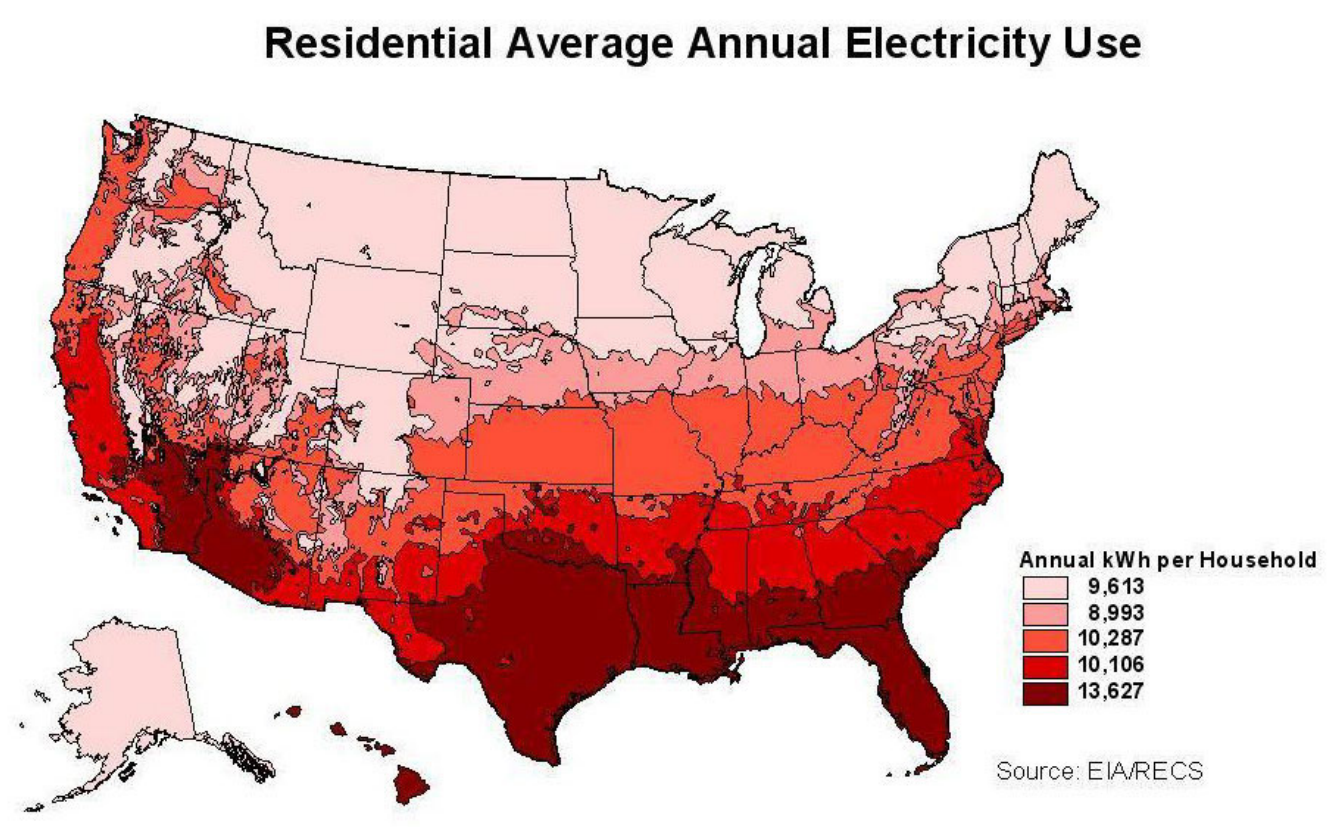
↓

Distribute by Climate (climate zone, sector)

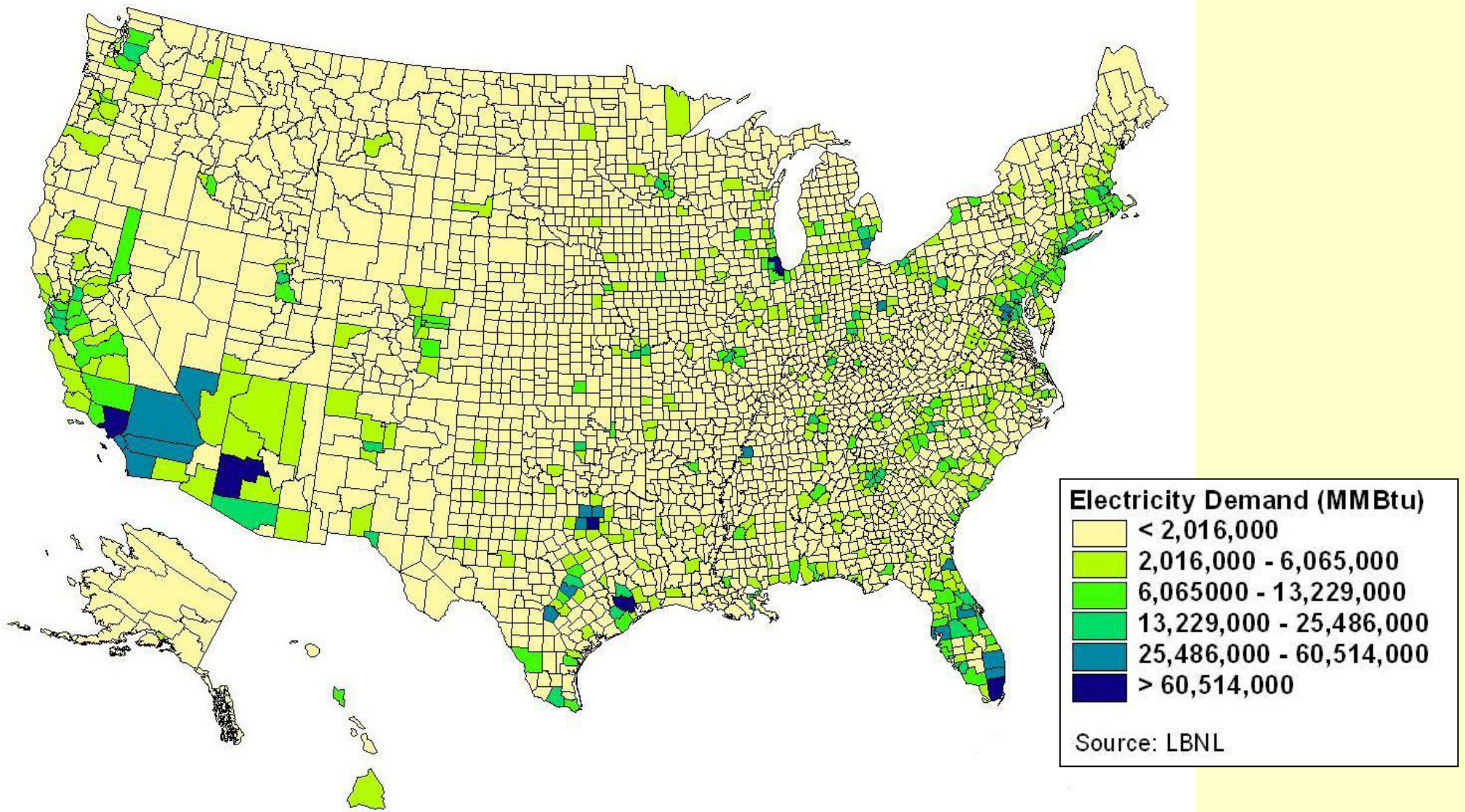
↓

Normalize by NEMS Energy Totals (census division, year, sector, fuel)

- Population forecasts by county (www.epa.gov/ttn/naaqs/ozone/areas/pop/pop_proj.htm)
- Climatic effects on annual energy intensities (1999 CBECS and 2001 RECS)



Output- Total Residential Electricity Use in 2025 by County



Major Findings

- The NEMS Disaggregation Engine is a demand side regionalization tool that is based on the forecasting capabilities of NEMS, and works directly to enhance the regional resolution in NEMS
- The scope is national but outputs are on a regional scale
- GIS is key to overlay of different weighting factors.
- Output can be generated for different fuels and sectors, but is dependent on the availability of regional forecast data.