# National Window Energy Savings Model:
## Application to Energy Star Criteria Revisions

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Slides available at: http://windows.lbl.gov/ESTAR2008

# Rationale: National Model

- DOE-2 runs only tell part of the story:
  - Four bldgs for each of 98 cities in database:
    - New vs. existing homes, 1 vs. 2 story
  - How do we weight this?
  - Also regional variation in:
    - Population density; window sales patterns.
    - Heating fuels and equipment penetration.
- National sales model weights these regional patterns.

# National Savings Model

- Estimates national and regional energy consumption in homes receiving window shipments.
    - New construction / remodel and replacement
- Savings from window programs calculated by comparing scenarios.
    - DOE-2 database allows wide range of U/SHGC simulations.
- Key details:
    - All windows assumed to go to single family homes.
    - Primary (source) energy consumption.
        - Accounts for generation / T+D losses from fossil electricity.
        - Conversion of factor of 3.22 (consistent with DOE data)

# Basic Calculation Principle

- Example: consider window sales for one region, one type of home (eg: New Single Story)

- Convert window sales into an equivalent # of households $N$

|  | Case 1 | Case 2 |
|---|---|---|
| U | $U_1$ | $U_2$ |
| SHGC | $SHGC_1$ | $SHGC_2$ |
| Energy consumption (DOE-2 regression) | $E_1$ | $E_2$ |

$$Savings = N * (E_1 - E_2)$$

- Need to estimate $N$ from window unit sales

  – Window market surveys (Ducker / AAMA report)

  – Average windows per home value.

  – For remodel/replacement market, 100% replacement assumed.

# Model Disaggregation

- New construction vs. remodel/replace

- 1 and 2 story homes

- Regional patterns
  - Regional standards (eg. E*)
  - Heating / Cooling penetration and equip.
  - Average windows per home
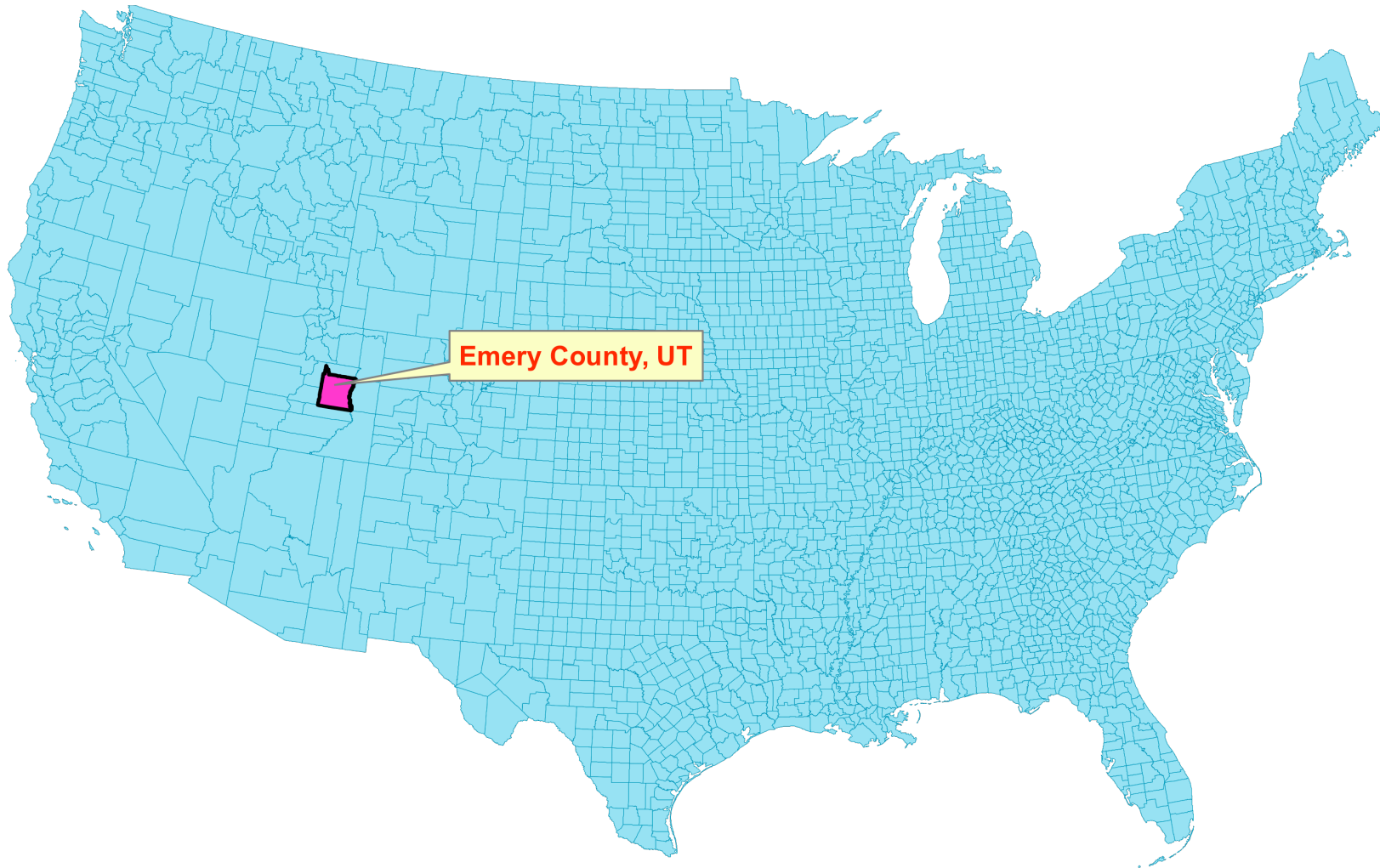
# Model Inputs and Data Sources

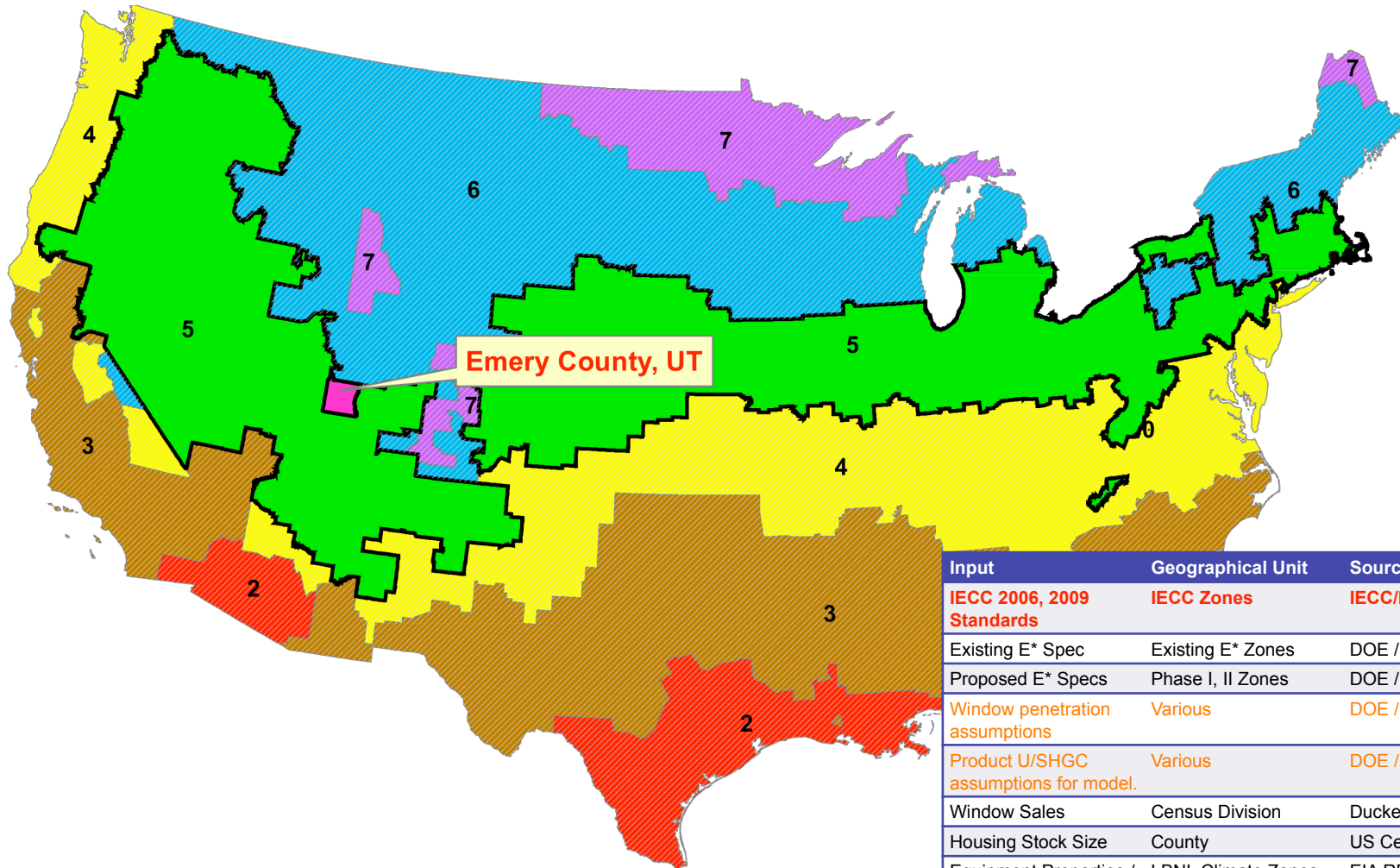| Input | Geographical Unit | Source |
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# County Based Model

- Great diversity in the geography of input data zones.

- Use county as lowest common denominator for analysis
  - Estimate energy savings for all 3100+ US counties

- Counties are assigned average properties from zones they "belong to".
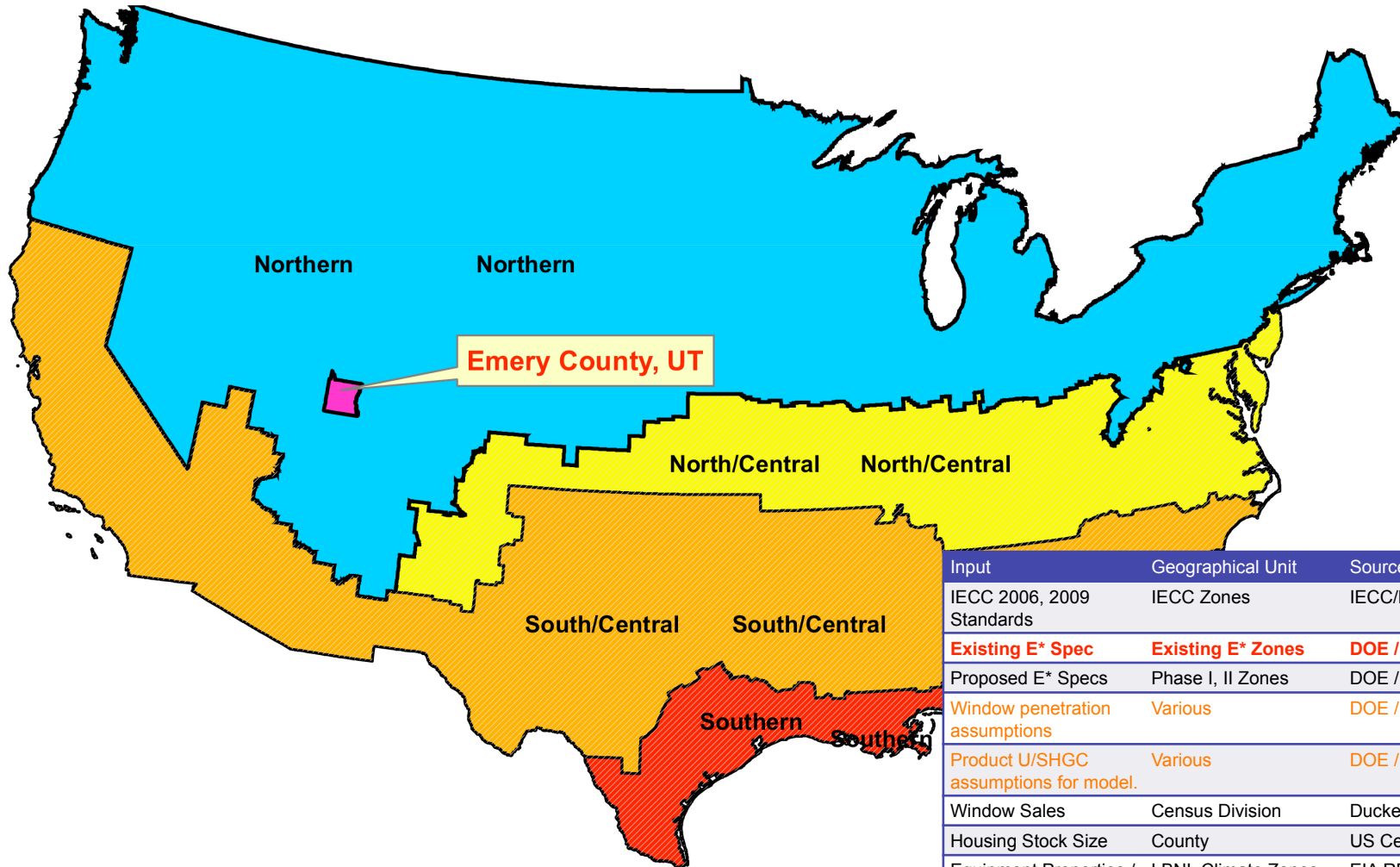  - Illustration follows....

# US County Map

Emery County, UT
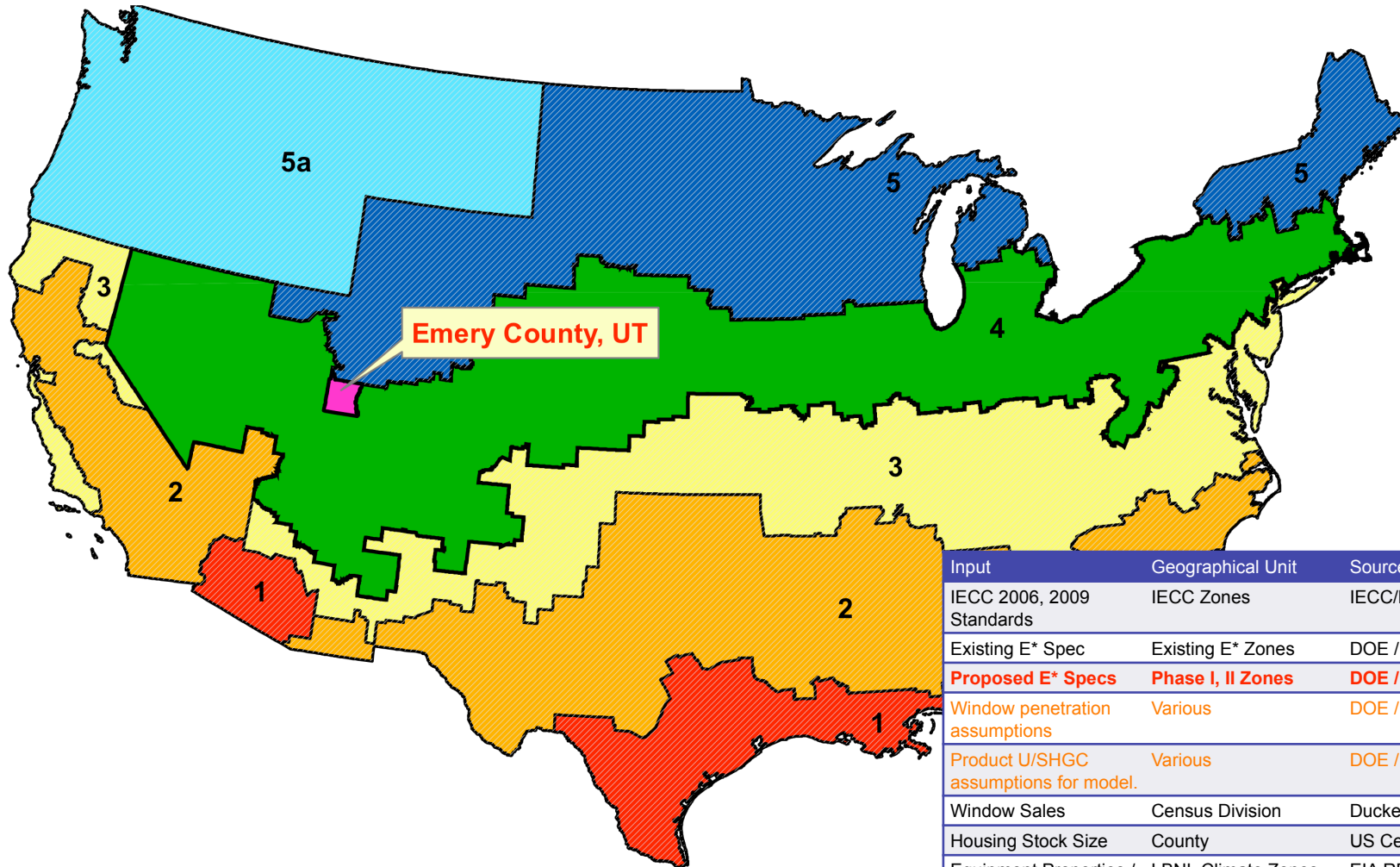
# IECC Zone Map



Emery County, UT

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# Existing E* Spec Map



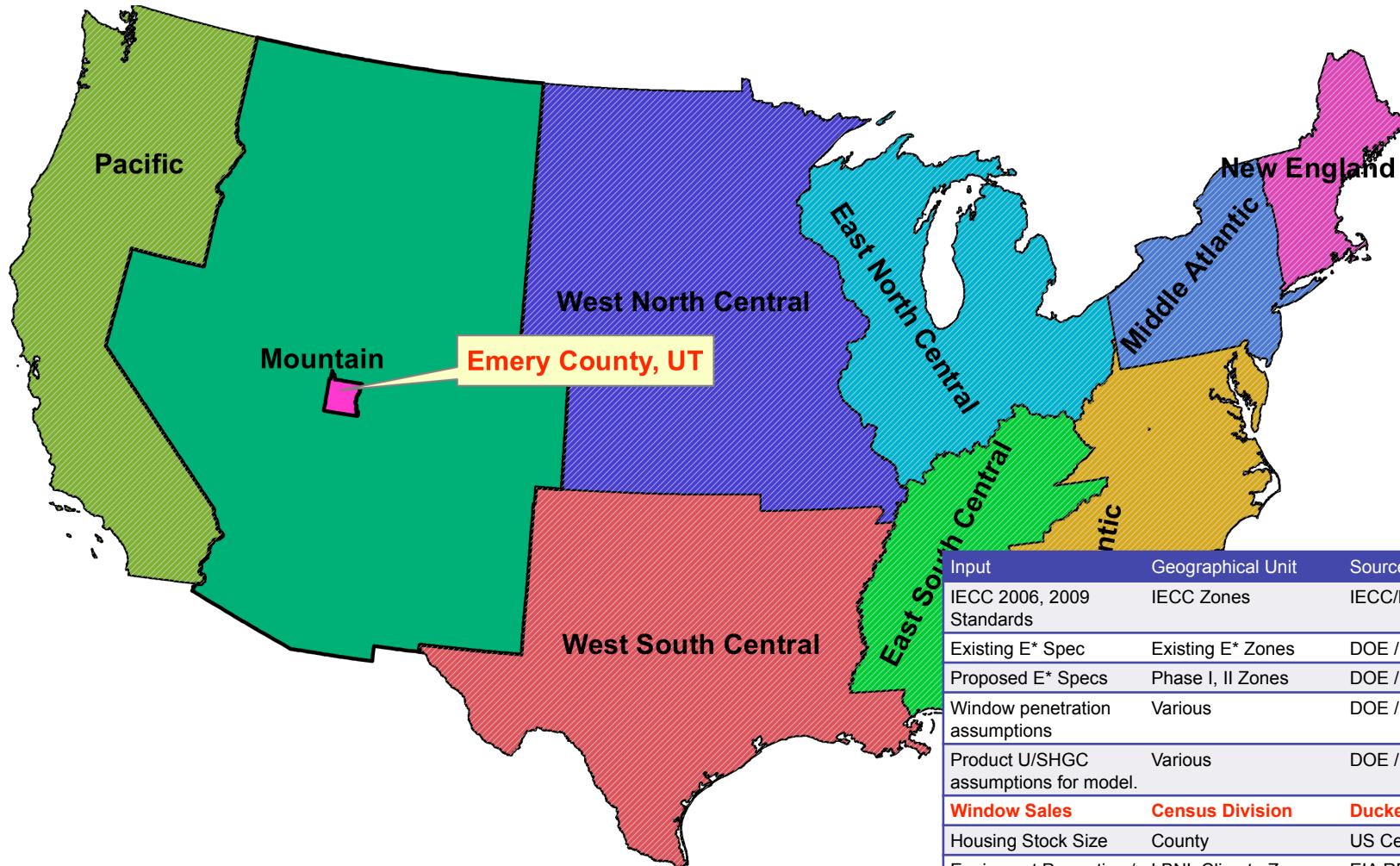| Input | Geographical Unit | Source |
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# Proposed E* Spec Map



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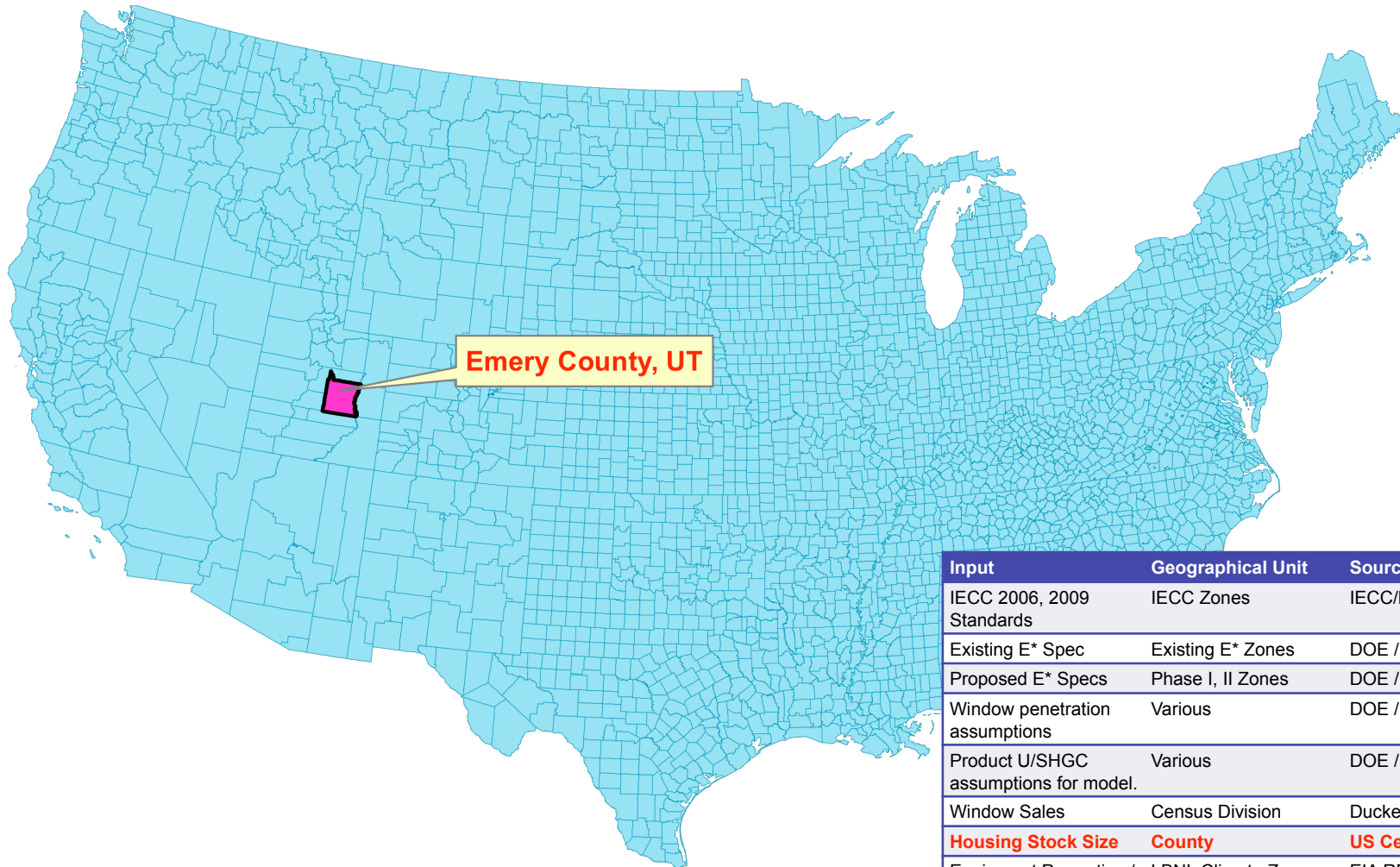| Input | Geographical Unit | Source |
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# US Census Divisions



Pacific

Mountain

Emery County, UT

West North Central

West South Central

East North Central

East South Central

Middle Atlantic

New England

Atlantic

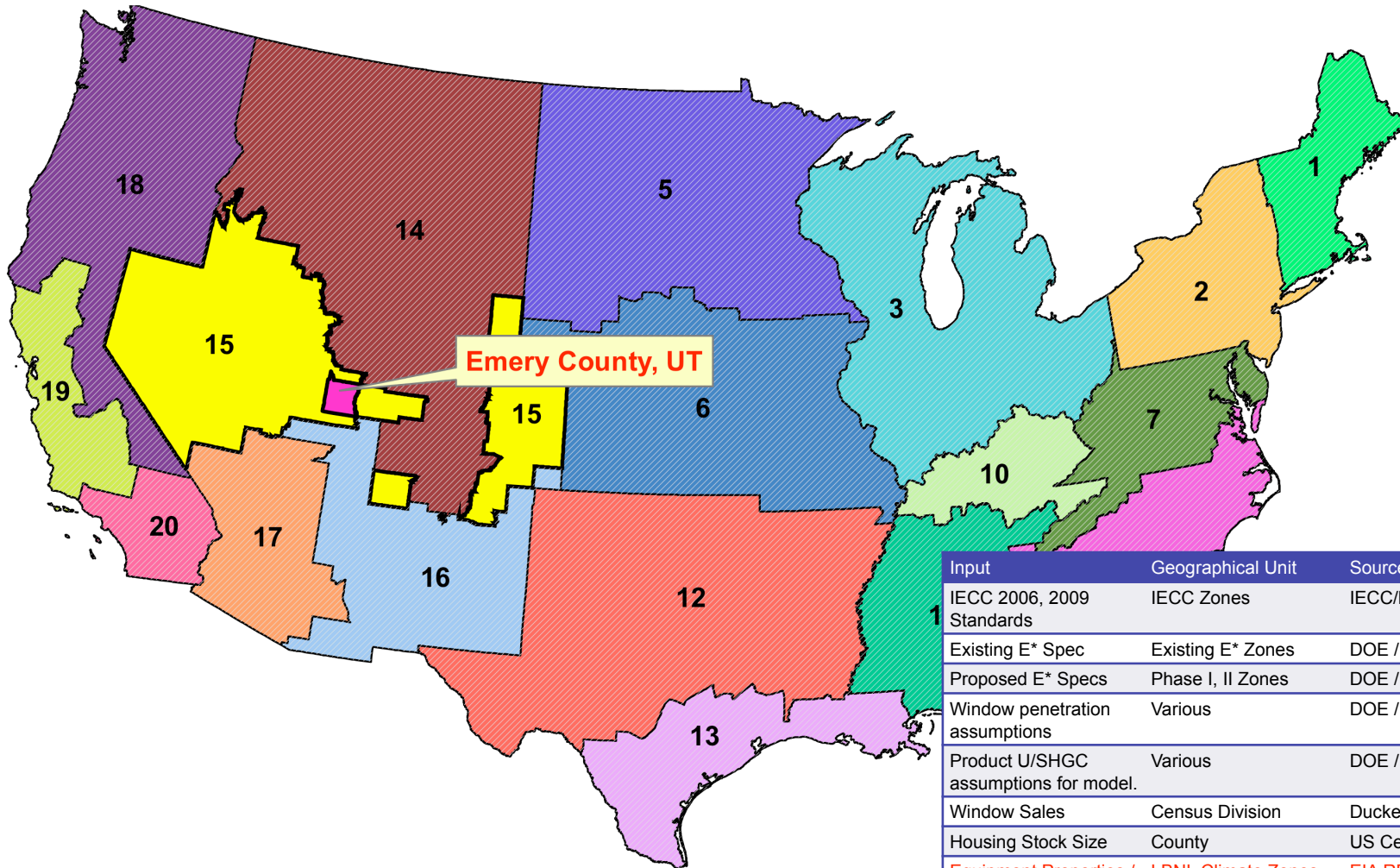| Input | Geographical Unit | Source |
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# RECS / LBNL Climate Zones



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# LBNL / DOE-2 Climate Zones
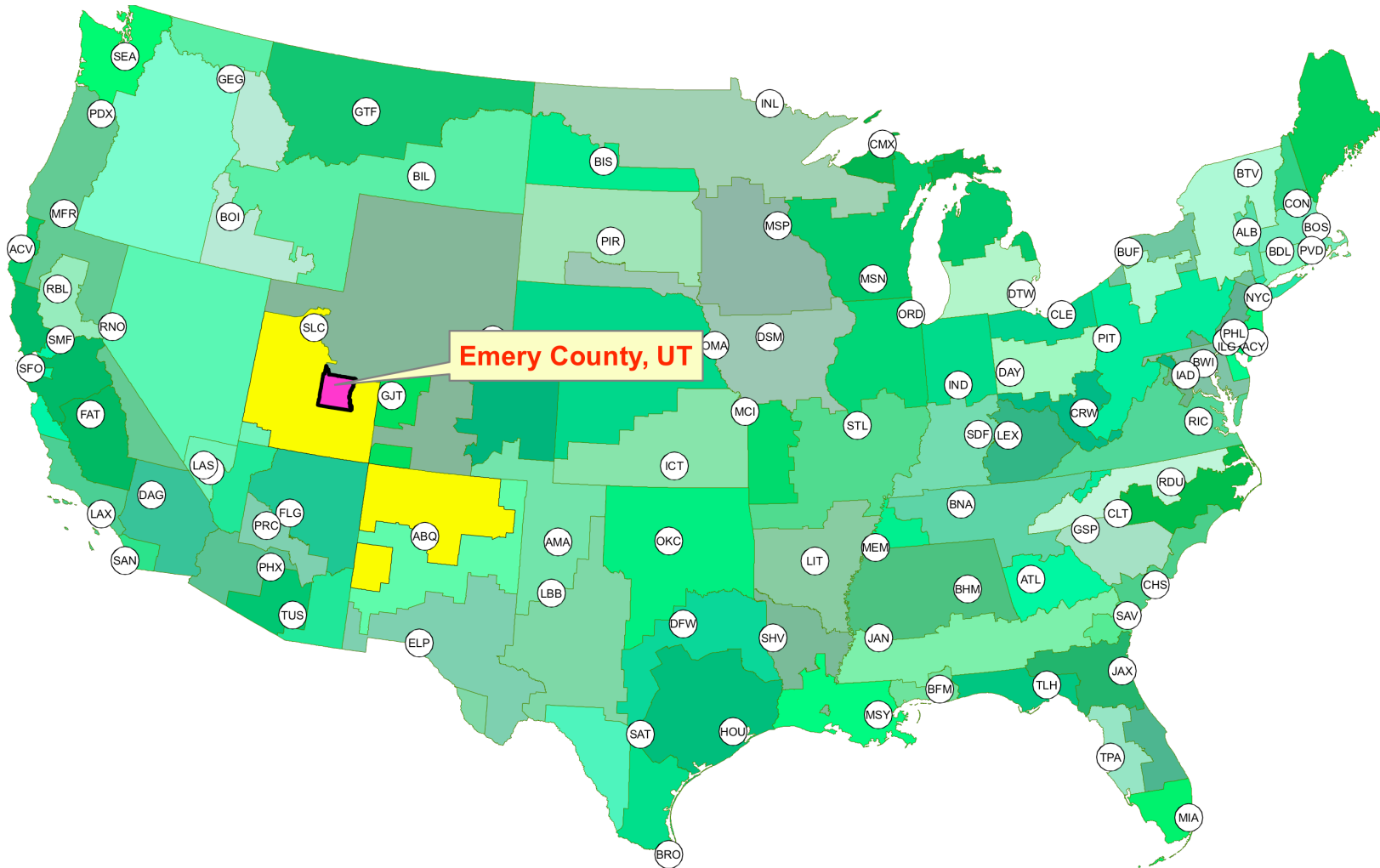
# County $\rightarrow$ Region $\rightarrow$ Nation

- Savings are first estimated at the county level.

- Energy savings are then aggregated to regional levels – eg. Phase I, II E* zones.

# Model "Tune-up"

- Simulations don't correspond perfectly with reality
- Need to make "bottom up" estimate agree with "top-down" values.
- Model is tuned to RECS 2001.
- Without calibration, model over-predicts heating by 20% and cooling by 30%.
  - Calibrations derived at a regional level.

# Next up: U / SHGC inputs

- Thanks!

- D&R to discuss U, SHGC, penetration assumptions and methodology.