



# New Methodology for Estimating Emissions from Residential Wood Combustion

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# RWC Significant Contributor to PM Emissions

- RWC emits large amounts of fine particulate matter and air toxics that have been shown to contribute to poor human health, air quality, and visibility
- RWC contributions to ambient air quality as high as 84%
  - Libby, MT





# Emission Inventories

- RWC PM<sub>2.5</sub> emissions make up about 7% of the national emissions inventory according to the 2002 NEI on an annual basis,
  - however local areas can experience high ambient concentrations during the heating season.





# EPA's National Emission Inventory

- NEI feeds Air Chemistry Models
- NEI is a Merge of State, local and EPA data
- EPA data used as default data
  - Used only when state or local data not submitted
  - For 2002, about half of the states submitted RWC data.
    - EPA data used for other half







# EPA Decided to Revise its Method to Estimate RWC Emissions

- To account for appliances not accounted for in the old methodology (e.g., outdoor hydronic heaters)
- To make the NEI methodology easier for states, local agencies and tribes to input their own location-specific knowledge
- To make the methodology easier for modelers and others to pull appliance population data from the NEI
- Assumptions made to calculate emissions in previous inventories (like percent of conventional wood stoves versus EPA certified woodstoves) was in need of updating.





# RWC Task Force

- Formed in March 2007
- Members;
  - Scott DiBiase, Pinal County, AZ
  - Di Tian, State of GA
  - David Fees, State of DE
  - Julie McDill, MARAMA
  - Sally Otterson, State of WA
  - Bart Sponsellar, State of WI
  - Christal Thompson, State of AL
  - Chris Swab, State of OR
  - David Wright, State of ME





# Goals of Task Force

Include previously ignored appliance types, like outdoor hydronic heaters, wax logs, and indoor wood furnaces.

Be transparent

Allow flexibility

Allow stakeholders to substitute their own parameters

Easy to update for future years

Use consistent and new SCCs







# Proposed New SCCs for Fireplaces

2104008100, Fireplace: general

2104008110, Fireplace: open

2104008120, Fireplace: enclosed (or otherwise modified)

2104008130, Fireplace: qualified for EPA voluntary program





# Fireplace Inserts

- 2104008200, Woodstove: fireplace inserts; general
- 2104008210, Woodstove: fireplace inserts; non-EPA certified
- 2104008220, Woodstove: fireplace inserts; EPA certified; non-catalytic
- 2104008230, Woodstove: fireplace inserts; EPA certified; catalytic





# Woodstoves

- 2104008300, Woodstove: freestanding, general
- 2104008310, Woodstove: freestanding, non-EPA certified
- 2104008320, Woodstove: freestanding, EPA certified, non-catalytic
- 2104008330, Woodstove: freestanding, EPA certified, catalytic
- 2104008340, Woodstove: freestanding, masonry heater
- 2104008400, Woodstove: pellet-fired, general
- 2104008410, Woodstove: pellet-fired, non-EPA certified
- 2104008420, Woodstove: pellet-fired, EPA certified







# Indoor Whole House Furnaces

- 2104008500, Furnace: Indoor, general
- 2104008510, Furnace: Indoor, cordwood-fired, non-EPA certified
- 2104008520, Furnace: Indoor, cordwood-fired, EPA certified
- 2104008530, Furnace: Indoor, pellet-fired, general
- 2104008540, Furnace: Indoor, pellet-fired, non-EPA certified
- 2104008550, Furnace: Indoor, pellet-fired, EPA certified





# Outdoor Hydronic Heaters

- 2104008600 Hydronic heater: general, all types
- 2104008610 Hydronic heater: outdoor
- 2104008620 Hydronic heater: indoor
- 2104008630 Hydronic heater: pellet-fired
- 2104008640 Hydronic heater: meets NESCAUM phase II standards





## Other

- 2104008700 Outdoor wood burning device, NEC
- 2104009000 Wax Firelog
- 2104010000 Biomass; all except wood







# Invalid SCC

- General; all RWC appliances







# The Pechan RWC Estimating Tool

- **MS Access REQUIRED**
  - allows states to view and update parameters
  - includes queries to recalculate emissions
  - everything at the county level to provide flexibility.
  - documentation for inputs provided







# Estimating Emissions

$$\text{Emissions} = n * b * d * ef$$

n = number of appliances

b = burn rate of appliance

Cords of wood burned /yr

d = wood density

Converts cords of wood burned to tons of wood burned

ef = emission factor

Lbs pollutant / ton of dry wood burned





# Fireplaces, Inserts, & Woodstoves

- Uses the American Housing Survey (US Census) to Populate Counties with the Number of Households that Use these Appliances to Heat Their Homes.
  - The AHS lists three different appliance types,
    - Fireplaces,
    - fireplaces with inserts,
    - wood stoves,
      - differentiates between appliances used for primary heating with supplemental heating.





# Outdoor Hydronic Heaters

- Have numbers of OHH units by State
  - Sales data from NESCAUM for OHH from 1990 to 2005.
  - allocated to county by fraction of woodstove in the county





# Indoor Wood-fired Furnaces

- MANE-VU States
  - Have estimated number of centralized cordwood heating systems.
    - “Control Analysis and Documentation for Residential Wood Combustion in the MANE-VU Region, Prepared for: Mid-Atlantic Regional Air Management Association, Inc. Prepared by: James E. Houck and Brian N. Eagle. OMNI Environmental Services, Inc. December 19, 2006.
  - Have estimated number of OHH
  - Determine indoor wood-fired furnaces by difference
  - Data is based on 2002. Until we get a reliable growth rate, will assume no growth. Have personal communication from John Crouch of HPBA saying that sales have been very slow since the NSPS in 1988.







# Indoor Wood-fired Furnaces Con't

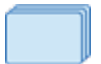
- LADCO states
  - Use MN data to estimate population
    - “Residential Fuelwood Assessment, State of Minnesota, 2002-2003 heating season”.  
Minnesota DNR
  - Report has number of units by region
    - Used fraction of woodstoves in county to allocate units to county level





# Indoor Wood-fired Furnaces Con't

- for WRAP and CENRAP states, populate states with furnaces proportionately to 0.7% of occupied units.
  - Number from 2001 survey in WA, OR, and ID
- Allocate to counties by proportion of # of WS.
- Zero out counties in climate zones 4 and 5.





# Burn Rates (cords/yr)

- Forest Service Reports from 8 states,
  - MN, IN, WI, KS, ND, SD, NE, MI
  - Years varying from 1992 to 2002
  - Surveys of Residential Fuel wood Consumption
- Problem; How to adjust burn rates in states with warmer climates?
  - Used ratio of the average BTU consumption to heat a house in climate zone 5 to the average BTU consumption in climate zone 1 to adjust burn rates in warmer climates
    - EIA 2005 data





# Wood Density (lbs/ft<sup>3</sup>)

- Burn rate data in cords (volume unit) and emission factors in tons of oven-dried wood (mass unit)
- Timber Products Output database, US Forest Service
  - County level database
  - Survey results of sawmill operators that provides volume of wood by species for several different categories of use, one of the uses being fuel wood
  - Used averages where no county sawmill data available
  - Assumed 80 ft<sup>3</sup>/cord to account for airspaces







# Emission Factors

- Review by Task Force
- Gap Fill missing pollutants
- Pull in missing HAP EFs from MARAMA RWC reports
- Use MARAMA EF for Fireplace VOC
  - 18.9 lbs/ton replaces 229 lbs/ton





# Status of New EPA RWC Tool

- Continue refining Tool
  - Appliances not accounted for
    - Pellet Stoves
    - Stoves burning biomass other than wood
      - E.g., corn
  - Urban/rural split
- Incorporate State data where available
  - Burn rates
    - Especially for areas not covered by the 2005 AHS & the Southeast states
  - Wood densities
  - Update proportion of EPA-certified appliances
    - Woodstove changeouts dramatically increase percentages of EPA certified WS

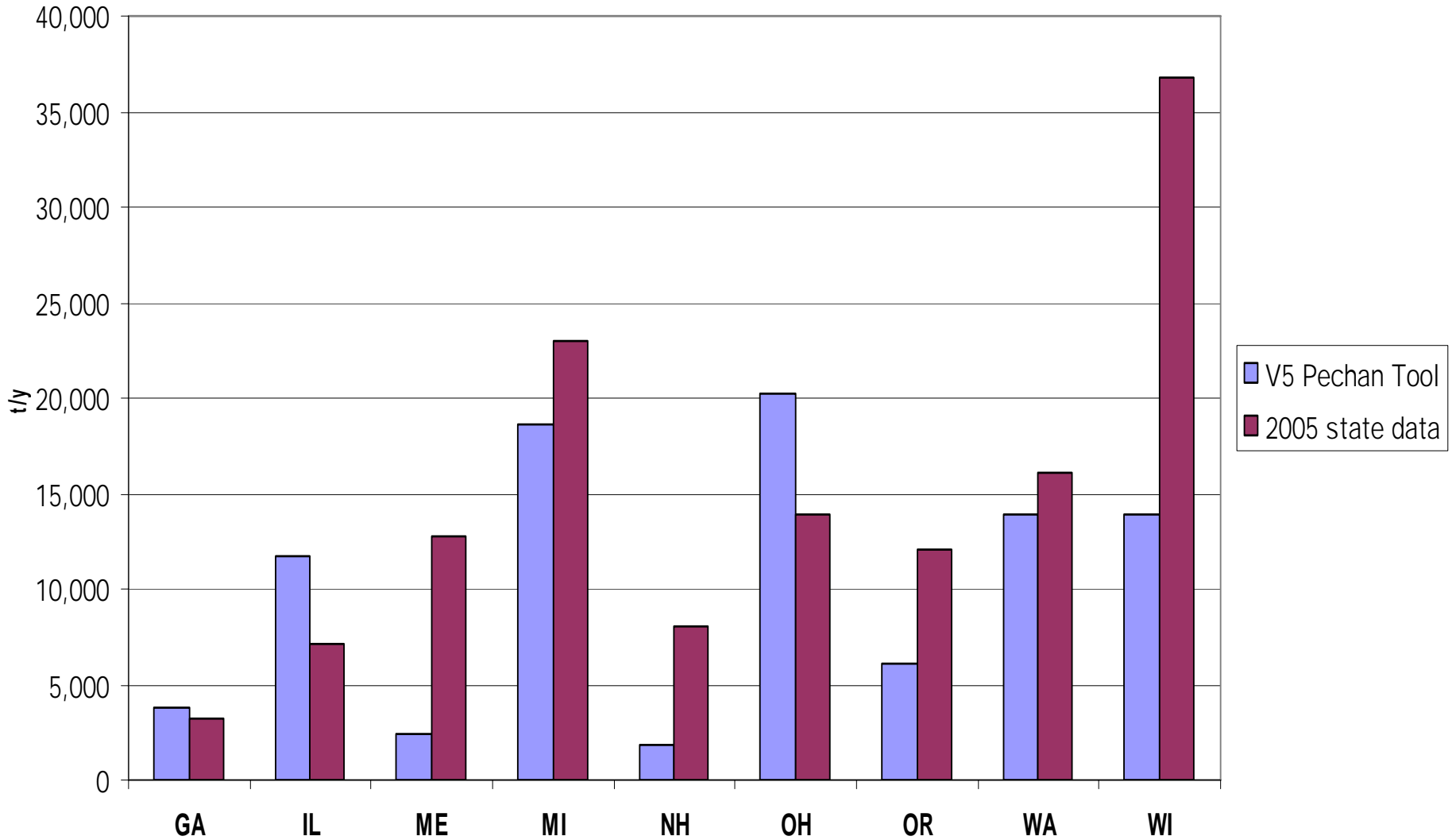




# Results

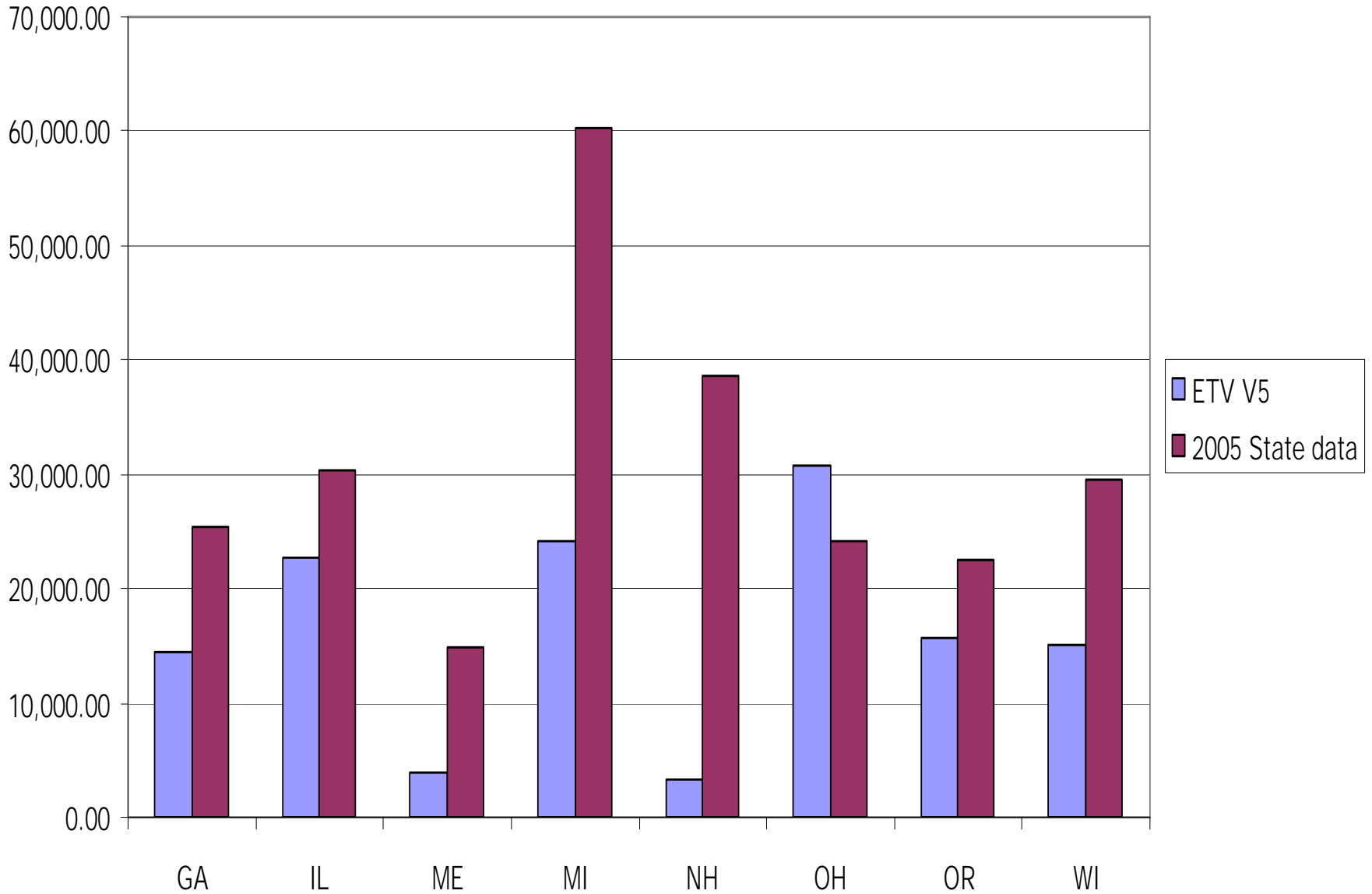


## 2005 RWC PM25-PRI Emissions

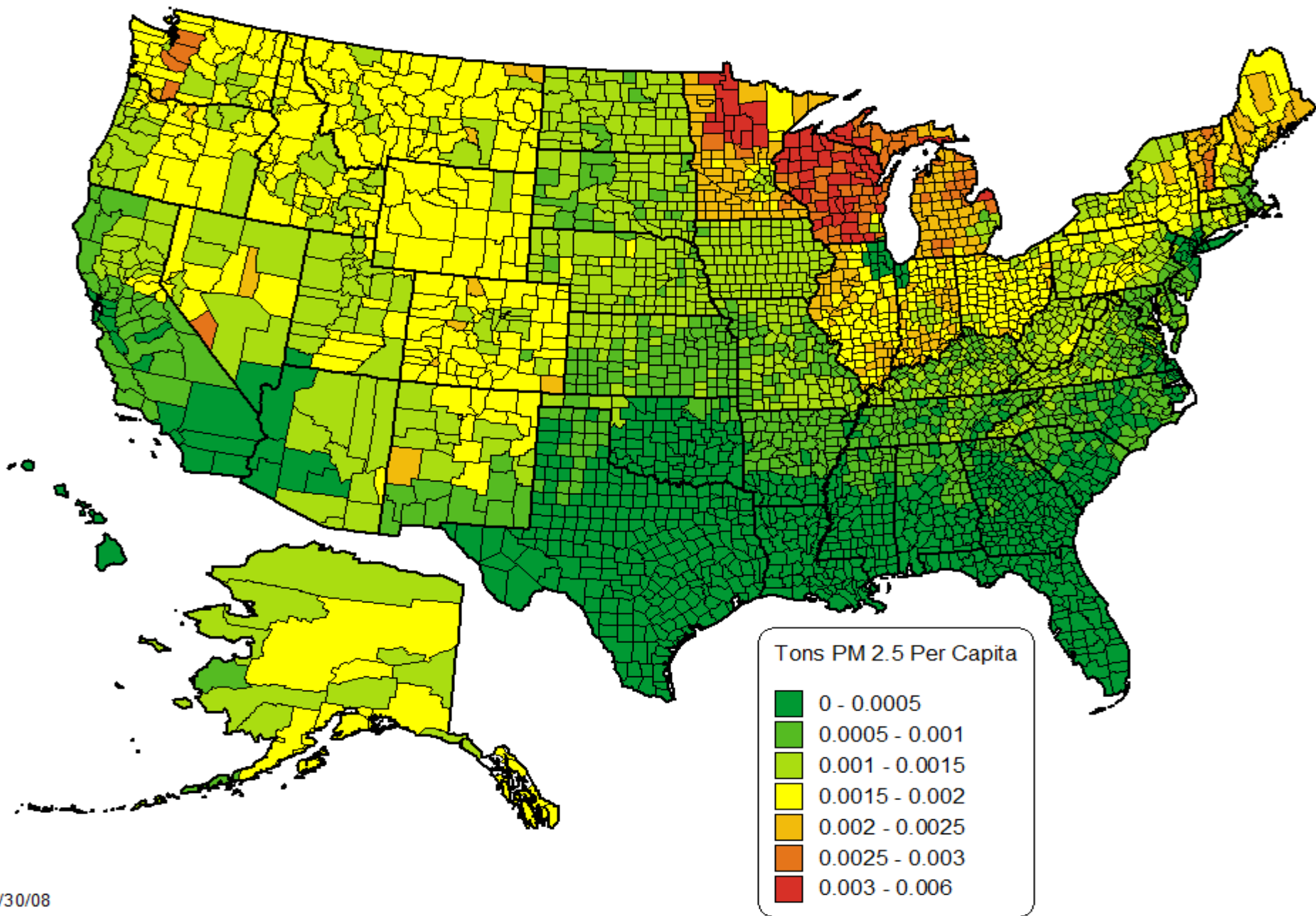




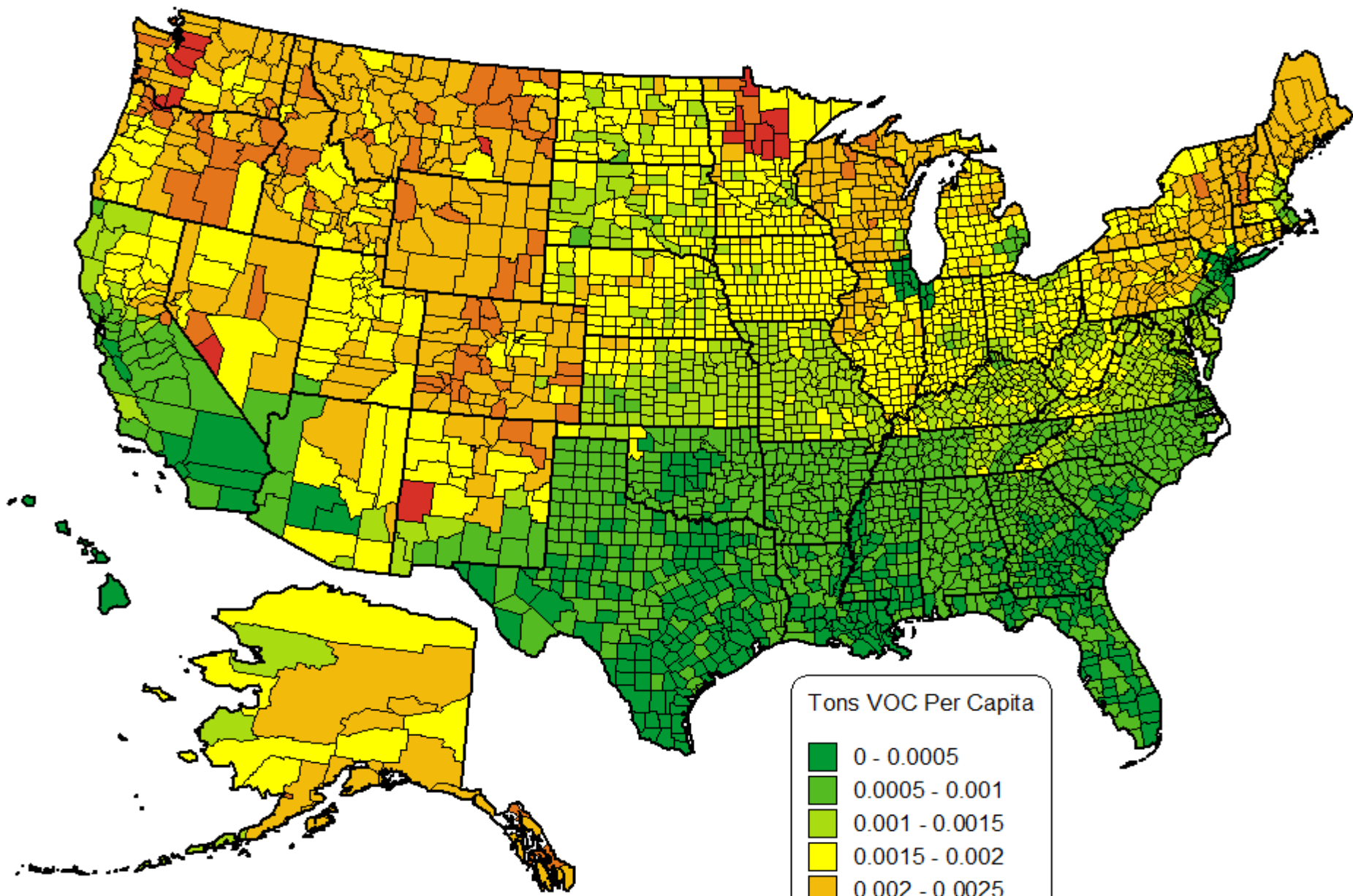
# VOC Emissions from RWC



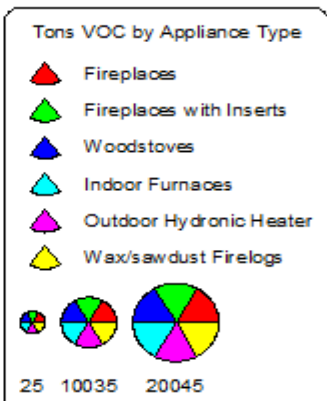
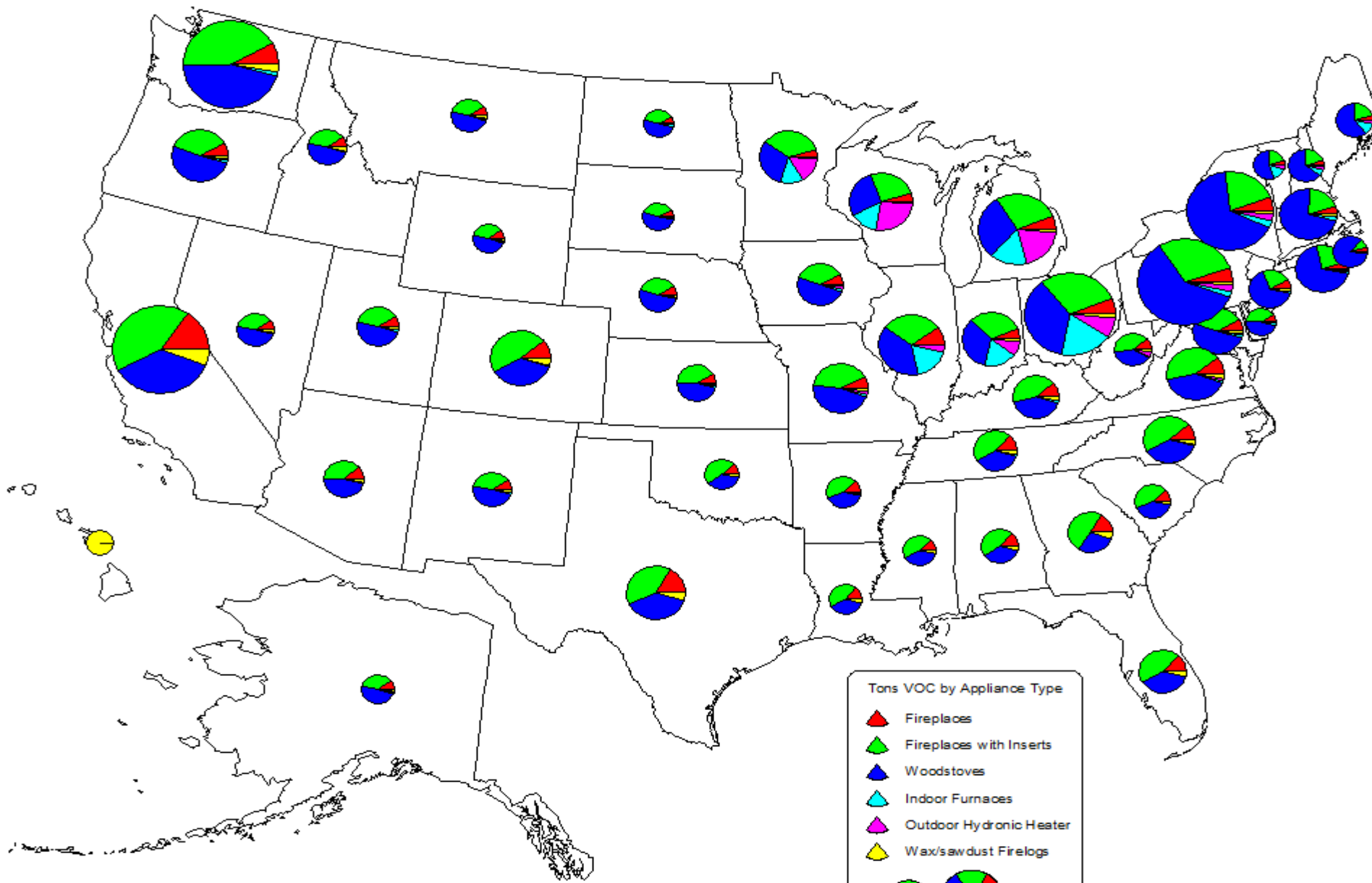
# Per Capita PM 2.5 Emissions from Residential Wood Combustion



# 2005 Per Capita VOC Emissions from Residential Wood Combustion

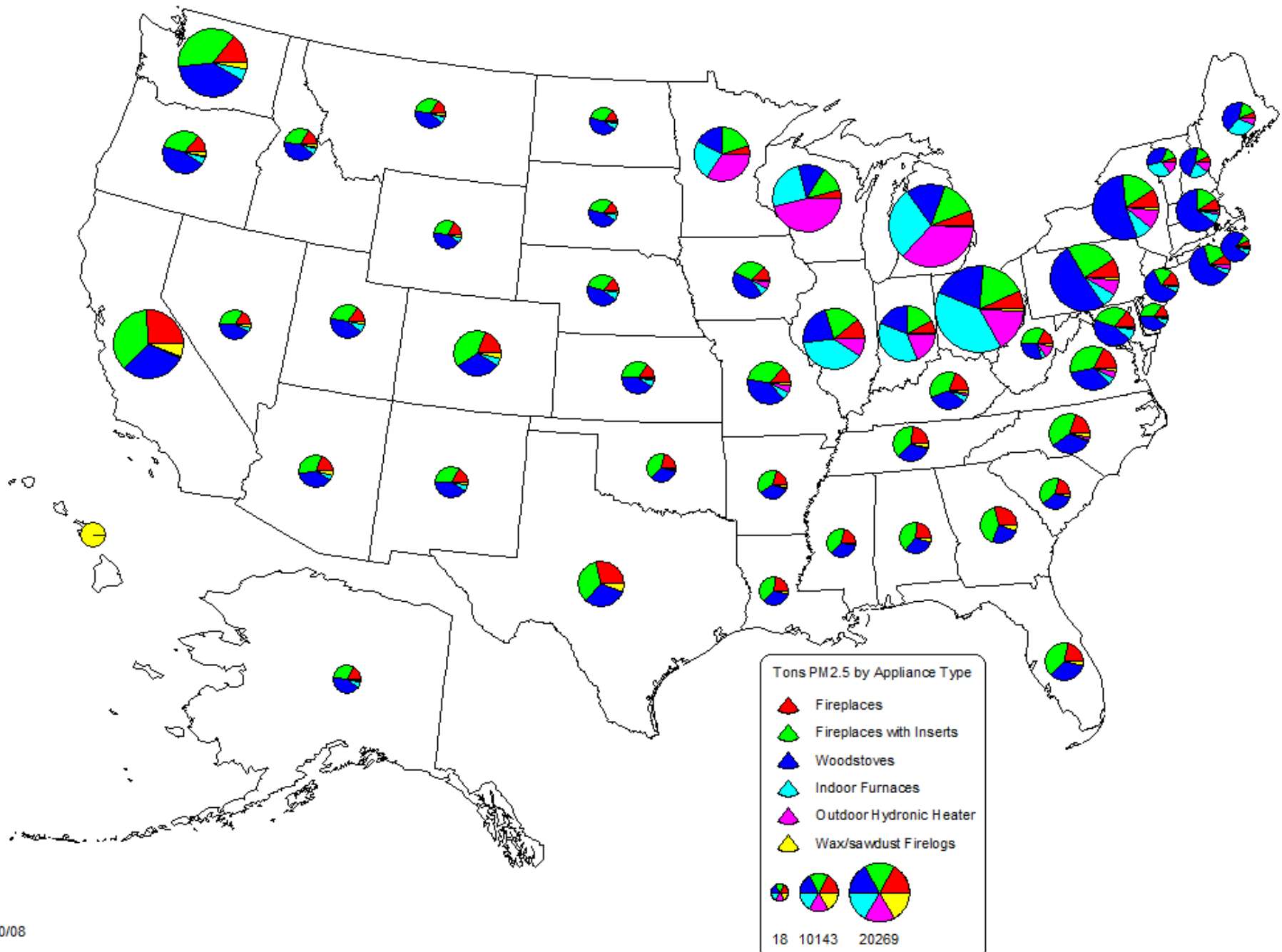


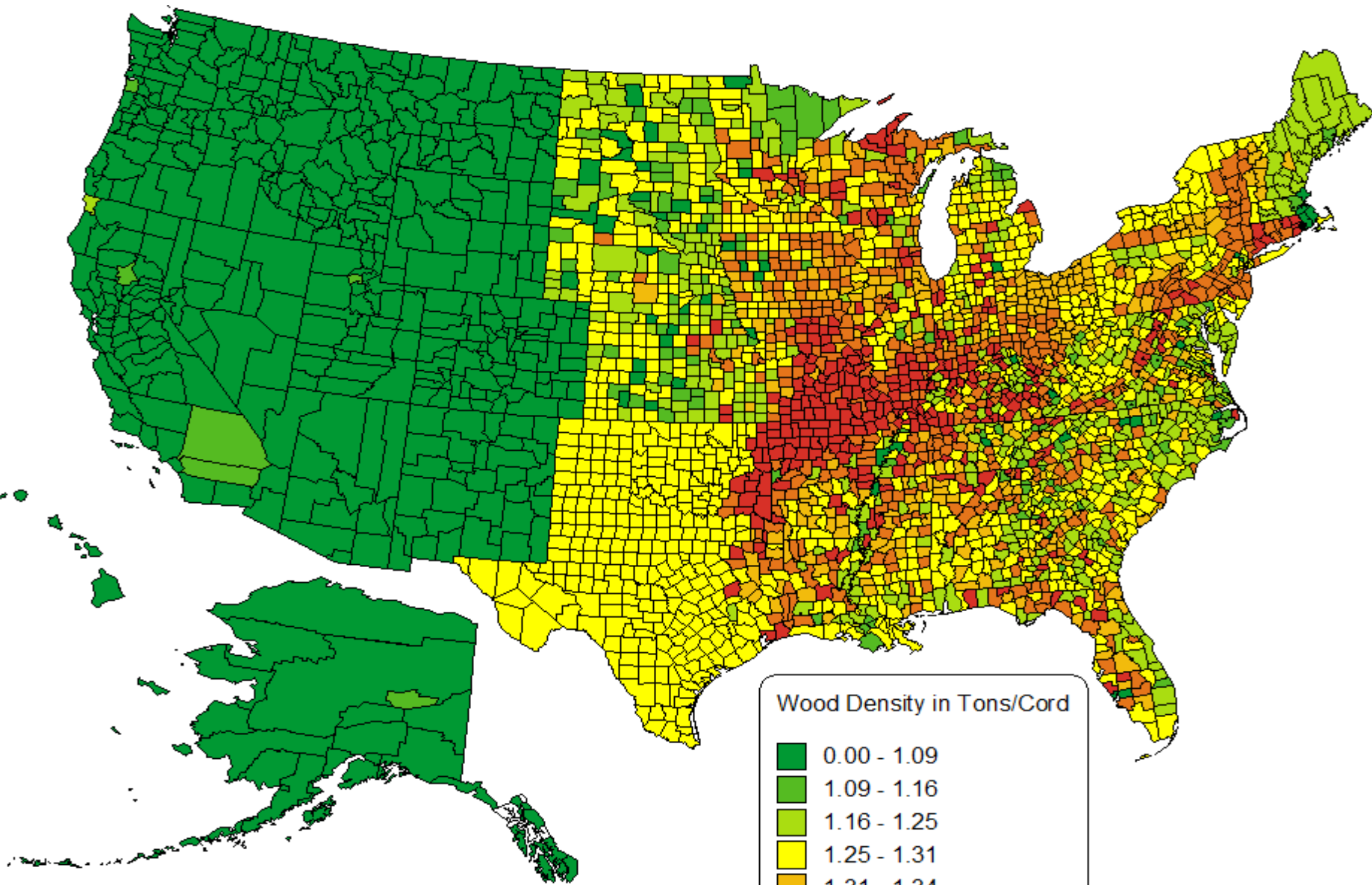
# 2005 VOC Emissions by Residential Wood Combustion Appliance Type





# 2005 PM2.5 Emissions by Residential Wood Combustion Appliance Type





Wood Density in Tons/Cord

- 0.00 - 1.09
- 1.09 - 1.16
- 1.16 - 1.25
- 1.25 - 1.31
- 1.31 - 1.34
- 1.34 - 1.39
- 1.39 - 1.57



# Work Remaining

- Continue emission factor review
- More county specific data
  - Appliance profiles
  - Burn rates
  - Wood densities

