Lessons Learned from the Residential Wood Combustion Surveys

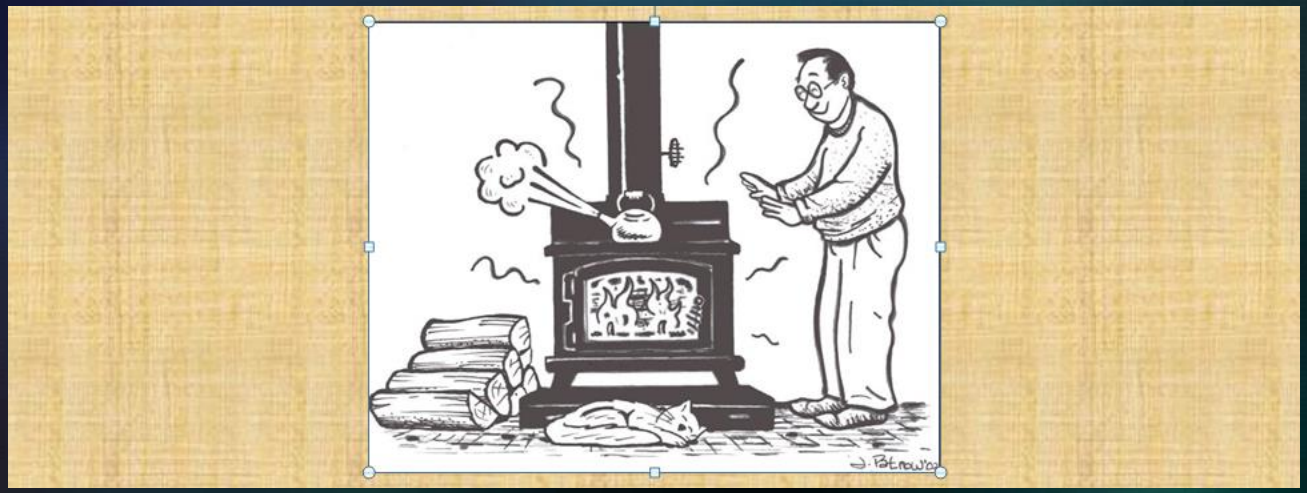
Chun Yi Wu
Lisa Herschberger
David Bael
Mary Jean Fenske
Kari Palmer

Minnesota Pollution Control Agency

- Introduction
- Data Analysis Methods
- Results and Discussions
- Summary

INTRUDUCTION

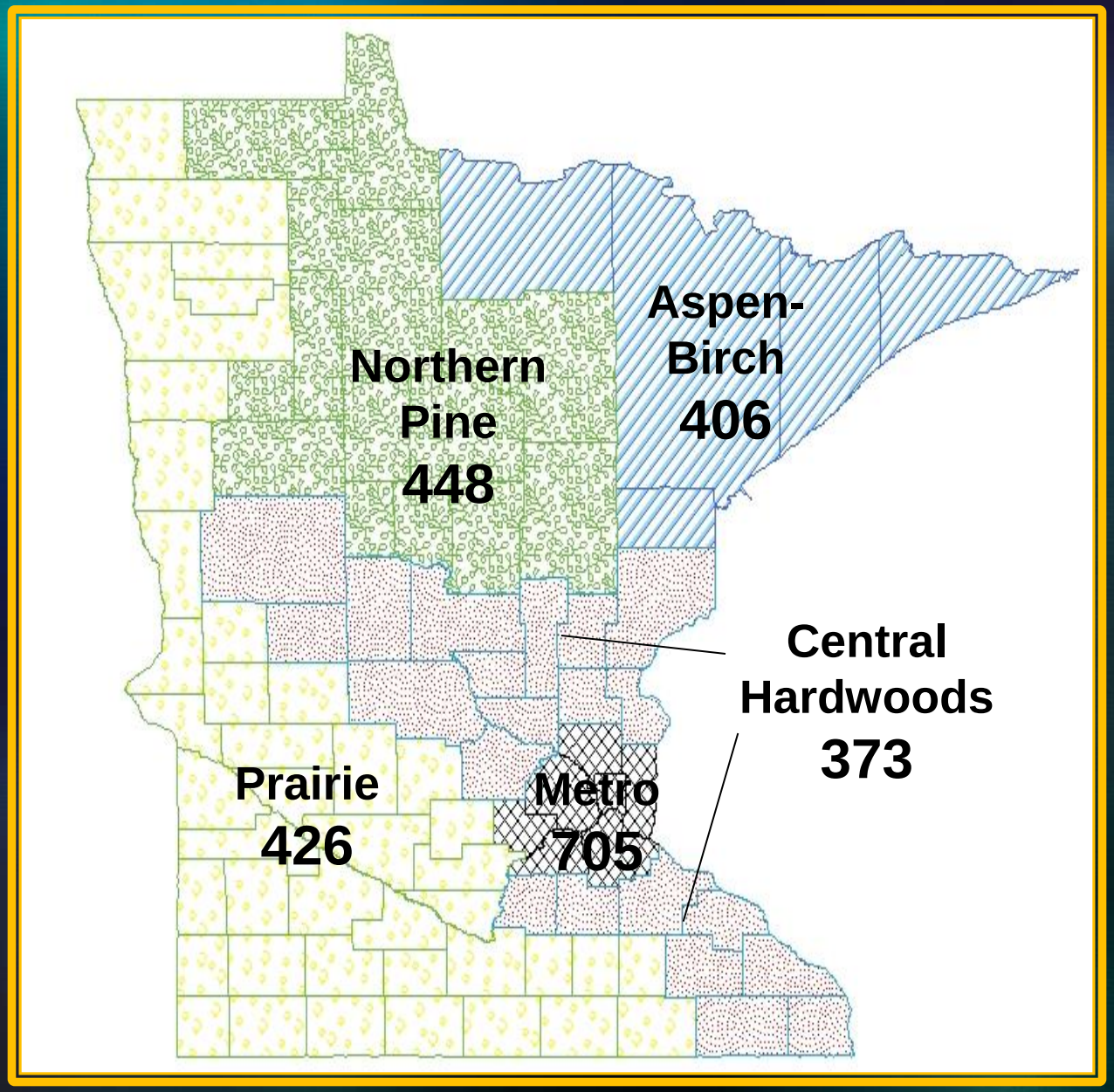
- Residential wood combustion (RWC) surveys since 1960
  - Important tool for forestry management and environmental strategies
  - Vehicle to collect better activity data
    - Significant $PM_{2.5}$ emissions from RWC



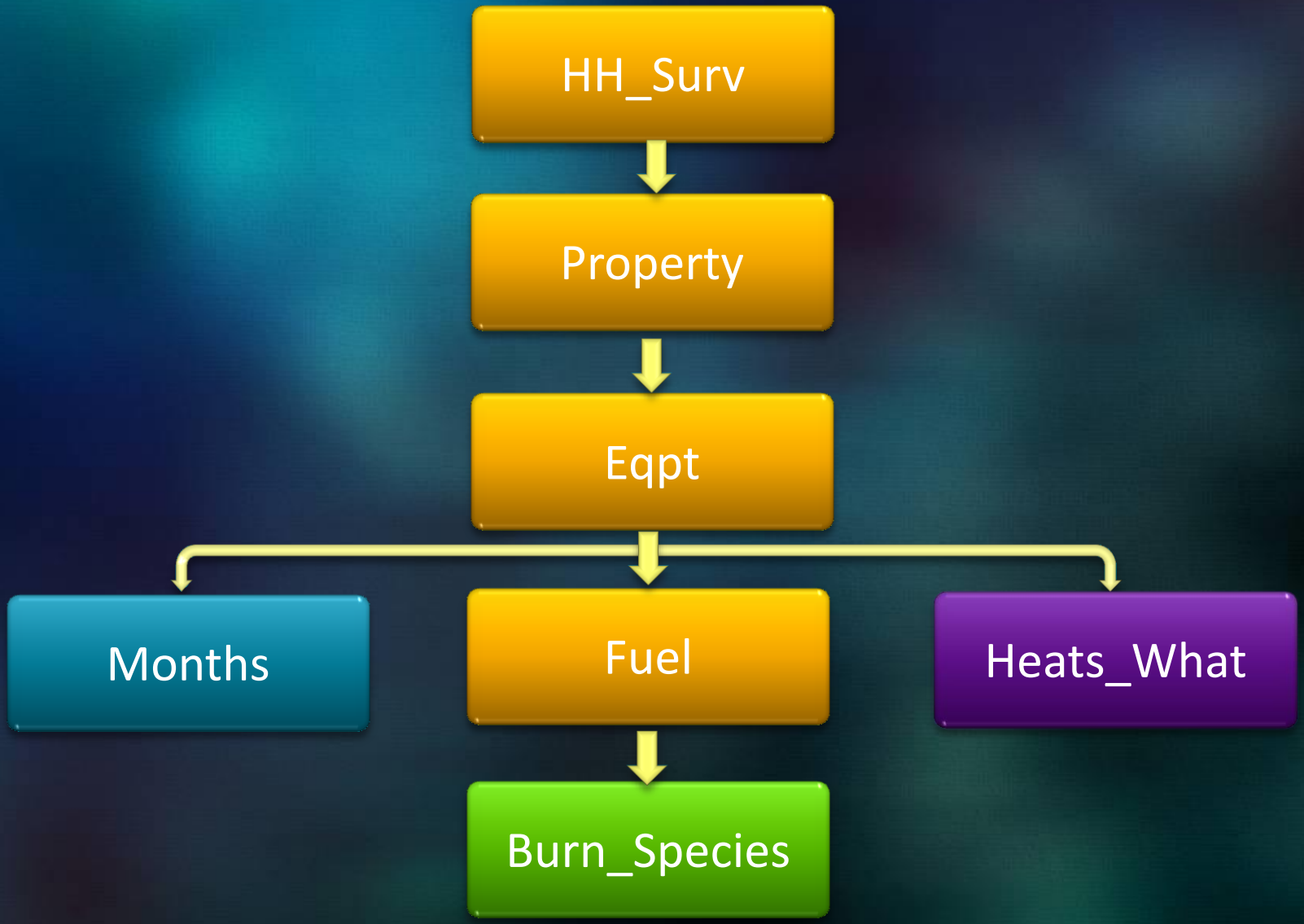
INTRUDUCTION

- Last survey - 2012
  - 6,658 Surveys
  - 2,358 Responses - 35%

Survey Regions and Number of Households Responded

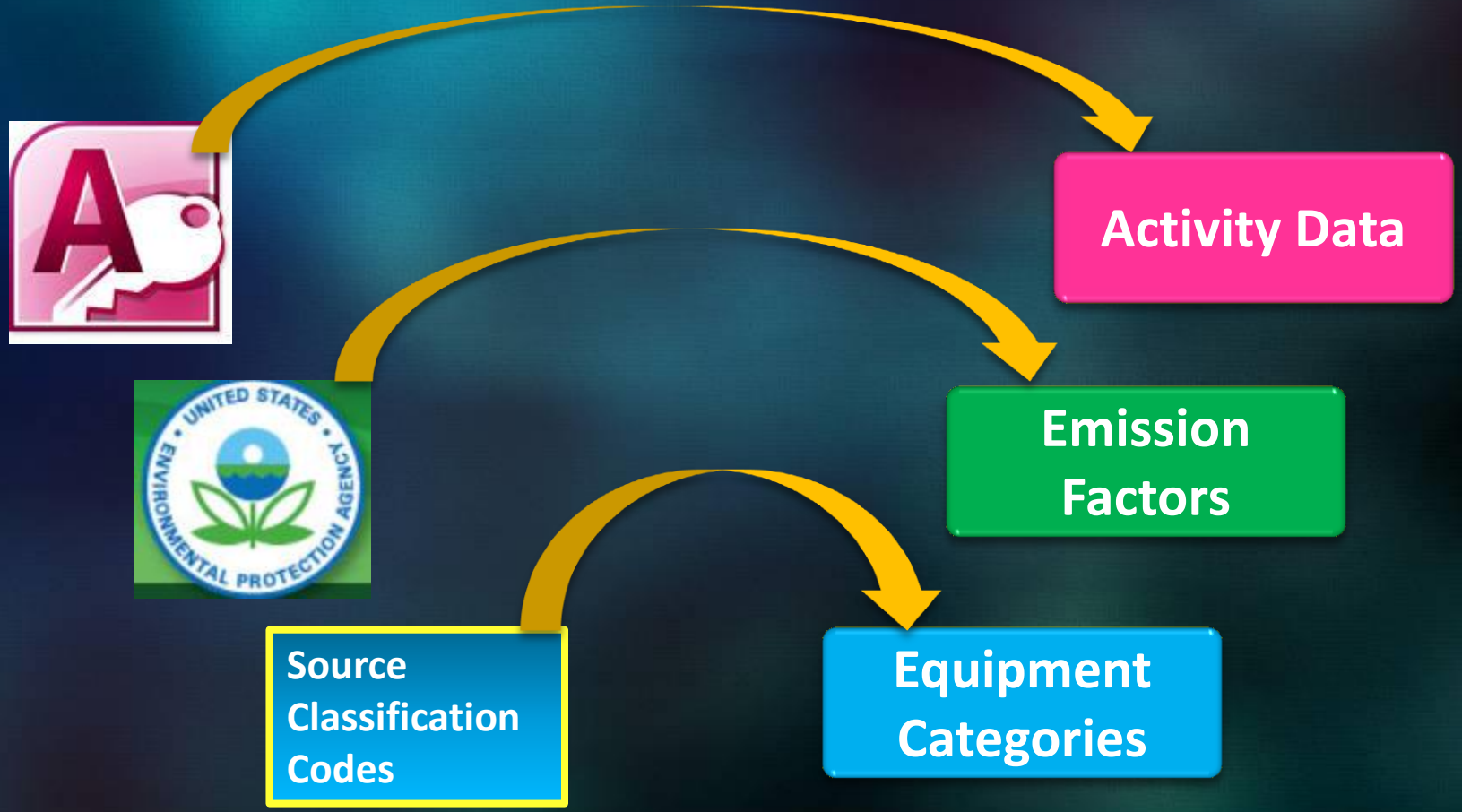


DATA ANALYSIS METHODS

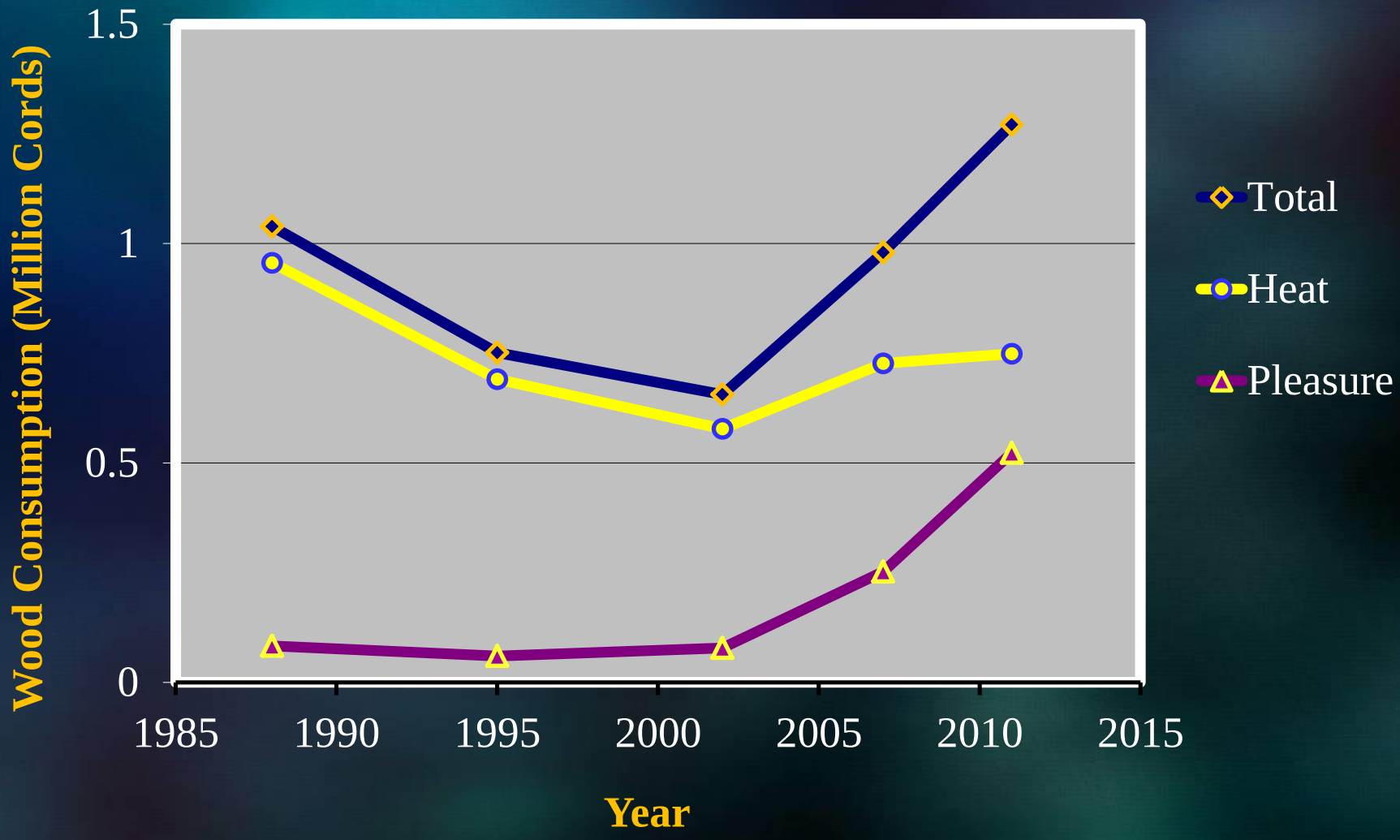


DATA ANALYSIS METHODS

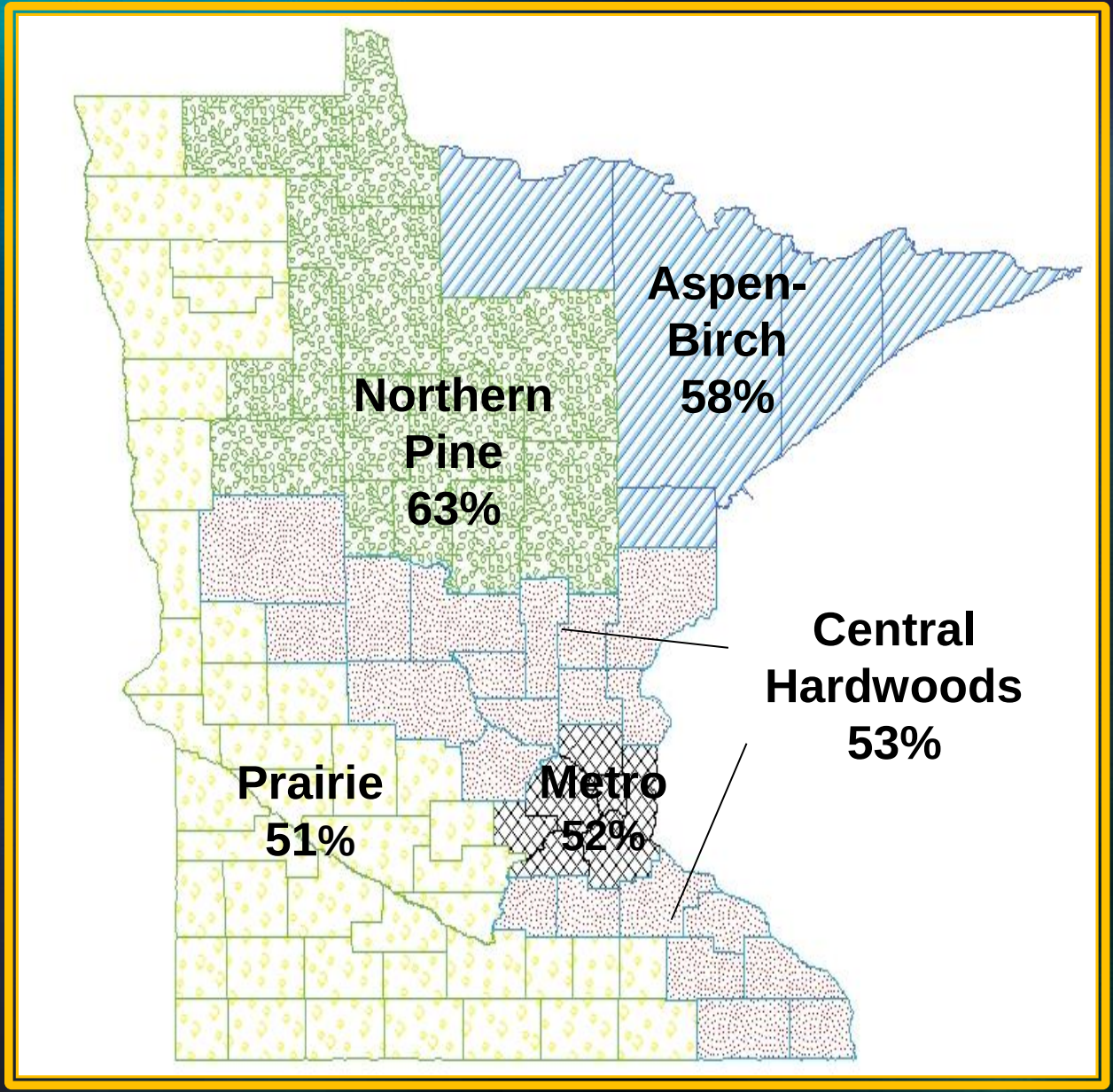
- Emissions

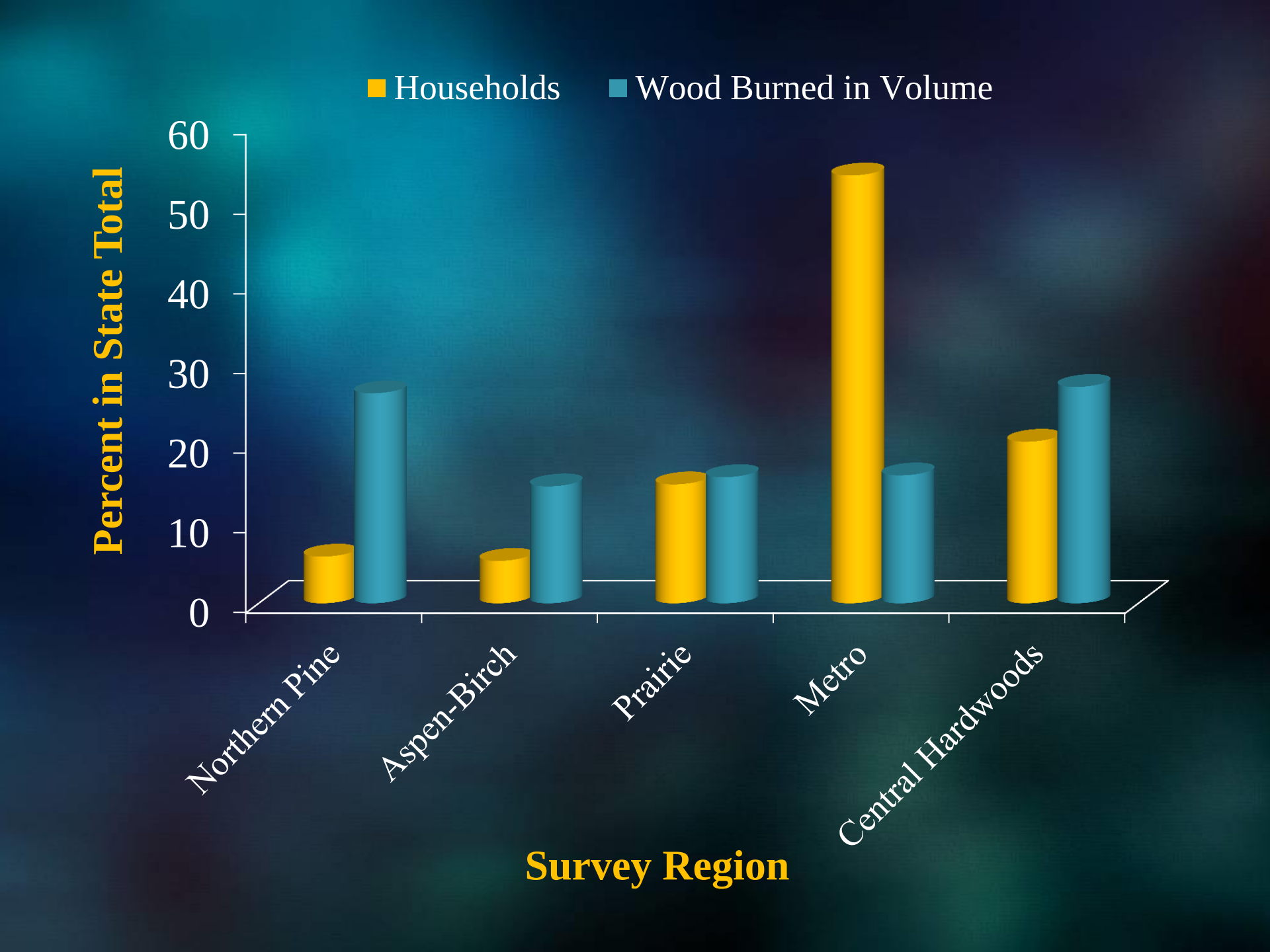


Residential Wood Consumption in Minnesota

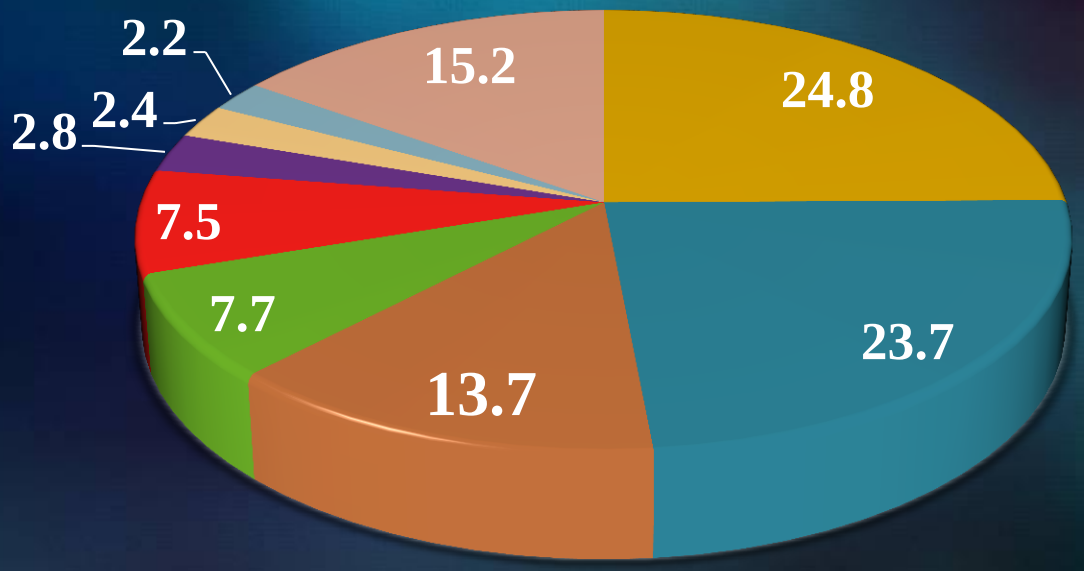


Percent of Households Burning Wood




Households
Wood Burned in Volume
Percent in State Total
60
50
40
30
20
10
0
Northern Pine
Aspen-Birch
Prairie
Metro
Central Hardwoods
Survey Region

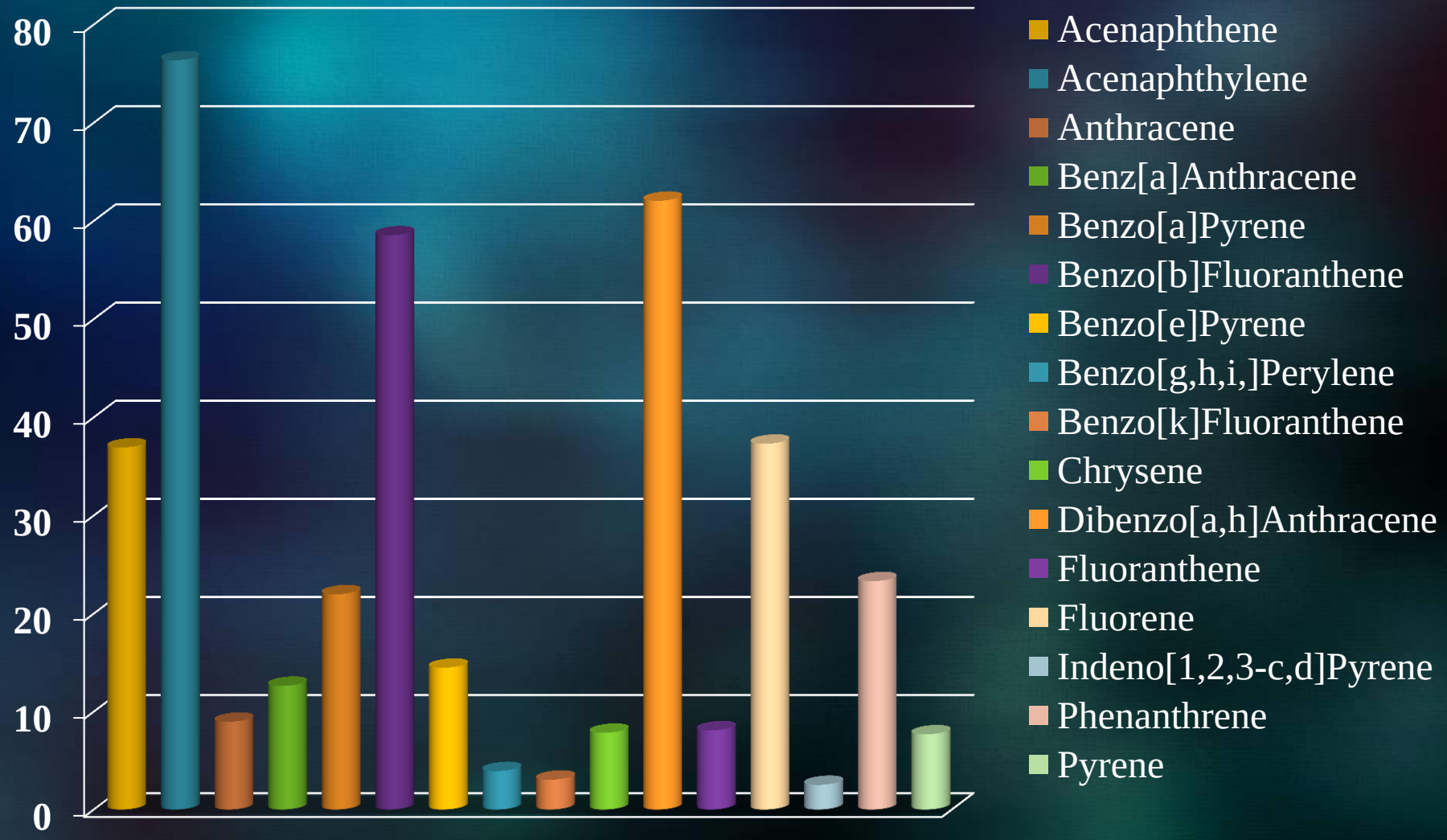
Emission Contribution to State Total (%) PM2.5



- Crops & Livestock Dust
- Wildfires
- **Residential Wood Comb**
- Agricultural Field Burning
- Prescribed Fires
- Industrial Boilers - Biomass
- Ferrous Metals Processes
- Paved Road Dust
- Other Sectors

Emissions data were from the current survey for RWC and the 2011 NEI V1 for others

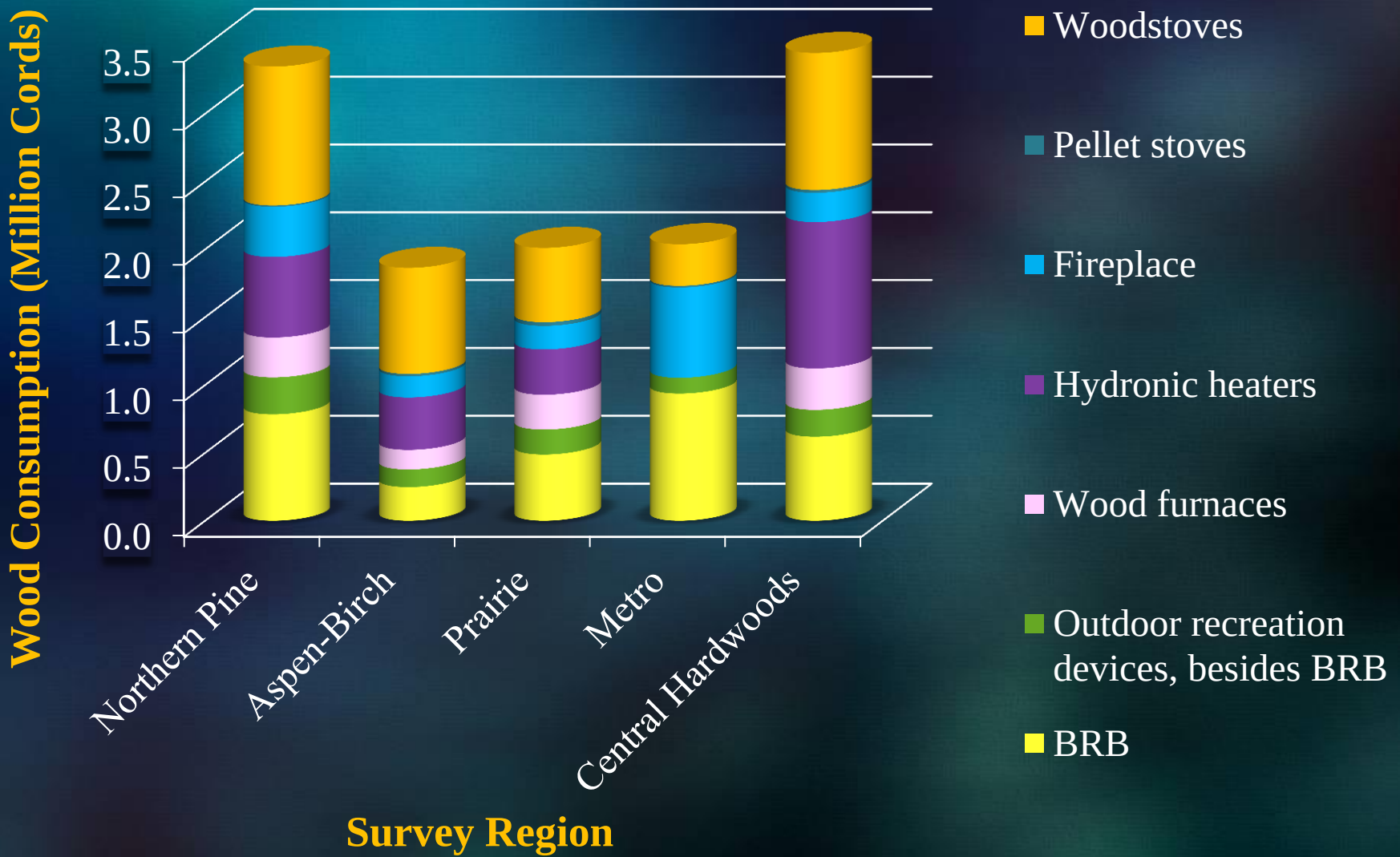
RWC Emission Contribution to State Total PAH (%)



Backyard Recreational Burning (BRB)

- Outdoor recreational wood burning devices in backyards
  - Fire rings
  - Fire-pits
  - Chimeneas
  - Others

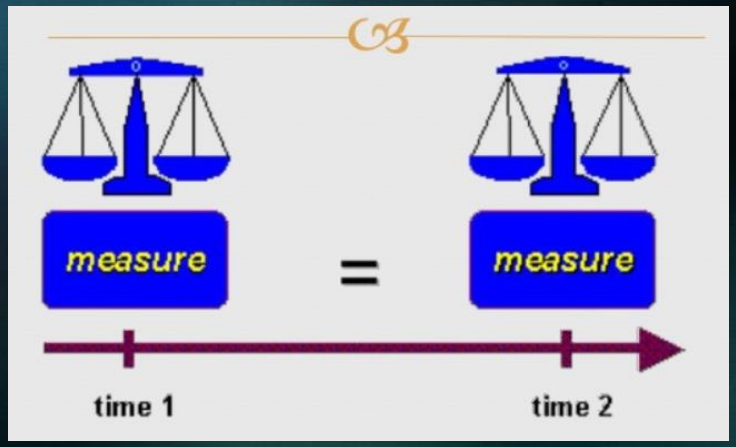
Volume of Wood Consumed



Data Reliability and Validity

- Validity
  - How well the results characterize what is truly occurring

- Reliability
  - Repeatability of the results



Number of Units of Equipment Reporting Burning Wood

Description	Northern Pine	Aspen-Birch	Prairie	Metro	Central Hardwoods	Statewide
Fireplace, general	68	46	30	110	42	296
Fireplace Inserts, non-EPA certified	19	6	5	15	10	55
Fireplace Inserts, EPA certified non-catalytic		2		4	1	7
Fireplace Inserts, EPA certified catalytic	3	5	1	4	3	16
Woodstoves, non-EPA certified	88	103	21	19	36	267
Woodstoves, EPA certified non-catalytic	10	12	2	2	5	31
Woodstoves, EPA certified catalytic	18	20	15	1	11	65
Pellet stoves	7	10	7	1	3	28
Wood furnaces	20	16	10		5	51
Hydronic heaters	23	16	4		9	52
Outdoor wood burning devices	474	331	250	332	293	1680
Wax logs for all combustors	14	2	7	44	13	80
Total	**744**	**569**	**352**	**532**	**431**	**2628**

Data Extrapolation Example

- Metro Region – Current Approach
  - 705 Survey responses
  - 1,127,600 Total households
  - Woodstoves, EPA certified catalytic
    - 1 Piece
    - 1 Cord of wood
    - Regional total wood burned

1 Cord x 1 x 1,127,600/705= 1,599 Cord

Data Extrapolation Example

- Metro Region – Possible Future Approach
  - 705 Survey responses
  - 1,127,600 Total households
  - Woodstoves, EPA certified catalytic
    - 1 Piece, 65 pieces in state
    - **0.5** Cord of wood – state average
    - Regional total wood burned

0.5 Cord x 1 x 1,127,600/705= 799.5 Cord

Wood Consumption Measures

Type of Wood	Unit of Measure	Conversion to Full Cords
Wood	Full Cord (4' x 4' x 8')	1
Wood	Face Cord	1/3
Wood	Bag or Bundle (1' x 1' x 2')	1/64
Pallets	Each	0.0434
Slab	Full Cord	1
Wood Pellet	Pound	0.000182
Wax Logs	Each	1/444

Descriptive Statistics for BRB Wood Consumption

Statistical Measures	Northern Pine	Aspen-Birch	Prairie	Metro	Central Hardwoods	Statewide
Count	300	200	164	265	191	1120
Average (Cord)	0.47	0.40	0.37	0.22	0.27	0.35
Median (Cord)	0.25	0.17	0.14	0.08	0.10	0.16
Minimum (Cord)	0.0023	0.0156	0.0023	0.0023	0.0023	0.0023
Maximum (Cord)	5	4	3	3	3	5
Count for >=3 Cords	6	3	5	1	2	17

2 Bundles of wood per day
10 Days per month
6 Months per year

1.9 Cords

SUMMARY

- Recent survey showed the second consecutive increase of wood consumption in Minnesota
- RWC contributed significantly to Primary PM2.5 and PAH emissions
- BRB played a large role in the RWC category particularly in the Metro region
- Majority BRB users used BRB as a means for some yard waste disposal
- Further attention to the BRB source category is warranted

RECOMMANDATIONS

- Improving the validity and reliability of the RWC activity data
  - Data collection
  - Data analysis
- Increasing awareness about the BRB emission source category
- Continue to Identify viable methods to reduce the emissions

ACKNOLEGEMENT

Dedicated work in conducting the MN 2011/2012 RWC survey

Cathy Jensen
Rocky Sisk

Minnesota Pollution Control Agency