

# Candidate Control Measures for Industrial/Commercial/Institutional (ICI) Boilers



Regional Air Quality Workshop

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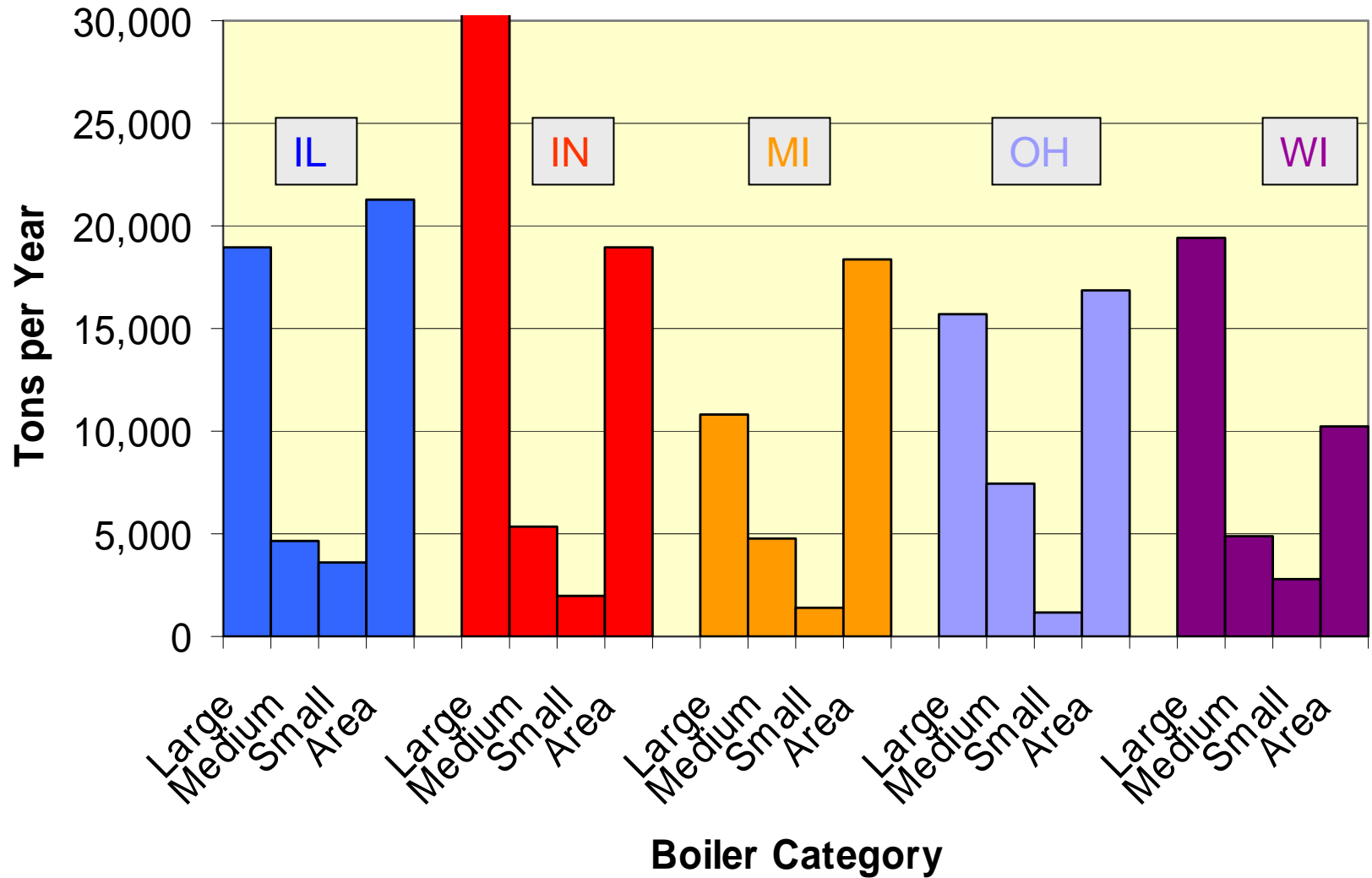
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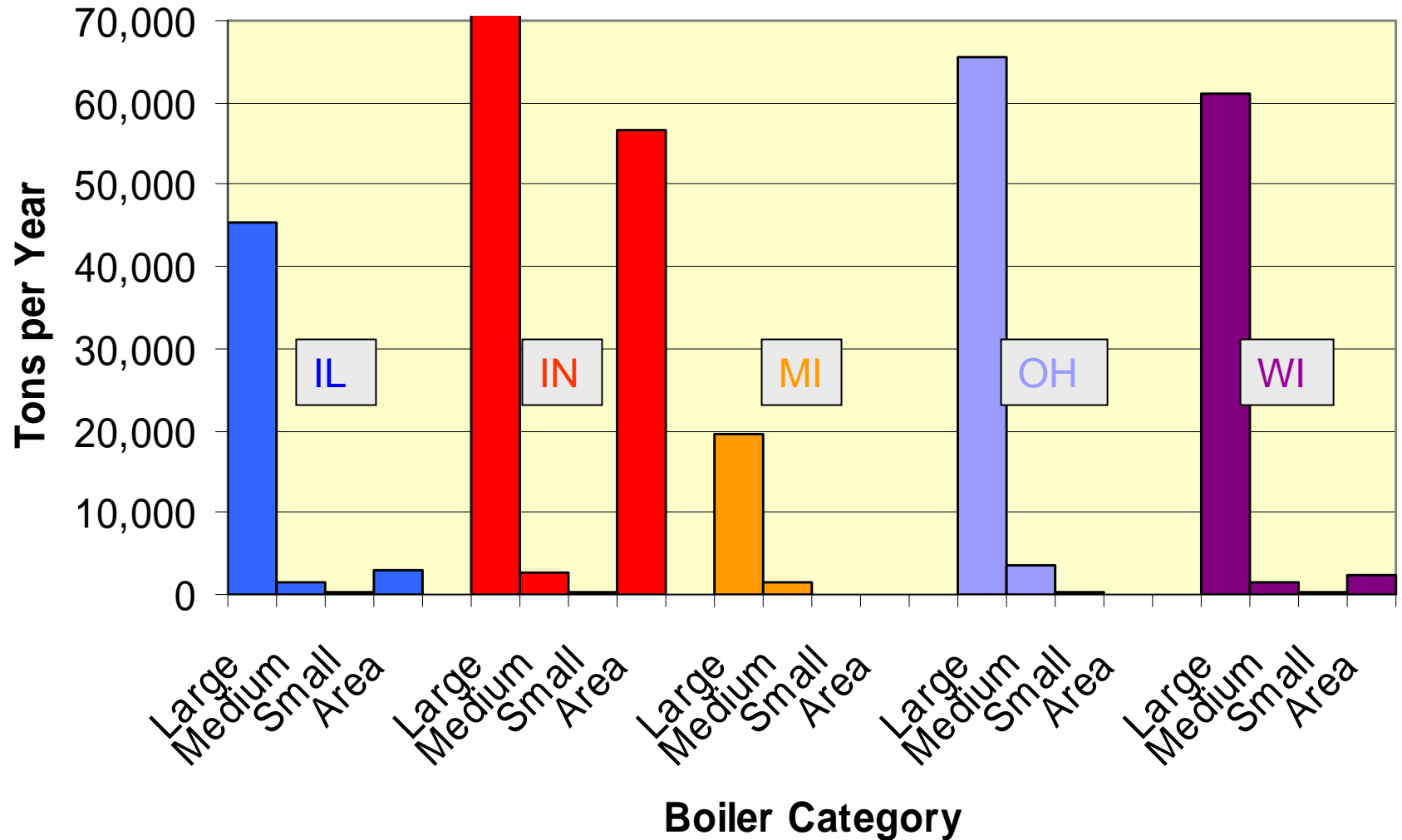
# Category Description: ICI Boilers

- Large contribution to NO<sub>x</sub> and SO<sub>2</sub> inventory in 5-state region
  - In 2002, accounts for 7% of total NO<sub>x</sub> and 12% of total SO<sub>2</sub>
  - Expected to increase to 18% of NO<sub>x</sub> and 22% of SO<sub>2</sub> in 2010 after CAIR
- Diverse Source Category
  - Fuels (coal, oil, natural gas, wood, or process gas)
  - Size ranges:
    - Industrial boilers typically in 10-250 mmBtu/hr range
    - Some industrial boilers can be as large as 1,000 mmBtu/hr
    - Commercial and institutional boilers typically < 15 mmBtu/hr
    - But there are several larger coal-fired C/I boilers
  - Boiler designs
  - Boiler age
  - Capacity utilizations
  - Existing pollution control systems
- These factors result in substantial variability in emission rates and candidate control options

# NOx Emissions by ICI Boiler Size Range



# SO2 Emissions by ICI Boiler Size Range



# Regulatory History: ICI Boilers

- New Source Performance Standards
  - Subpart Db >100 mmBtu/hr after June 19, 1984
  - Subpart Dc 10-100 mmBtu/hr after June 9, 1989
  - Revised in 1998 for improved NO<sub>x</sub> control
- NSR (BACT or LAER)
- 1-hour Ozone SIPs (NO<sub>x</sub> RACT waiver)
- NO<sub>x</sub> SIP Call
  - 5-month NO<sub>x</sub> allowances for >250 mmBtu/hr
  - Wisconsin, northern part of Michigan excluded
- Boiler MACT (Subpart DDDDD)
- Title IV Acid Rain Opt-in Program
- BART

# Regulatory History: ICI Boilers

- Variety of unit level emission limits resulting from SIP, NSPS, NSR, or MACT requirements
- Overlaid on these unit-level requirements are system-wide allowances of the NO<sub>x</sub> SIP call and the Acid Rain SO<sub>2</sub> opt-in program
- The specific emission limits and control requirements for a given ICI boiler vary and depend on boiler age, size, and geographic location

# Available NOx Technology and Retrofit Costs for ICI Boilers

Fuel	Technology	NOx Reduction	Capacity Factor	<u>Cost Effectiveness (\$/ton)</u>		
				1000 mmBtu/hr	250 mmBtu/hr	100 mmBtu/hr
Coal	LNB	51%	83%	256	389	512
Coal	LNB + OFA	65%	83%	306	454	593
Coal	SCR	80%	83%	876	1,123	1,349
Coal	SNCR	40%	83%	1,285	1,473	1,625
Gas	LNB + OFA	60%	94%	280	424	559
Gas	SCR	80%	94%	986	1,354	1,689
Gas	SNCR	40%	94%	1,842	2,193	2,521
Oil	LNB + OFA	50%	86%	326	477	615
Oil	SCR	80%	86%	760	997	1,245
Oil	SNCR	40%	86%	1,485	1,670	1,840

LNB – Low NOx Burner

SNCR Selective Non-Catalytic Reduction

OFA – Overfire Air

SCR – Selective Catalytic Reduction

Source: U.S. EPA. *Methodology, Assumptions, and References Preliminary NOx Controls Cost Estimates for Industrial Boilers*. November 2003.

# Available SO<sub>2</sub> Technology and Retrofit Costs for ICI Boilers

Fuel	Technology	SO <sub>2</sub> Reduction	Capacity Factor	<u>Cost Effectiveness (\$/ton)</u>		
				1000 mmBtu/hr	250 mmBtu/hr	100 mmBtu/hr
Coal High S	IDSI	40%	83%	633	763	943
Coal Low S	IDSI	40%	83%	697	849	1,075
Coal	SDA	90%	83%	381	569	790
Coal High S	Wet FGD	90%	83%	373	528	664
Coal Low S	Wet FGD	90%	83%	461	661	836
Oil	Wet FGD	90%	86%	693	1,011	1,285

IDSI – In-Duct Dry Sorbent Injection (coal only)

SDA – Spray Dryer Absorber (coal only)

FGD – Flue Gas Desulfurization (coal and oil)

Source: U.S. EPA. *Methodology, Assumptions, and References Preliminary SO<sub>2</sub> Controls Cost Estimates for Industrial Boilers*. November 2003.

# Candidate Control Measures: ICI Boilers

- *Measure ICI1 – Apply 60% NO<sub>x</sub> and 40% SO<sub>2</sub> Reduction to All Medium and Large ICI Boilers*
  - Applies to Large (>250 mmBtu/hr) and medium (100-250 mmBtu/hr) ICI boilers
  - NO<sub>x</sub> - 60% percent reduction which is comparable to the levels used in developing the NO<sub>x</sub> SIP call budgets (note: no additional controls are applied for boilers already subject to the NO<sub>x</sub> SIP call).
  - SO<sub>2</sub> - 40% percent reduction is achievable using dry sorbent injection-type systems

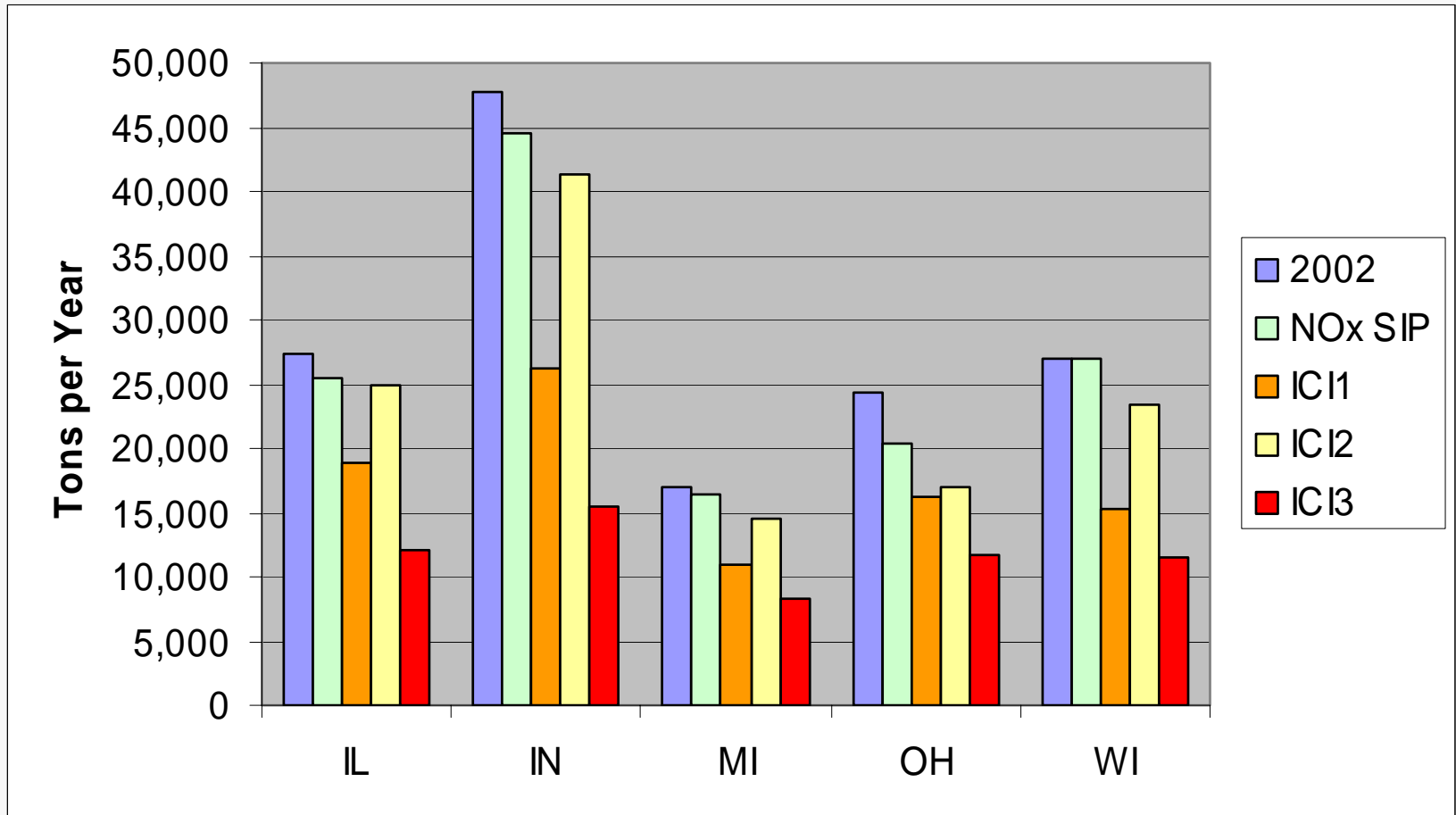
# Candidate Control Measures: ICI Boilers

- *Measure ICI2 – Apply Likely Controls to ICI Boilers Subject to BART Requirements*
  - Applies case-by-case control requirements for those ICI boilers subject to BART
  - NO<sub>x</sub> - 80 percent reduction for NO<sub>x</sub> (based on ultra-low NO<sub>x</sub> burner or SCR technology)
  - SO<sub>2</sub> - 90 percent reduction for SO<sub>2</sub> (based on a wet or dry FGD systems)

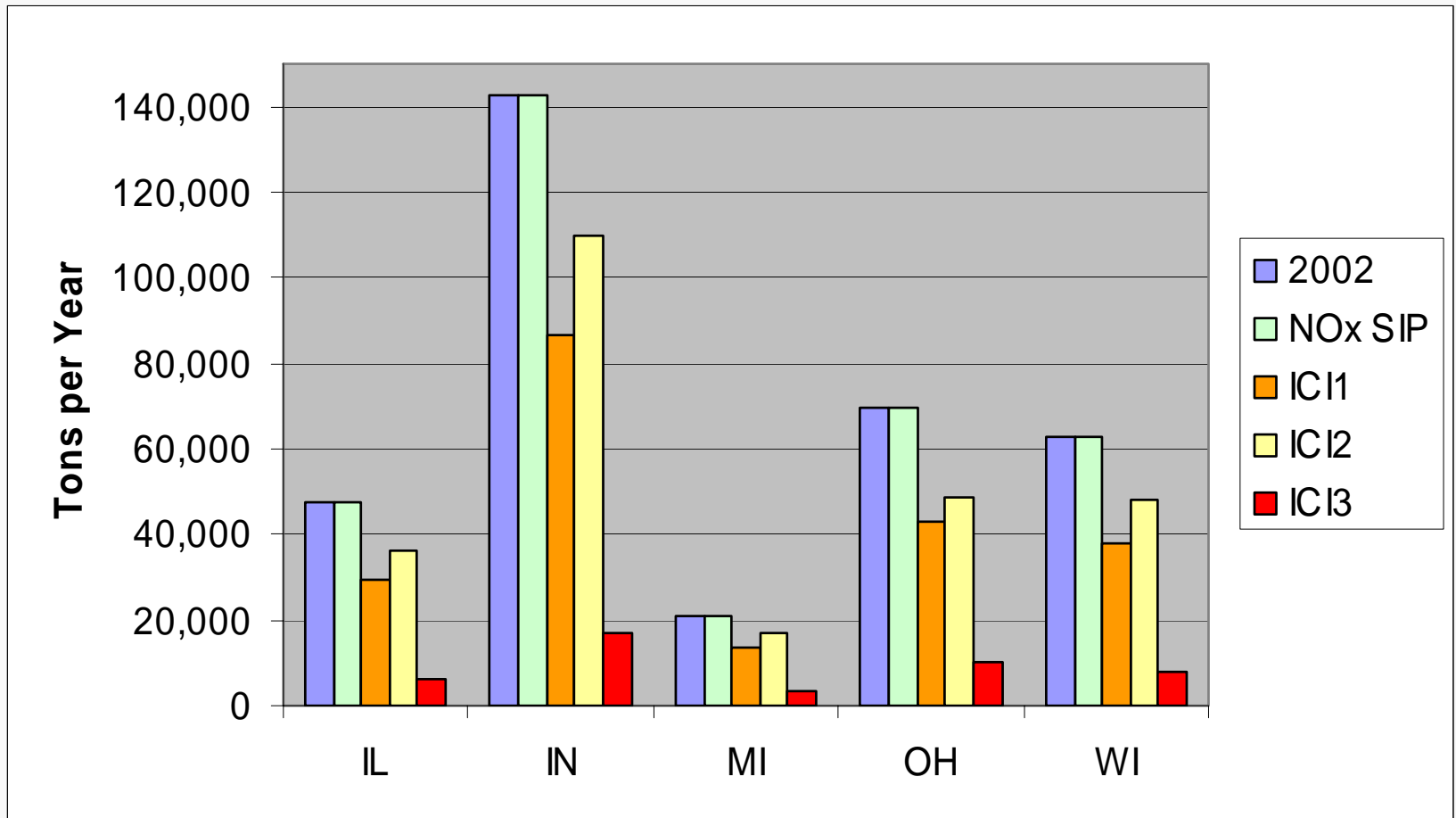
# Candidate Control Measures: ICI Boilers

- *Measure ICI3 – Apply 80% NO<sub>x</sub> and 90% SO<sub>2</sub> Reductions (similar to BART) to All Medium and Large ICI Boilers*
  - Applies to Large (>250 mmBtu/hr) and medium (100-250 mmBtu/hr) ICI boilers
  - NO<sub>x</sub> – 80% percent reduction, which is comparable to the BART level of control (note: incremental reductions are applied for boilers already subject to the NO<sub>x</sub> SIP call).
  - SO<sub>2</sub> – 90% percent reduction based on a wet or dry FGD systems

# NOx Emissions for ICI Boilers for Candidate Control Measures



# SO2 Emissions for ICI Boilers for Candidate Control Measures



# Cost Effectiveness: ICI Boilers

<b>Control Measure</b>	<b>Pollutant</b>	<b>Percent Reduction</b>	<b>Cost Effectiveness (\$/ton)</b>
<i>ICI1 – Apply 60% NO<sub>x</sub> and 40% SO<sub>2</sub> Reduction to All Medium and Large ICI Boilers</i>	NO <sub>x</sub>	60	280 to 1,399
	SO <sub>2</sub>	40	633 to 1,075
<i>ICI2 – Apply Likely Controls to ICI Boilers Subject to BART Requirements</i>	NO <sub>x</sub>	80	536 to 4,493
	SO <sub>2</sub>	90	1,622 to 5,219
<i>ICI2 – Apply 80% NO<sub>x</sub> and 90% SO<sub>2</sub> Reduction (similar to BART) to All Medium and Large ICI Boilers</i>	NO <sub>x</sub>	80	536 to 4,493
	SO <sub>2</sub>	90	1,622 to 5,219

# Other Issues: ICI Boilers

- Timing for reductions
  - Ozone SIPs in 2007, compliance by 2009
  - RH SIPs in 2008, BART controls not until 2013
- Geographic applicability
  - Entire LADCO/MRPO region
- Seasonal applicability
  - Ozone season only or year-round for NO<sub>x</sub>
- Rule Implementation Issues
  - Cap and trade (national, multi-region, LADCO only?)
  - State specific or source specific RACT?
  - Case-by-case BART

# Questions? ICI Boilers

